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THE RISK OF THE FEMALE ATHLETE TRIAD IN COLLEGIATE ATHLETES AND NON-ATHLETS

by

Carla J. Southwick

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Health, Physical Education, and Recreation

Approved:

Julie A. Gast Major Professor	Mary Doty Committee Member
Richard D. Gordin, Jr. Committee Member	Byron R. Burnham Dean of Graduate Studies

UTAH STATE UNIVERSITY
Logan, Utah

2008

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ABSTRACT

The Risk of the Female Athlete Triad in

Collegiate Athletes and Non-Athletes

by

Carla J. Southwick, Master of Science

Utah State University, 2008

Major Professor: Dr. Julie A. Gast
Department: Health, Physical Education and Recreation

In prior research, the female athlete triad has been found in both female athletes and female non-athletes. This health concern, which once was thought to only affect the physically active, is now finding women who are not physically active to be at risk also. This study consisted of 192 female participants with 103 collegiate athletes and 89 non-athletes. All participants were attending Utah State University at the time of the study. The instruments used in this study included the EAT-26, menstrual cycle history questionnaire, osteoporosis questionnaire, and time spent in exercise questionnaire.

Results from the present study found statistically significant difference between athletes and non-athletes being at risk for the female athlete triad with female athletes having a higher percentage (4.8%, 3.4%). The risk of disordered eating and osteoporosis was also found to be statistically significant with non-athletes (12.2%, 96.6%) having a higher percentage at risk compared to the athletes (7.7%, 86.5%) when observed independently from the female athlete triad. When menstrual cycle dysfunction was

observed independently from the female athlete triad it was found to not be statistically significant between the two groups ($\chi^2(1,N=192)=.132$, $p=.716$). This study also found no statistical significant correlation between the risk of the female athlete triad and excessive amounts of time spent in exercise in athletes ($r=.113$, $p=.256$) and non-athletes ($r=-.041$, $p=.706$). When each component of the female athlete triad was run independently it was found that there was also no statistically significant correlation between the risk of the components and excessive exercise. A statistically significant correlation was found between those at risk of disordered eating ($r=.648$, $p<.01$) or menstrual cycle dysfunction ($r=.216$, $p<.01$) and the risk of the female athlete triad. Another statistically significant correlation was found between those at risk of osteoporosis and those with menstrual cycle dysfunction ($r=.182$, $p=.012$).

When athletes were observed as either being involved in a lean sport or being involved in a non-lean sport, statistical significance was found with non-lean (17.4%) sport athletes, $\chi^2(1,N=103)=83.971$, $p<.01$, having a higher overall percentage of being at risk of the female athlete triad compared to the athletes involved in lean (5%) sports. Again each component was observed separate from the female athlete triad and statistical significance was found with disordered eating, $\chi^2(1,N=103)=73.485$, $p<.01$, and osteoporosis, $\chi^2(1,N=103)=57.563$, $p<.01$. Disordered eating was found to have a higher percentage of those at risk of disordered eating in non-lean athletes(8.4%) while risk of osteoporosis was found in all the lean athletes.

(110 pages)

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CHAPTER I

INTRODUCTION

Background of the Problem

Athletics has become a very popular activity for many individuals. More and more females are participating in athletics and while this has many benefits, it may cause some female athletes life long health problems. Three of these health problems include disordered eating, amenorrhea, and osteoporosis. In 1992 the American College of Sports Medicine (ACSM) termed these three disorders as the female athlete triad. Some female athletes may perceive that decreasing their body size will help them excel at their sport. These females may begin by dieting and limiting the amount of food they consume which may develop into disordered eating patterns.

Disordered eating is classified into three groups by The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). These three groups are anorexia nervosa, bulimia nervosa, and eating disorders not otherwise specified (APA, 1994). Golden (2002) defined disordered eating as anything that is a way of weight control that is unhealthy. College age females have been found to be at a greater risk of develop disordered eating compared to other populations (Hoek, 1995). Collegiate athletes has also been found to be at risk of developing disordered eating compared to other age groups (Beals & Manore, 2002; Johnson, Powers, & Dick, 1999; Roberts, Glen, & Kreipe, 2003). Yet, recent research has found disordered eating more often in non-collegiate athletes compared to collegiate athletes (DiBartolo & Shaffer, 2002; Hopkinson & Lock, 2004; Reinking & Alexander, 2005; Stanford-Martens et al., 2005;

Thompson & Gabriel, 2004). However, in the 1980s to 1990s a good deal of research found athletes to have a greater risk of developing an eating disorder compared to the controls (Hausenblas & Carron, 1999; Smolak, Murnen, & Ruble, 2000).

Amenorrhea is considered the most recognizable sign of the female athlete triad (American College of Sports Medicine [ACSM], 1997). Amenorrhea is defined as the absence of ones menstrual cycle for 3-6 months or no menstrual cycle be age 16 years (Golden, 2002). However, amenorrhea has not been found as frequent in collegiate athletes as in Olympic level athletes in past research. However, oligomenorrhea was found quite often in collegiate athletes in past research (Roberts et al., 2003; Thompson & Gabriel, 2004). For this reason this study will look at both amenorrhea and oligomenorrhea. Oligomenorrhea is when a female has six to nine cycles per year or the cycle is greater than 35 days (Lo, Herbert, & McClean, 2003; Rust, 2002). When comparing athletes to non-athletes Greydanus and Patel (2002) found irregular menses to be as much as 60% in athletes and 5% in non-athletes.

The loss of bone mass may be increased by amenorrhea and disordered eating. According the ACSM (1997) some factors that could contribute to the amount of bone loss include menstrual irregularities, type of skeletal loading activities, nutritional status, and genetic components. Osteoporosis is not found in the athletic population very often but high intensity exercise may put female athletes at risk of developing osteoporosis later in life (Braam, Knapen, Geusens, Browns, & Vermeer, 2003). Many athletes experience stress fractures during their careers which may be due to decreased bone mass density [BMD] (Beals & Manore, 2002; Bennell, Malcolm, Thomas, Wark, & Brukner, 1996; Loud, Gordon, Micheli, & Field, 2004).

Statement of the Problem

The internal and external pressures placed on female athletes to achieve or maintain unrealistically low body weight may be an underlying cause of the female athlete triad (ACSM, 1997). This study determined if these increased pressures and the amount of time spent in exercise put a female athlete at greater risk of developing the female athlete triad (disordered eating, amenorrhea, & osteoporosis) compared to the female college age population.

Purpose of the Study

Research has found that females are at risk of developing the female athlete triad at any level of activity (Beals & Manore, 2002; DiBartolo & Shaffer, 2002; Hopkinson & Lock, 2004; Johnson et al., 1999; Roberts et al., 2003; Stanford-Martens et al., 2005; Torstviet & Sundgot-Borgen, 2005). The female athlete triad is not only found in those that participate on competitive athletic teams but also the general population of college age females (DiBartolo et al., 2002; Hopkinson & Lock; Reinking & Alexander, 2005; Stanford-Martens et al.; Thompson & Gabriel, 2004). Research has found the general college age female population to be at a greater risk of developing the female athlete triad compared to the collegiate female athlete population in recent years but other research has found the collegiate female athletes to be at greater risk (Hausenblas & Carron, 1999; Smolak et al., 2000). Yet, few studies have considered the amount of time spent in exercise related to the risk factors of developing the female athlete triad. This study looked at the general college female population compared to the collegiate female athlete

and the amount of time that is spent in exercise and their risk of developing the female athlete triad.

Research Questions

The research questions for this study included:

1. Are female athletes and non-athletes at a Division I university at risk of the female athlete triad?

2. Is there a difference in those at risk of the female athlete triad between the female athletes and female non-athletes?

3. Is there a relationship between the amount of time spent in exercise and the risk of the female athlete triad for athletes?

4. Is there a relationship between the amount of time spent in exercise and the risk of the female athlete triad for non-athletes?

5. Are there specific sports at a division I university whose participants are at greater risk of the female athlete triad?

Limitations

The limitations of this study included:

1. The population is mostly homogenous, young, Caucasian, and middle class, which does not represent other populations.

Delimitations

The delimitations of this study included:

1. Female athletes involved in collegiate sports and female non-athletes will be used in this study. Female athletes involved in elite or recreational activities may not be represented.

2. Due to self-reported questionnaires the results may not be accurate due to dishonesty and personal bias of the participants.

3. A non-random sampling procedure will be used, the results of this study may not be applied to other populations.

Assumptions of the Study

The assumptions of this study included:

1. The instruments to be used in this study are valid and reliable to measure the desired variables.

2. The self-reported questionnaires will be answered honestly by the participants.

Definitions of Terms

The definitions of the terms for this study included:

Amenorrhea: An absence of menstrual cycles for 3-6 consecutive months in those that have begun menstruating or no menstrual cycle by age 16 years (Golden, 2002).

Anorexia nervosa: One who refuses to maintain body weight over a minimally normal weight for age and height, intense fear of gaining weight or becoming fat even though they are underweight, disturbance in their evaluation of their weight or shape, and

for postmenarchal females the absence of at least three consecutive menstrual cycles (APA, 1994).

Bulimia nervosa: One who has recurrent episodes of binge eating, recurrent inappropriate behavior to prevent weight gain, binge eating and inappropriate compensatory behavior at least twice a week for 3 months, and self-evaluation is influenced by body shape and weight (APA, 1994).

Disordered eating: One that does not meet all the criteria for anorexia nervosa (AN), bulimia nervosa (BN), or eating disorders not otherwise specified (EDNOS) yet engages in one of the criteria for the eating disorders as defined by the DSM-IV (APA, 1994).

Eating disorders not otherwise specified (EDNOS): One that meets all of the criteria for anorexia, except amenorrhea, or the weight criterion. It also includes those that meet all the criteria for bulimia but binge less than twice a week and/or for less than three months (APA, 1994).

Oligomenorrhea: A woman has six to nine cycles per year or the cycle is greater than 35 days (Lo et al., 2003; Rust, 2002).

Summary

This chapter provided background that supported the need for this study. The ability to recognize and assist those females that are at risk of the female athlete triad had an impact for this study. The limitations, delimitations and assumptions placed on this study were also included in this chapter.

The next chapter provided empirical evidence from published literature relating to the study to provide further evidence for the need of this study. Chapter III discusses the methodology of this study.

CHAPTER II

REVIEW OF LITERATURE

Introduction

According to the ACSM (1997) the internal and external pressures placed on female athletes to achieve or maintain unrealistically low body weight may be an underlying cause of the female athlete triad. In 1992, the ACSM coined the term female athlete triad to describe the combination of disordered eating, amenorrhea, and osteoporosis. The female athlete triad is caused by an imbalance of energy expenditure and energy intake (Golden, 2002). This literature review will discuss the current research on (a) disordered eating, (b) amenorrhea, (c) osteoporosis, (d) and exercise as it relates to the female athlete triad.

Controversy has been raised over whether the female athlete triad does exist. The reasoning for this is that the general population of women has been found to be more at risk of the triad than elite athletes. Individual components of the triad have been found in athletes but all three components are not found very often. Some other concerns include disordered eating including those with abnormal eating patterns. Amenorrhea includes any menstrual dysfunction and osteoporosis includes osteopenia. With broadening what each is classified some are concerned that almost any woman could be considered “at risk” (DiPietro & Stachenfeld, 2006).

Disordered Eating

Disordered eating as defined by Golden (2002), is the use of any unhealthy method to control weight. Disordered eating can lead to electrolyte imbalances, mental slowing, and decreased athletic ability. Other health problems can include thermoregulatory problems, cardiac abnormalities, nutritional deficiencies, weak immune system, depression, and hypoestrogenism (Lo et al., 2003). Disordered eating can be particularly harmful to athletes because it may cause them to experience dehydration, decreased muscle mass, loss of fat, loss of strength and endurance, and increased reaction time (Golden). The physical stress of training along with disordered eating may cause inadequate nutrient intake due to poor food choices and skipping meals (Fruth & Worrell, 1995). A factor that may impact a female developing disordered eating is age. Hoek (1995) found female college students are at a higher risk of developing disordered eating compared to other populations.

Definitions of Disordered Eating and Eating Disorder

As mentioned earlier disordered eating is classified as the practice of unhealthy weight control methods (Golden, 2002). For this study individuals classified as having disordered eating will be those that do not meet all the criteria for anorexia nervosa (AN), bulimia nervosa (BN), or eating disorders not otherwise specified (EDNOS) but engage in one of the criteria for the eating disorders.

Eating disorders can be classified into three groups. They are termed by The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (APA, 1994) as an eating disorder. The first group is anorexia nervosa (AN), an anorexic is

described as one who refuses to maintain body weight over a minimally normal weight for age and height, intense fear of gaining weight or becoming fat even though they are underweight, disturbance in their evaluation of their weight or shape, and for postmenarchal females the absence of at least three consecutive menstrual cycles (APA, 1994).

The second group is termed Bulimia Nervosa (BN). A bulimic individual is described as one who has recurrent episodes of binge eating, recurrent inappropriate behavior to prevent weight gain, binge eating and inappropriate compensatory behavior at least twice a week for 3 months, and self-evaluation is influenced by body shape and weight (APA, 1994).

The third group termed by the DSM-IV (APA, 1994) is eating disorders not otherwise specified (NOS). Eating disorders not otherwise specified was added to help in the early identification of eating disorders. The females that fit this category are those that meet all of the criteria for anorexia with the exception of amenorrhea, or the weight criterion. It also includes those that meet all the criteria for bulimia but binge less than twice a week for less than three months (APA, 1994). Another group that meets the criteria are those that eat small amounts of food, chewing and spitting out food without swallowing, or binge eating without purging (Prather & Hunt, 2005).

The full criteria of anorexia nervosa or bulimia nervosa are not met by many adolescents suffering from a clinically significant eating disorder. Females that have the female athlete triad may not have a distorted body image and many may even have a normal body weight. Their lean body mass proportion may be higher than other females (Golden, 2002).

Athletes and Disordered Eating or Eating Disorder

A population that has been studied more recently to determine the prevalence of eating disorders is the athlete population. In many female athletic teams the pressure to succeed and be in exceptional shape has made the study of athletes and disordered eating and eating disorders more prevalent. For example, Roberts et al. (2003) conducted a study involving 226 female high school athletes to determine the prevalence of disordered eating in females who participated in school sponsored sports. The sports surveyed included soccer, cheerleading, field hockey, swimming, tennis, and cross-country/ track. The participants were given the Eating Attitude Test-26 (EAT-26). An eating disorder was considered if a score was over 20 on the EAT-26. Of the 226 participants 19 scored over 20 on the EAT-26. The study found that athletes reportedly increased their exercise (67%), skipped meals (50%), fasted (11%), smoked (10%), or vomited (4%) at least once a month in the last year to control their weight or shape (Roberts et al.).

Beals and Manore (2002) conducted a study examining the symptoms of the female athlete triad in collegiate athletes. When looking at the likelihood of an eating disorder, they found, of the 425 participants from 7 universities across the United States, 3.3% were currently or had previously been diagnosed of having anorexia nervosa and 2.3% were diagnosed as currently having or previously had bulimia nervosa. A score on the EAT-26 of 20 or higher was found in 15.2% of the participants. The Body Dissatisfaction Subscale of the Eating Disorder Inventory (EDI-BD), with scores greater than or equal to 12, was 32.4% of the participants. It was also reported that 67% consciously limited food intake (Beals & Manore).

In a similar study, Johnson et al. (1999) surveyed 1,445 athletes, from 11 Division I schools, 562 of which were females, to determine the likelihood of an eating disorder. In the females they found 1.1% met the requirements for BN, none met the requirements for AN, 10.85% binged at least once a week and 5.52% had purging behaviors. They also found 34.75% were at risk of developing AN and 38% were at risk of developing BN. "At risk for AN" was defined as one who has a Body Mass Index (BMI) less than or equal to 20 kg/m², or amenorrhea or Eating Disorder Inventory -2 Drive for Thinness (EDI-2 DT) scale greater than or equal to 10, or Eating Disorder Inventory -2 Body Dissatisfaction (EDI-2 BD) greater than or equal to 12. To be at risk for BN one had to have greater than six episodes of the following behavior over 3 months: binge eating or vomiting, using laxatives or diuretics, using diet pills, or score on EDI-2 DT greater than or equal to 10 or BD greater than or equal to 12.

Research has found athletes at both the collegiate level and the high school level to be at risk of developing disordered eating behaviors or an eating disorder (Beals & Manore, 2002; Johnson et al., 1999; Roberts et al., 2003).

Athletes Versus Non-athletes and Disordered Eating

As mentioned previously, athletes have been studied to determine the likelihood of developing an eating disorder. In addition, studies have focused on determining if being a female athlete is a risk factor or protective factor in the development of disordered eating and eating disorders. This section will look at studies examining both the athletes and non-athletes and their risk of developing disordered eating.

Stanford-Martens et al. (2005) conducted a study examining disordered eating in 489 individuals with 266 being females. Of the females, in the sample, 158 were athletes

at a National Collegiate Athletic Association (NCAA) Division I university and 108 females were non-athletes. The Questionnaire for Eating Disorder Diagnoses was used to determine the prevalence of disordered eating. They found non-athlete females were significantly more likely to have disordered eating than Division I collegiate athletes. Subclinical eating disorder was met by 31.5% of the non-athletes and clinical eating disorder was met by 8.3% of the non-athletes compared to the athletes where 14.5% met the criteria for subclinical and 5.1% for a clinical eating disorder. The participants that met the criteria for and eating disorder were diagnosed with EDNOS (Stanford-Martens et al.).

Thompson and Gabriel (2004) found similar results in their study involving 37 NCAA Division I collegiate athletes and 18 college females enrolled in an upper level health course. Prevalence of an eating disorder was assessed by asking the question "Have you ever perceived or been told that you have an eating disorder?" (p. 203). Their results showed 11.1% of non-collegiate athletes and 8.6% collegiate athletes responded yes to having been told they had an eating disorder (Thompson & Gabriel). When analyzing the Drive for Thinness subscale in the EDI-2 Reinking and Alexander (2005) found 12.9% of non-collegiate athletes and 7.1% of collegiate athletes were at risk of disordered eating after surveying 84 collegiate athletes and 62 non-collegiate athletes.

DiBartolo and Shaffer (2002) found similar results when surveying 115 non-athletes and 94 athletes at a Division III college. When using the EAT they found the non-athletes to have a mean of 10.90 and the athletes to have a mean of 5.40 with a significance at the .001 level. The EDI-BD found the non-athletes to have a mean of 11.73 and the athletes to have a mean of 6.66 with a significance at the .001 level as well.

Meaning non-athletes had more eating concerns and disturbed body images compared to the athletes.

Female athletes who competed in soccer, swimming, and running sports at Stanford University and recreational athletes involved in the same three activities (*n* = 119) were given the EAT-26 to determine disordered eating in the sample. Of the collegiate athletes 7.8% were at risk of participating in disordered eating behaviors and 10.3% of the recreational athletes were at risk of participating in disordered eating behaviors. The recreational athletes were also found to purge by vomiting, laxatives, or diuretics more often than the varsity athletes (7.4%, 3.9%). The recreational athletes also purge by exercise more often than the varsity athletes (37.9%, 27.5%). According to this study disordered eating behaviors are found more often in recreational athletes than in varsity athletes (Hopkinson & Lock, 2004).

A study was conducted in Norway on 669 female elite athletes and 597 controls (Torstviet & Sundgot-Borgen, 2005) to determine if elite athletes are at an increased risk of developing the female athlete triad. Elite athletes were "defined as one who qualified for the national team at the junior or senior level, or who was a member of a recruiting squad" (p.185). With using the EDI-BD Torstveit and Sundgot-Borgen reported 27.6% of the controls and 14.7% of the athletes had a score greater than or equal to 14 on the EDI-BD indicating a risk of developing an eating disorder. Also, 26.9% of the athletes and 13.8% of the controls met the criteria for both disordered eating and menstrual dysfunction. They also reported that eight of the athletes and five of the controls met all of the criteria for the female athlete triad.

Sundgot-Borgen and Torstviet (2004) performed another study involving all the elite athletes in Norway and a control group. Of the 572 female athletes be used for their study, 115 (20%) had an eating disorder. Eleven (2%) of the athletes had anorexia nervosa, 36 (6%) had bulimia nervosa, 23 (4%) had athletic anorexia, and 45 (8%) had eating disorders not otherwise specified. For the 574 controls 52 (9%) were found to have an eating disorder. One was found to have AN, 17 (3%) had BN, and 34 (6%) had ED-NOS. The results of this study showed that the female athletes were more likely to have eating disorder habits than the female controls.

A meta-analysis was performed by Smolak et al. (2000) to determine if athletes were found to be at risk of developing an eating disorder compared to controls. Thirty-four studies were used in the meta-analysis with the qualifications including, both female athletes and controls, a measurement that could be compared to the normal, and results in percentages, means and standard deviations, *t*-tests, *F* values, or *r* values. Once these requirements were met their analysis of college-age females found a significant difference ($z = 2.98$, $p < .01$) of athletes being more susceptible to an eating disorder compared to the control groups.

A similar analysis was performed by Hausenblas and Carron (1999) using 92 studies. Bulimic and anorexic characteristics were found to be greater in athletes than the control groups. Bulimia nervosa had an ES of 0.16, $SD = .23$, and $n = 142$ while anorexia nervosa had an ES of 0.12 $SD = .21$, and $n = 56$ for athletes. There was no difference between the two groups when looking at Drive for Thinness with ES of -0.01, *SD* of .23, and $n = 130$ (Hausenblas & Carron, 1999).

More recent research has found disordered eating more often in non-collegiate athletes compared to collegiate athletes (Stanford-Martens, et al., 2005; Thompson & Gabriel, 2004; Reinking & Alexander, 2005; Hopkinson & Lock, 2004; DiBartolo et al., 2002). However, the meta-analysis by Smolak et al. (2000) and Hausenblas and Carron (1999) found athletes to have a greater risk of developing an eating disorder compared to the controls. These results may differ from the studies mentioned previously due to the fact that most were performed in the late 1980s to early 1990s. Research has found that samples including elite athletes to be more likely to have disordered eating or eating disorders and menstrual dysfunction compared to non-athletes and collegiate athletes (Torstveit & Sundgot-Borgen, 2005).

Lean Versus Non-lean Athletes and Disordered Eating

Much speculation has been drawn to whether certain sports are more prevalent to have disordered eating and other such problems due to appearance and the size of the athlete. Athletes involved in gymnastics, cheerleading, diving, swimming, and cross country are often referred to as lean-sport athletes or aesthetic athletes. This section will look at the research on these athletes.

In the study mentioned previously by Beals and Manore (2002), it found that out of the 72 aesthetic athletes defined in this study as cheerleading, diving, and gymnastics 3.3%, had been or were at the time of the study diagnosed as having anorexia nervosa and 2.3% with bulimia nervosa. In this study an EAT-26 score greater than or equal to 20, meaning one might be at risk of disordered eating, was found in 27.7% of the athletes. This is significantly different from the endurance and team/anaerobic athletes sample. An EDI-BD score less than or equal to 12 was found in 41.6% of the aesthetic athletes

meaning the athlete is at an "elevated score" and are at risk of developing an eating disorder (Beals & Manore, 2002).

Another study, also mentioned previously, by Torstveit and Sungot-Borgen (2005) found athletes involved in aesthetic sports at a younger age, had lower height and weight compared to all other sport groups. In this study, lean-sport athletes were defined as having a mean weight of 57.2 kg while non-lean-sport athletes had a mean weight of 64.3 kg. Six percent of lean athletes and 3.9% non-lean athletes scored greater than or equal to 15 on the EDI-DT. Using the EDI-BD they found 10.5% of lean athletes and 16.9% of non-lean athletes to score greater than or equal to 14. Both of these scores on the EDI-DT and the EDI-BD represented an increased risk of developing an eating disorder (Torstveit & Sungot-Borgen, 2005).

Reinking and Alexander (2005) conducted a study using 84 Division I university athletes to determine the prevalence of disordered eating behaviors in non-lean athletes (participants in basketball, volleyball, soccer, field hockey, and softball) (n = 68) and lean athletes (participants in swimming and cross-country) (n = 16). Through using the EDI-2 the found disordered eating in 2.9% of non-lean athletes (n = 2) and 25% in lean athletes (n = 4). One was found to be at risk if they exceeded 14 on the Drive for Thinness scale.

Another study on collegiate athletes involving 112 females (65 lean-sport athletes and 47 non-lean-sport athletes) was given the Eating Disorder Inventory Symptom Checklist and the Eating Disorder Examination Questionnaire (Beals & Hill, 2006). Lean-sport athletes were defined as those participating in diving, cross-country, swimming and track (sprinting events) while non-lean-sport athletes included field

hockey, softball, tennis, track (field events). Two lean-sport athletes reported they had been diagnosed with anorexia nervosa and one athlete also involved in a lean-sport reported being diagnosed with bulimia nervosa. Four more athletes also involved in lean-sports believed they had an eating disorder (Beals & Hill, 2006). Body dissatisfaction was reported more in the non-lean-sport athletes (36%) than the lean-sport athletes (19%) (Beals & Hill).

Lean-sport female athletes involved in gymnastics, cheerleading, diving, swimming, and cross country were found to have a higher percentage of disordered eating or an eating disorder compared to athletes not involved in non-lean sports (Beals & Hill, 2006; Beals & Manore, 2002; Reinking & Alexander, 2005; Torstveit & Sungot-Borgen, 2005). According to the research, the speculation may be correct that lean-sport athletes maybe at a greater risk of disordered eating compared to those not involved in lean-sports.

Amenorrhea

The most recognizable sign of the female athlete triad is amenorrhea (ACSM, 1997). Amenorrhea is defined as an absence of menstrual cycles for three to six consecutive months in those that have begun menstruating or no menstrual cycle by age 16 (Golden, 2002). Some of the causes of amenorrhea may include: exercise, pregnancy, thyroid disease, an occult prolactinoma, and polycystic ovary syndrome (Golden). Some other factors that may contribute to menstrual dysfunction include: energy balance, exercise intensity and training practices, body weight and composition, disordered eating

behaviors, and physical and emotional stress levels (Manore, 2002). The interest for this review is on energy balance relating to disordered eating and exercise intensity.

This absence of a menstrual cycle is categorized as primary or secondary amenorrhea (Golden, 2002). Primary amenorrhea occurs when no menstrual cycle has occurred by the age of sixteen. Secondary amenorrhea is an absence of at least three to six consecutive menstrual cycles in women who have begun menstruating (Golden). Another classification of menstrual dysfunction is oligomenorrhea. This occurs when a woman has six to nine cycles per year or the cycle is greater than 35 days (Lo et al., 2003; Rust, 2002).

Low estrogen levels are often a result of menstrual dysfunction and, this can lead to a decrease in bone acquisition during adolescent years (Prather & Hunt, 2005). These factors can cause osteopenia, scoliosis, and stress fractures (Holschen, 2004). Low body weight and body fat was thought to cause amenorrhea in the 1970's. It is now thought that exercise stress and energy availability "dietary energy intake minus exercise energy expenditure" (ACSM, 1997, p. iii), are possible cause.

It has been speculated that athletes may have a tendency of having a menstrual dysfunction. One study (Bale, Doust, & Dawson, 1996) involving 10 top class female distance runners, 10 female anorexics from a recovery center, and 20 elite female gymnasts all between the ages of 9-16 were evaluated for secondary amenorrhea. Of the four distance runners who had started menstruating two were found to be amenorrheic along with one of the five gymnasts. All seven of the anorexics who had started menstruating were reported as being amenorrheic at the time of the study (Bale et al.).

Cobb and colleagues (2003) conducted a study on 91 female competitive runners running at least 40 miles per week during their peak training. These females were given a questionnaire to assess their menstrual history. They found 26% of the participants were oligomenorrheic and 10% were amenorrheic. Oligomenorrheic was defined as having four to nine menstrual cycles per year and amenorrheic was defined as having fewer than four menstrual cycles in the past year. The oligomenorrheic females were reported to have 45% fewer menstrual cycles in their lifetime than the eumenorrheic females. They also ran 18% more miles per week compared to the eumenorrheic females (Cobb et al.). Cobb et al. concluded from their study disordered eating is related to menstrual irregularity quite strongly, low bone mineral density (BMD) is associated with irregular menstrual cycles, and disordered eating is associated with low BMD when irregular menstrual cycles are absent.

Roberts et al. (2003) surveyed 139 athletes in grade 7-12 who had experienced menses for at least a year. Five reported secondary amenorrhea, 19 reported oligomenorrhea, 50 reported 7 to 9 menses in the past year and 65 reported 10 or more menses in the previous year. Athletes who participated in running sports were found to experience infrequent menses compared to athletes not involved in running sports (57.1%, 15.4%) (Roberts et al.).

Hopkinson and Lock (2004) surveyed 119 female recreational and collegiate athletes at Stanford University on disordered eating habits and their menstrual cycle history. Within the collegiate athletes 42.9% had irregular menstrual cycles and 14.3% were amenorrheic. Of the recreational athletes 13.4% had irregular periods and 2.9% were amenorrheic.

A study mentioned earlier by Thompson and Gabrial (2004) with 37 Division I athletes and 18 college females found women who had reported an eating disorder started menstruation at an older age than those who did not report having an eating disorder. Of the collegiate athletes 5.7% reported both menstrual dysfunction and an eating disorder. They also found that 2.8% of the collegiate athletes were amenorrheic while none of the non-athletes were amenorrheic. Oligomenorrhea was found in 30.6% of the collegiate athletes and 16.7% of non-collegiate athletes (Thompson & Gabriel). This was determined by a questionnaire about their current menstrual status, asking whether they had a menstrual cycle in the last six months, in the last six weeks, or every 25-35 days (Thompson & Gabriel).

Beals and Manore (2002) surveyed 425 collegiate athletes from seven universities about their menstrual history. They found 3 (1%) had no menstrual cycle, 35 (11.9%) reported less than or equal to six cycles in the past year, and 25 (8.4) reported more than 12 cycles in the past year. Beals and Manore also found 113 (26.7%) of the 425 female collegiate athletes surveyed were using OC to help regulate their menstrual cycles. Of the athletes that reported irregular menstrual cycles 95 (31%) were not using OC to help regulate their menstrual cycle.

A study was performed on 50 nationally or higher ranked British middle or long distance female runners ages 17 to 35 years old. A questionnaire was administered to the 50 females about their menstrual history. Gibson and colleagues reported 24 to experience amenorrhea (0-3 menstrual cycles per year), 9 to experience oligomenorrhea (4-9 menstrual cycles per year), and 17 to be eumenorrhea (10-13 menstrual cycles per year) (Gibson, Mitchell, Harries, & Reeve, 2004).

Sixty-three elite female athletes, competing at a regional level, were given questionnaires to determine their menstrual status (Punipilai, Sujitra, Ouyporn, Teraporn, & Sombut, 2005). Of the 44.4% in the sample who reported having a menstrual dysfunction, amenorrhea was found in 57% with oligomenorrhea in 25% and short cycle in 18%. Amenorrhea was defined as having three or less menstrual cycles in a year, oligomenorrhea was defined as having four to nine menstrual cycles in a year, and short cycle was having 13 or more cycles in a year. Menstrual dysfunction occurred in 61% of the participants after they became an athlete (Punpilai et al.).

A study mentioned previously by Torstveit and Sundgot-Borgen (2005) surveyed 669 athletes and 597 controls to determine if elite athletes are at an increase risk of developing the female athlete triad. Athletes involved in leanness sports had a higher percentage of menstrual dysfunction (42%) compared to nonleanness athletes (25.8%) and controls (24.5%). This study defined menstrual dysfunction as having amenorrhea (no menstrual cycle by age 16 or absence of three or more consecutive menstrual cycles after menarche), oligomenorrhea (35 days or more between cycles) , and short menstrual cycle (less than 22 days between cycles) (Torstveit & Sundgot-Borgen, 2005).

Some studies have not found a link between athletes and controls for example Reinking and Alexander (2005) found no significant difference in menstrual dysfunction between athletes (n = 84) and non-athletes (n = 62). In this study, each participant was an undergraduate at a Division I university. The participants completed a questionnaire on their menstrual history. Reinking and Alexander found 21% of all their subjects had oligomenorrhea or amenorrhea.

Castelo-Branco and colleagues conducted a study on 115 adolescent girls ages 12-18 years who were involved in dance at School of Dance of Tucuman Country or attended a public school in Tucuman Country. When comparing dancers (n = 38) to controls who attended the public schools (n = 77) it was found 58% of the dancers had normal cycles, 34% had oligomenorrhea, and 8% had amenorrhea. For the controls 75% of them had normal cycles, with 14% having oligomenrrhea, and 11% had other abnormalities (Castelo-Branco, Reina, Montivero, Colodron, & Vanrell, 2006).

Menstrual dysfunction is classified as primary amenorrhea, secondary amenorrhea, or oligomenorrhea (Golden, 2002; Lo et al., 2003; Rust, 2002). Irregular menses and anovulation is found more often in athletes compared to none athletes with those involved in running sports experiencing infrequent menses more often than those not involved in running sports (Greydanus & Patel, 2002; Roberts et al., 2003). Research has also found athletes involved at the Olympic level to experience menstrual dysfunction more often than those involved at the collegiate level (Meyer et al., 2004; Roberts et al.; Thompson & Gabriel 2004).

Osteoporosis

Amenorrhea and disordered eating may reduce bone mass and increase rates of bone loss. This is similar to what occurs in postmenopausal women or women with premature ovarian failure, pituitary tumor, or anorexia nervosa. A factor that contributes to the amount of bone loss includes the length and severity of their menstrual irregularity, type of skeletal loading activities, nutritional status, and genetic components (ACSM, 1997). The loss of bone can be classified as either osteopenia, which is one to two and a

half standard deviations less than adult mean body mass density or osteoporosis which is two and a half standard deviations less than young adult mean BMD (World Health Organization [WHO], 1994).

Resorption and deposition balance determines bone mass. Exercise in excess may cause negative bone turnover through negative feedback on sex hormone secretion. Low estrogen levels may cause an increase of osteoclast, which promotes the breakdown of bone. Estrogen limits bone resorption, stimulates calcitonin, and promotes renal retention of calcium (Khan et al., 2001). Calcium and estrogen in combination was found to increase bone mass four percent in one year in amenrrheic and menopausal women (Holschen, 2004). A stress fracture occurs "from an imbalance in the bone remodeling process. With repetitive stress a bone over time, new bone deposition cannot keep up with the damage from the stress and bone resorption" (Joy & Campbell, 2005, p. 323).

The adolescent years are very important in obtaining peak bone mass in females. Forty to 60% of bone mass is obtained during the adolescent years. During these years any negative condition can have long lasting morbidity (Golden & Shenker, 1992). Before the age of 20, 60-70% of peak bone mass in women has been acquired. Women continue to build bone until the age of 34 years. After the age of 35 years women typically lose one third to one half percent of bone mass a year (Donaldson, 2003). Fractures are one thing that can be caused by this deceased bone mass which may be caused by delayed menarche or prolonged amenorrhea.

When comparing BMD in Olympic level female athletes with college female athletes using a duel energy x-ray absorptiometry (DEXA), it has been reported that the Olympic athletes had a 5.8% difference for the whole body and 13.5% in the greater

trochanter compared to the college females (Meyer et al., 2004). This may mean that increased exercise may increase BMD.

Yet, another study found high intensity exercise to put females at risk of developing osteoporosis. In 79 female endurance athletes measured over a 2-year time period their femoral neck BMD decreased in both the athletes that were amenorrhea and eumenorrhea. The amenorrhea athletes had a decrease of 6.5% over the 2-year period while the eumenorrhea athletes decreased 3.9%. The athletes' lumbar spines remained constant over the 2 years (Lavienja et al., 2003).

Fredericson and Kent (2005) reported a case study involving an elite distance runner who had been amenorrheic until the age of 23. For this athlete they found that estrogen replacement therapy and calcium supplementation were not effective in improving her BMD without weight gain. This athlete continued to participate in weight-bearing exercise which may have contributed to the patient being able to improve her BMD. According to Golden (2002) "body weight is the most important determinant of bone mineral density"(p. 13). Low BMD is associated with low body weight while improvement in bone mass occurs with increased body weight.

Stress fractures may occur in athletes due to low BMD and exercise. One study using 5,461 preadolescent and adolescent girls, age 11 to 17 years, found through a questionnaire 149 had a history of a stress fracture (Loud et al., 2004). It was also found the older they were the more stress fractures were reported. The 2% of the 11-12 year olds experienced a stress fracture while 3.9% of the 15-year-olds had reported a stress fracture and 4.6% of the 16-year-olds had reported a stress fracture. It was found for the girls who exercised over 16 hours per week, 5% of the girls had experienced a stress

fracture compared to those that exercised less than one hour a week (2.0%) (Loud et al., 2004). Loud et al. also found the activities that had the most stress fractures were activities involving running, cheerleading or gymnastics.

Beals and Manore (2002) found a high percentage of college athletes to have experienced a muscle or bone injury during their college career. They surveyed 425 collegiate athletes for seven universities across the United States, 65.9% of the athletes had received a muscle injury during their collegiate career and 34.3% reported having received a bone injury during their collegiate career thus far.

Bennell et al. (1996) did a study on the incidence and distribution of stress fractures in competitive track and field athletes. They reported 10 competitive track and field female participants out of the 53 in the study suffered a stress fracture in the 12 month time period of the study. Of the 53 females 41.5% (n = 22) reported a previous stress fracture. Bennell et al. observed women to men and found the prevalence of stress fractures more in women who sustained 0.86 stress fractures for every 1,000 hours training compared to the men at 0.54.

A study mentioned earlier by Torstviet and Sundgot (2005) questioned elite athletes from Norway on disordered eating, menstrual dysfunction, and osteoporosis. When comparing athletes to controls on the risk of osteoporosis they found 17.2% of the 669 athletes and 12.2% of the 597 controls had a previous stress fracture.

Thompson and Gabriel (2004) surveyed athletes and controls from a Division I university. They found when asked "Do you currently or have you ever had a stress fracture or a performance related injury?" 67.6% of the 37 athletes and 27.9% of the 18 controls answered yes.

Recurrent stress fractures may occur in athletes. Korpelainen, Orava, Karpakka, Siira, & Hulkko, (2001) conducted a study to determine risk factors for recurrent stress fractures in athletes. Their study consisted of 19 men and 12 women of which 61% of which were runners who ran an average of 117km it was found each athlete had an average of 3.7 stress fractures. Women had stress fractures most often in their foot and ankle while men were in the fibula and tibia (Korpelainen et al., 2001). Of the 12 women 10 were available to get menstrual history. Six of the women had normal menstrual cycles the remaining four had irregular menstrual cycles, two ages 26 and 27 had primary amenorrhea (Korpelainen et al.).

Delayed menarche or prolonged amenorrhea may lead to osteoporosis by increasing the rate of bone loss (ACSM, 1997). Research has not found osteoporosis frequently in the athletic population but stress fractures are found in many athletes (Beals & Manore, 2002; Bennell et al., 1996; Lavienja et al., 2003; Loud et al., 2004; Torstiet & Sundgot-Borgen, 2005). Athletes were also found to experience stress fractures more often than non-athletes (Thompson & Gabriel, 2004; Torstiet & Sundgot-Borgen, 2005).

Exercise

Most athletes will spend many hours a week training for their sport. The amount of time spent in this training may have an impact on their over all health. This may be more so for females compared to males. Excessive exercise may be related to the prevalence of an eating disorder, amenorrhea, and osteoporosis. The intent of this review is to determine if the amount of time spent in exercise has an effect in the risk of developing the female athlete triad.

Penas-Lledo, Vaz Leal, and Waller (2002) surveyed 124 female outpatients who had an eating disorder to determine the likelihood of excessive exercising within the sample. They found 57 reported exercising excessively during the time of the study, 29 were diagnosed with AN and 28 were diagnosed with BN. An excessive exerciser was defined as one who exercised at least five times a week for at least one hour without stopping with the aim of burning calories. The exercisers had higher BMI's, greater level of eating psychopathology, and depression compared to those that were not excessive exercisers. Anorexics who exercised had higher levels of bulimic and general eating symptoms compared to those who did not exercise.

A study mentioned previously by Catelo-Branco and colleagues (2006) on adolescent girls (ages 12 – 18 years) involved in the School of Dance of Tucuman County (n = 38) and girls enrolled in public schools in Tucuman County (n = 77) found dancers who dance on average 15.5 hours per week and had been dancing 7.2 years delayed their menarche by almost half a year.

Similar results were found in a study by Punpilai and colleagues (2005) involving 63 female athletes who exercised an average of 19 hours per week. The participants completed questionnaires on their sport training, weight control, and menstrual status. Female athletes who started training before menarche started at age 12.7 years while those who trained before menarche started at age 11.9 years. Menstrual dysfunction (amenorrhea, oligomenorrhea, and short cycle) was found in 44.4% of the participants (Punpilai et al.).

Torstveit and Sundgot-Borgen (2005) found the average amount of time spent in exercise of the 938 athletes surveyed to be 13.2 hours per week while the 900 controls

exercised and average of 5.3 hours per week. Yet, 69.2% of the controls were at risk of developing the female athlete triad compared to 60.4% of the athletes. However, athletes experienced menstrual dysfunction and stress fractures more than the controls. Another study done by Sundgot-Borgen and Torstveit (2004) found that athletes (660 females, 960 males) exercised 12.3 hours per week while the controls (780 females, 916 males) exercised 3.6 hours per week. The athletes were found to be at greater risk of an eating disorder compared to the controls.

Athletes that exercise in excessive amounts may cause damage to their body. Excessive exercise may experience greater risks of developing depression and eating psychopathology (Penas-Lledo et al., 2002). When dealing with menstrual dysfunction increased amount of exercise may either delay menarche, cause primary or secondary amenorrhea, or cause oligomenorrhea (Catelo-Branco et al., 2006). Excessive exercisers may also be at risk of developing an eating disorder compared to controls (Torsveit & Sundgot-Borgen, 2005).

Summary

This review of literature looked at the female athlete triad which consists of disordered eating, amenorrhea, and osteoporosis. It also looked at the impact that exercise reportedly has on developing the female athlete triad. In more recent years disordered eating was found more often in non-collegiate athletes compared to collegiate athletes (DiBartolo et al., 2002; Hopkinson & Lock, 2004; Reinking & Alexander, 2005; Stanford-Martens et al., 2005; Thompson & Gabriel, 2004). Unlike in disordered eating irregular menses was found more often in athletes than non-athletes (Greydanus & Patel,

2002). As for osteoporosis it was not found in many athletes but many athletes did experience stress fractures which may due to decrease BMD (Beals & Manore, 2002; Bennell et al., 1996; Lavienja et al., 2003; Loud et al., 2005). Excessive exercise may lead to menstrual dysfunction and increase the risk of developing and eating disorder (Catelo-Branco et al., 2006; Torsveit & Sundgot-Borgen, 2005). Chapter III presents the methodology that will be used in this study.

CHAPTER III

METHODOLOGY

Chapter Overview

This chapter will discuss the procedures of this study. The procedures discussed include: (a) research design, (b) sampling methods, (c) instruments for collecting data, (d) data collection procedures, and (e) data analysis. The validity of the instruments will also be addressed.

Research Design

This study used a nonrandom sample, cross-sectional research design that consisted of correlational and descriptive statistical analysis that determined the risk of the female athlete triad in athletes and non-athletes. This study examined if there was a correlational relationship between the risk of the female athlete triad and the amount of time spent in exercise in female athletes and non-athletes. It also examined if there was a relationship between the risk of the female athlete triad in athletes compared to non-athletes. A cross-sectional design was used to allow data to be collected from both athletes and non-athletes. The limitation of using a cross-sectional design was that it did not allow data to be collected over a period of time to determine if changes in time spent in exercise affected the risk of developing the female athlete triad. The nonrandom sample selection did not allow the generalization of the findings of this study to groups of female athletes and non-athletes in other settings.

Sampling and Setting

The sample for this study was non-random and involved female athletes and non-athletes. All participants were students at Utah State University (USU). The target population for this study was female college students. This population was selected due to college age females being at greatest risk of developing disordered eating habits (Hoek, 1995).

The athlete participants for this study included female athletes attending USU involved in gymnastics, track and field, cross country, soccer, softball, basketball, tennis, and volleyball. The non-athlete participants were USU female students enrolled in Psychology 1010. All female athlete participants were given the surveys at a team meeting or after their scheduled conditioning time. The non-athletes were given the surveys in their class. All participants, athletes and non-athletes, were instructed to take the surveys home and complete them in private. The surveys were then picked up by the student researcher a week later at the same location the surveys were administered.

Demographic Information

As for the demographics of the female athletes and non-athletes it was found that there were significance difference in height and age. Yet, the magnitude of these results was small. No significant difference was found with weight. The demographics were evaluated to describe the females who participated in the current study. It is unlikely that these small differences had an affect on the statistical analysis of this study.

Table 1 displays the demographic statistics for female athletes and non-athletes in age, height and weight. An independent *t* test showed no significance difference in

weight between groups. While significance difference with an alpha of < .05 was found in height, $t(182.7) = -2.35$, $p = .02$, and age, $t(90.87) = 3.43$, $p = .002$, indicating that athletes were found to be younger and weighed more. Effect size was determined by using the equation $d = t\sqrt{(n1+n2/n1n2)}$. When calculated all three effect size were found to be small so there is a small magnitude of difference on age, height, and weight.

Table 1

Demographic Results for Athletes and Non-athletes on Age, Height, and Weight

	Female Athletes (n = 103)				Female Non-athletes (n = 89)						
Variable	Mean	*SD*	Min	Max	Mean	*SD*	Min	Max	*t*	*p*	*ES*
Age	19.35	1.24	18	24	21.52	6.2	18	47	3.43	.002	.496
Height (m)	1.69	3.67	1.42	1.88	1.66	3.32	1.40	1.91	-2.35	.02	.002
Weight (kg)	65.41	23.68	44.45	101.60	65.37	31.74	38.56	126.55	-.02	.98	.142

Instrumentation

The instruments used in this study include: (1) Eating Attitudes Test -26 (EAT-26), (2) a questionnaire regarding the participants menstrual cycle in the past year, (3) questionnaire regarding the participants exercise patterns, and (4) an osteoporosis risk questionnaire. These questionnaires were used to determine the risk of the female athlete triad, rather than for the purpose of diagnosing subjects with the female athlete triad.

With permission from David M. Garner, Ph.D. (Appendix A) the EAT-26 was used to determine the risk of the participants involved in an eating disorder (Appendix B). The EAT-26 has been found to be useful in screening those at risk of an eating

disorder in high school age students, college and students, and athletes (Garner, Rosen, & Barry, 1998). Reliablity and validity has been determined by Garner, Olmsted, Bohr, and Garfinkel (1982) along with Lee, Kwok, Liau, and Lleung (2002) and Mintz and O'Halloran (2000).

The EAT-26 consists of 26 questions and five behavioral questions with the first 26 questions divided into three subscales. The three subscales are dieting, bulimia and food preoccupation, and oral control. The scoring for the first 25 questions have six possible answers with always =3, usually =2, often =1, sometimes = 0, rarely= 0, never =0. For question #26, possible responses include, always =0, usually =0, often =0, sometimes =1, rarely =2, never =3. Of these points if an individual scores a 20 or higher it indicates concerns about dieting, body weight or problematic eating behaviors. For the behavioral questions the six possible answers include never, once a month or less, 2-3 times a month, once a week, 2-6 times a week, once a day or more. The fifth question answer was a yes no response. The five behavioral symptoms questions refer to symptoms that are common in those with eating disorders (Garner et al., 1982).

To determine the participants' menstrual cycle history a questionnaire developed by the student researcher was administered. The questionnaire asked the age of menarche and the number of cycles in the last 12 months with responses including 0, 1-3, 4-6, 7-9, 10-12 or >12. It also asked if they are currently taking oral medication or hormone replacements to regulate their menstrual cycles (see Appendix C). Due to this study looking at oligomenorrhea and amenorrhea, subjects were considered at risk if they met the requirements for oligomenorrhea or amenorrhea (nine or less cycles per year). This questionnaire was developed through an extensive review of literature on determining the

different types of menstrual cycles that a female can experience. Also, a panel of experts added insight to improve this questionnaire.

A questionnaire, also developed by the student researcher, was given to determine the amount of time the participants spent in exercise. They were asked the number to days per week they spend in exercise to a point where they break a sweat, and the amount of time per day they spend in exercise (see Appendix C). This instrument was developed through review of the literature and by a panel of experts.

The final questionnaire is the Osteoporosis Risk Questionnaire (Appendix D). This questionnaire is an adapted version of a questionnaire by The Osteoporosis Evaluation Program University Hospital, Syracuse, New York (n.d.). Permission was not obtained to use the adapted version due to writer not responding to multiple attempts by student researcher and a member of the expert panel.

This questionnaire consists of 31 “yes” or “no” responses along with more detailed questions. The detailed questions are number three which asks about the amount of alcoholic beverages consumed, question 17 which asks how many stress fractures they have been diagnosed with, and question 20 which asks if while breast-feeding was calcium supplements used. Questions 1-11 deal with questions that one may change to reduce their risk of osteoporosis. Questions 12-22 are questions that one can not change to reduce their risk of osteoporosis. While questions 23-31 deal with questions that one might be able to change to reduce their risk of osteoporosis.

The writer of the original survey established a point system for each question ranging from 1 to 4 points. All “yes” responses are positive points except for question number five in which “no” is the positive point. Also, established by the original writer is

a risk point scale. Someone receiving zero to eight points is considered low risk. Someone scoring nine to sixteen points is considered moderate risk while a score of 17 to 25 is considered high risk. For this study one was considered at risk if they met the requirements for moderate or high risk.

Instrument Validity

A study of all four measurements regarding content validity was performed to determine if each question and the four questionnaires together determined what was intended to be measured, risk of the development of the female athlete triad. A panel of experts was selected to determine the content validity of the questionnaires. These include two orthopedic physicians, one general practice physician specialized in sports medicine, one general practice physician who works with college age students, a nurse practitioner specialized in women's health and a professor of health education. Each was hand delivered the questionnaires and a cover letter (see Appendix E) which explained the purpose of the study. A specific time limit for their response was stated in the cover letter. Each questionnaire written by the student researcher provided a box after each question asking: "Is the above question appropriate for this study?" and "Are there changes to this question you would recommend?" At the conclusion of each questionnaire written by the student researcher the panel was asked: "Do you feel this questionnaire has content validity?" Also, at the conclusion of the osteoporosis risk questionnaire the panel was asked: "Does the above point system represent the levels or developing osteoporosis?" The EAT-26 and the scoring and interpretation page was also given to each individual on the panel. At the end of all four instruments they were asked:

"Do you feel the risk of developing the female athlete triad is determined by the questionnaires?" to determine if the given instruments represented what is intended to be measured.

All six health professionals reported, in their opinion, the questionnaires did display content validity. They did mention when asked if they felt the three questionnaires represented the risk of the female athlete triad that it was a fair assessment of the risks and the questionnaires did cover the major factors but they would not determine if they have the female athlete triad. They did give some helpful insights into clarifying the questions so there is no confusion on what is being asked. Due to their remarks, some wording was changed to make the questions clearer. These minor changes allow for a more concise measure of the risk of the female athlete triad.

Data Collection Procedures

Prior to collecting data approval for the study was gained from the Institutional Review Board (IRB) at Utah State University. There was a letters of information distributed prior to collecting data, to both female athletes and non-athletes (Appendix F).

The coaches for all varsity sports and USU with women athletes (cross country, track and field, soccer, volleyball, gymnastics, tennis, softball, and basketball) were contacted to determine a time to collect data. Professors in Psychology 1010 were contacted for permission to collect data from their classes. Both males and females were given the surveys in the classes. However, the males were not asked to complete the menstruation portion of the survey. Data from the males were not used for the study. All participants were given the surveys at the time arranged by the researcher and coach or

professor. The participant were given oral instructions of the surveys. All participants were instructed to complete the surveys at home. The researcher arranged a time with the coach or professor the following week or a time that was convenient with the coach to collect the surveys.

When an effect size was run a very large number was determined for the college age females to be surveyed. For this reason an equal amount of female athletes (150) and college age females (150) was desired for the study.

Table 2

Demographic Information for Number and Classification of Participants

Sport participation	*n*	% of sample	Response rate
Non-athlete	89	46.4%	
Athlete	103	53.6%	79.2%
Cross country	8	4.2%	80%
Track & Field	20	10.4%	86.9%
Volleyball	14	7.3%	82.3%
Gymnastics	12	6.3%	80%
Soccer	21	10.9%	80.8%
Basketball	14	7.3%	87.5%
Softball	10	5.2%	50%
Tennis	4	2.1%	100%

There were 192 participants involved in this study. There were 103 (53.6%) were athletes and 89 (46.4%) were non-athletes. Table 2 shows the demographics of number of non-athletes and athletes and the categorization of athletes in each sport used in the study.

For the athletes 8 (4.2%) were cross country runners, 20 (10.4%) were track and field athletes, 14 (7.3%) were volleyball players, 12 (6.3%) were gymnasts, 21 (10.9%) were soccer players, 14 (7.3%) were basketball players, 10 (5.2%) were softball players, and 4 (2.1%) were tennis players.

Data Analysis Procedures

Due to the outcome variable (at risk of the female athlete triad) being binary, logistic regression was used to determine whether a female was at risk of the female athlete triad. All research questions used a logistic regression with some using other statistical methods to determine their significance. This is shown in Table 2.

To determine if female athletes were at a greater risk compared to the college age females a logistic regression was ran to determine if they were at risk of the female athlete triad and a chi-square analysis, with alpha < .05, was also ran to determine if female athletes were at a greater risk of the female athlete triad, due to the outcome being binary. A binary variable and continuous variable were involved when determining if there is a correlation between the amount of time spent in exercise and the risk of the female athlete triad, so a Spearman correlation was performed to determine if there was a correlation between the two variables. The outcome of lean versus non-lean athletes being at risk of the female athlete triad is binary so a chi-square analysis was performed with alpha at < .05. All statistical analysis was conducted in SPSS 15.0 (SPSS Inc., 2006).

Table 3

Research Question, Survey Item, and Statistical Analysis

Research Question	Corresponding Survey Item	Statistical Analysis
1. It was expected that this study would find female athletes and non-athletes at a division I university to be at risk of the female athlete triad.	EAT-26, menstrual cycle questionnaire, Osteoporosis Risk Questionnaire	Logistic regression
2. It was expected that this study would find female athletes to have a significantly higher risk of the female athlete triad compared to non-athletes.	EAT-26, menstrual cycle questionnaire, Osteoporosis Risk Questionnaire	Logistic regression, Chi-Square
3. It was expected that this study would find athletes that spend excessive amounts of time in exercise to be at greater risk of the female athletes triad.	EAT-26, menstrual cycle questionnaire, Osteoporosis Risk Questionnaire, time spent in exercise questionnaire	Logistic regression, Spearman correlation

(table continues)

Research Question	Corresponding Survey Item	Statistical Analysis
4. It was expected that this study would find non-athletes that spend excessive amounts of time in exercise to be at greater risk of the female athlete triad.	EAT-26, menstrual cycle questionnaire, Osteoporosis Risk Questionnaire, time spent in exercise questionnaire	Logistic regression, Spearman correlation
5. It was expected that this study would find those involved in lean sports to be at greater risk of the female athlete triad compared to non-lean sport athletes.	EAT-26, menstrual cycle questionnaire, Osteoporosis Risk Questionnaire	Logistic regression Chi-Square

Missing Data

Missing data was found in all four questionnaires along with demographic information. There were nine participants with missing data in one or more of their demographic information. The demographic information was never left blank due to the information not being prevalent for the current study. For the EAT-26 there were 15 participants with missing data. The missing data was scored as a zero due to them already being at risk or three (highest amount of points for a given question) added to their score would not put them at risk for disordered eating. There were also 15 participants with missing data in the osteoporosis questionnaire. The same procedure for the EAT-26 was used for this questionnaire with the exception that the points would vary depending on

the question with missing data. As for the menstrual cycle history questionnaire there was one participant missing all questions and four were missing one question. If their history could not be determined by the other two questions the data remained blank. This occurred for one participant and the participant with no answers was also left blank. Amount of time in exercise had seven participants with missing data and this data was left missing. With all data missing this was taken into account as missing data when statistical analysis was ran.

Summary

This study examined if there was a relationship between the risk of the female athlete triad and the amount of time spent in exercise in athletes and non-athletes. It also determined if athletes are at a greater risk of the female athlete triad compared to non-athletes. This chapter discussed the methodology of this study and the statistical analysis procedures.

CHAPTER IV

RESULTS

Chapter Overview

This chapter will discuss the statistical analysis results for each of the research questions along with additional statistical analysis. As stated in Chapter III statistical significance was found with an alpha level <.05. Chapter III also contains the procedures that were preformed to conduct the analysis.

Research Questions

Research Question One: Are female athletes and non-athletes at a division I university at risk of the female athlete triad?

Research question one expected this study to find both female athletes and non-athletes at a division I university to be at risk of the female athlete triad. A simple binary logistic regression analysis was used to determine if the risk of the female athlete triad were found in both female athletes and non-athletes. The dependent variable used for this analysis was risk of the female athlete triad, this was determined by a female participant meeting or not meeting the requirements to be at risk for disordered eating, menstrual cycle dysfunction and osteoporosis. The instruments used to determine the risk included the EAT-26, menstrual cycle history questionnaire, and the osteoporosis questionnaire. As for the independent variable, it was determined by the group, either athlete or non-athlete. The results from the simple binary logistic regression analysis for the first research question are shown in Table 4. The odds of a female participant being at risk of the female athlete triad were found to not be significant (OR=.684, p=.610). It was found

that eight of the 192 participants were at risk of the female athlete triad. This was determined by the frequency of a participant being at risk for disordered eating, amenorrhea, and osteoporosis. Of the eight, it was found five were female athletes while three were female non-athletes. This was also found by using the frequency of females at risk of the female athlete triad in either athlete or non-athlete groups.

Table 4

Simple Logistic Regression Results for Female Athlete Triad, Disordered Eating, Menstrual Cycle History, and Osteoporosis

Variable	B	*z*-squared	*df*	Sig.	Odds ratio	-2 log likelihood	Nagelkerke R. squared
TRIAD	-.38	.260	1	.610	.684	66.244	.005
DE	.408	.669	1	.413	1.503	118.799	.008
MC	-.327	1.250	1	.264	.721	260.623	.009
OSTEO	1.421	4.663	1	.031	4.141	104.338	.068

Note. TRIAD= female athlete triad; DE =disordered eating; MC =menstrual cycle dysfunction; OSTEO =osteoporosis.

By determining the frequency for a female being at risk of disordered eating, menstrual cycle dysfunction, or osteoporosis it was found: out of the 192 participants, 18 were at risk of disordered eating, 91 had irregular menstrual cycles, and 176 were at risk of osteoporosis, with 95 considered moderately at risk and 79 considered at high risk. A simple binary logistic regression was also conducted on each of the components of the female athlete triad independently. The variables were labeled as followed; disordered eating, menstrual cycle dysfunction, and osteoporosis being the dependent variable and the group, athlete and non-athlete, the independent variable. The odds of being at risk of

osteoporosis were found to be statistically significant (OR=4.141, p=.031) while disorder eating (OR=1.503, p=.413) and menstrual cycle history (OR=.721, p=.264) were not found to be statistically significant.

Research Question Two: Is there a difference in those at risk of the female athlete triad between the female athletes and female non-athletes?

The second research hypothesis expected the current study to find female athletes to have a significantly higher risk of the female athlete triad compared to female non-athletes. A chi-square test was performed to determine if there was a difference between female athletes and female non-athletes and the risk of the female athlete triad. The results of the chi-square test were statistically significant, $\chi^2(1,N=192)=161.33, p<.01$, indicating that there was a difference between female athlete and female non-athletes and their risk of the female athlete triad. Percentages were also calculated to determine the differences between the groups. It was found that 4.8% (5) female athletes and 3.4% (3) female non-athletes were found to be at risk for the female athlete triad. Thus, the female athlete triad was found more often in female athletes than female non-athletes. These results can be found in Table 5.

A chi-square analysis was also performed for each of the three components of the female athlete triad as also shown in Table 4. A significant difference between athletes and non-athletes was found in disordered eating $\chi^2(1,N=192)=126.75$, $p<.01$ and osteoporosis $\chi^2(1,N=192)=133.33$, $p<.01$. Percentages were also calculated to determine the difference between the groups. It was found that 7.7% of athletes and 12.2% of non-athletes were found to be at risk for disordered eating. For osteoporosis it was found that 86.5% of athletes and 96.6% of non-athletes were at risk. Regarding menstrual cycle

irregularities, a statistically significant difference between female athletes and female non-athletes, $\chi^2(1,N=192)=.132$, $p=.716$ was not found. However, 51% (53) of athletes and 43.8% (39) of non-athletes were found to have menstrual cycle irregularities. By determining the frequency for menstrual cycle dysfunctions it was found that 21 athletes and two non-athletes had primary amenorrhea and 24 athletes and 28 non-athletes were taking oral medication to regulate their menstrual cycles.

Table 5

Chi-Square Results for Those at Risk for the Female Athlete Triad in Both Athletes and Non-athletes

	Female Athletes		Female Non-Athletes			
Variable	*n*	%	*n*	%	χ^2	*p*
TRIAD	5	4.8%	3	3.4%	161.33	.000**
DE	8	7.7%	10	12.2%	126.75	.000**
MC	53	51%	39	43.8%	.132	.716
OSTEO	90	86.5%	86	96.6%	133.33	.000**

Note. ** $p < .01$ TRIAD= female athlete triad; DE= disordered eating; MC= menstrual cycle irregularities; OSTEO= osteoporosis.

Research Question Three: Is there a relationship between the amount of time spent in exercise and the risk of the female athlete triad for athletes?

The third research hypothesis expected to find athletes that spent excessive amounts of time in exercise to be at greater risk of the female athlete triad. An excessive exerciser was defined as one who exercised over the mean minutes per week (679) for the female athletes in the current study. A 2-tailed Spearman correlation was used to determine if there was a relationship between excessive amount of time in exercise and the risk of the female athlete triad. A statistically significant correlation was not found between excessive exercisers and athletes for those at risk of the female athlete triad as shown in Table 6. Disordered eating, menstrual cycle dysfunction, and osteoporosis were also analyzed with a 2-tailed Spearman correlation with excessive exerciser also being a variable. Statistical significance was not found as also shown in Table 6.

Research Question Four: .Is there a relationship between the amount of time spent in exercise and the risk of the female athlete triad for non-athletes?

The fourth research hypothesis expected to find non-athletes that spent excessive amounts of time in exercise to be at greater risk of the female athlete triad. As mentioned in research question three, a participant that exercised 679 minutes per week or more was classified as an excessive exerciser. A 2-tailed Spearman correlation was used to determine if there was a correlation between non-athletes that were excessive exercisers and the risk of the female athlete triad. A statistically significant correlation was not found between excessive exercisers and the non-athletes for those at risk of the female athlete triad (r = -.041, p = .706) as shown in Table 6. Statistical significance was also

not found when each component was looked at independently, in both athlete and non-athletes.

Table 6

Spearman Correlation for Excessive Exercisers in Female Athletes and Non-athletes and the Risk of the Female Athlete Triad

	Athlete (n = 103)	Non-athlete (n = 89)
	EE	EE
TRIAD	.113	-.041
sig. (2-tailed)	.256	.706
DE	.118	-.077
sig. (2-tailed)	.237	.472
MC	-.182	-.195
sig. (2-tailed)	.068	.069
OSTEO	-.172	.041
sig. (2-tailed)	.083	.706

Note. EE= excessive exerciser; TRIAD= female athlete triad; DE= disordered eating; MC= menstrual cycle; OSTEO= osteoporosis.

Research Question Five: Are there specific sports at a division I university whose participants are at greater risk of the female athlete triad?

The fifth research hypothesis expected to find athletes that were involved in lean sports to be at greater risk of the female athlete triad compared to athletes not involved in lean sports. A chi-square analysis was used to determine the results for this research question. As shown in Table 7, a statistically significant difference $\chi^2(1,N=103)=83.971$, $p < .01$ was found for the females at risk of the female athlete triad in athletes involved in

lean sports and those involved in non-lean sports. Percentages were calculated to determine the difference between the lean and non-lean sports. Of the 20 lean-sport athletes involved in this study, 5% (1) were found to be at risk of the female athlete triad while 17.4% (4) of the 83 non-lean athletes were found to be at risk of the female athlete triad. In summary, the risk of the female athlete triad was found more often in non-lean athletes compared to lean athletes. Yet, the number of participants was not equal between the lean and non-lean sports so no conclusions can be made from the results.

Table 7

Chi-square Results for Lean and Non-lean Athletes for Risk of the Female Athlete Triad

	Lean athletes *n*=20		Non-lean athletes *n*=83			
Variable	*n*	%	*n*	%	χ^2	*p*
TRIAD	1	5%	4	17.4%	83.971	.000**
DE	1	5%	7	8.4%	73.485	.000**
MC	16	80%	37	44.6%	.248	.619
OSTEO	20	100%	70	84.3%	57.563	.000**

Note: ** $p < .01$ TRIAD= female athlete triad; DE= disordered eating; MC= menstrual cycle; OSTEO= osteoporosis.

A chi-square analysis was also conducted on disordered eating, menstrual cycle dysfunction, and osteoporosis to determine if there was a difference between lean athletes and non-lean athletes and their risk of these health concerns. When disordered eating, menstrual cycle dysfunction and osteoporosis were observed separately there was statistical significance found in disordered eating $\chi^2(1,N=103)=73.485$, $p<.01$, and

osteoporosis $\chi^2(1,N=103)=57.563$, $p<.01$. However, statistical significance was not found in menstrual cycle history $\chi^2(1,N=103)=.248$, $p=.619$ when comparing lean athletes to non-lean athletes. Percentages were again calculated to determine the difference. Non-lean female athletes were found to have a higher percentage of being at risk for disordered eating compared to female lean athletes. Of the lean athletes 5% (1) was found to be at risk of disordered eating while 8.4% (7) non-lean athletes were found to be at risk. Risk for the development of osteoporosis was found in both lean and non-lean athletes with the lean athletes having a higher percentage of risk. The results found all of the lean (20) and 84.3% (70) of the non-lean athletes were found to be at risk. As for irregular menstrual cycle 80% (16) of the lean athletes and 44.6% (37) of the non-lean athletes were found to have irregular menstrual cycles. So, lean athletes had a higher percentage of irregular menstrual cycles compared to non-lean athletes. Also, determine from the frequency of age of menarche 16 or greater it was found 21 athletes that had primary amenorrhea with 11 participating in lean sports.

Additional Analysis

An additional analysis outside of the research questions was also conducted to give further insight into the female athlete triad. This analysis was conducted to determine if there was a significant correlation between the components of the female athlete triad and their risk of the female athlete triad. A 2-tailed Spearman correlation was run on both athletes and non-athletes to determine if there was a correlation within the three components of the female athlete triad. Disordered eating, menstrual cycle, osteoporosis, and the female athlete triad were all variables used in this analysis. As shown in Table 8 a significant positive correlation was found between risk of the female

athlete triad and irregular menstrual cycle (r=.216, p<.01). A significant positive correlation was also found between the risk of the female athlete triad and disordered eating (r=.648, p<.01), along with the risk of osteoporosis and irregular menstrual cycle (r=.182, p=.012). From the results of the correlation it could be said that there is a relationship between irregular menstrual cycle and the risk of the female athlete triad, disordered eating and the risk of the female athlete triad, and osteoporosis and irregular menstrual cycle. However, this only determines a relationship, it can not be said that one causes the other.

Table 8

2-tailed Spearman Correlation Involving Risk of the Female Athlete Triad

	TRIAD	DE	MC	OSTEO
TRIAD	--	.648**	.216**	.063
sig. (2-tailed)		.000	.003	.386
DE	--	--	-.027	.032
sig. (2-tailed)			.707	.656
MC	--	--	--	.182*
sig. (2-tailed)				.012
OSEO	--	--	--	--

Note. **p < .01, * p < .05. TRIAD= female athlete triad; DE= disordered eating; MC= menstrual cycle; OSTEO= osteoporosis.

Summary

Chapter IV discussed the statistical results that were found for each of the five research hypothesis questions along with the demographic information for the female participants. Additional analysis was also reported to give insight into different aspects of

this study. Chapter V will present a discussion of the findings of this study along with what has been found in past research on the female athlete triad.

CHAPTER V

DISCUSSION

Chapter Overview

This chapter will discuss the finding of the current study along with how they relate to previous research performed on the female athlete triad in athletes and non-athletes. This chapter will also discuss the interventions that may help females at risk for the female athlete triad. The limitations of this study along with recommendations for further research will also be discussed in this chapter.

Summary of Findings

Many researchers have studied the female athlete triad (Beals & Manore, 2002; DiBartolo & Shaffer, 2002; Hopkinson & Lock, 2004; Johnson et al., 1999; Roberts et al., 2003; Stanford-Martens et al., 2005; Torstviet & Sundgot-Borgen, 2005) prior to this current study (refer to Table 9). There have also been researchers who studied both female athletes and female non-athletes (DiBartolo et al., 2002; Reinking & Alexander, 2005; Thompson & Gabriel, 2004; Torstveit & Sundgot-Borgen). The significance of this current study was to determine if the amount of time spent in exercise has a significant correlation to those at risk of the female athlete triad. Prior research has not taken into account the amount of time a female participates in exercise as it relates to her risk of developing the female athlete triad. This research includes that aspect.

Table 9

Research Question, Study Results, and Supporting Research

Research Question	Study Results	Supporting Research
1. Risk of the female athlete triad in both female athletes and non-athletes at a division I university.	Both female athletes and non-athletes were found to be at risk of the female athlete triad but it was not significant.	Thompson & Gabriel, 2004; Torstveit & Sundgot-Borgen, 2005
2. Significantly greater risk of the female athlete triad in female athletes compared to non-athletes.	Female athletes were found to be at a significantly greater risk of the female athlete triad compared to non-athletes	Thompson & Gabriel, 2004
3. Significantly greater risk of the female athlete triad in female athletes that spend excessive amounts of time exercising.	Female athletes that exercise for excessive amounts of time were not found to be at a significant greater risk of the female athlete triad.	No previous research

(table continues)

Research question	Study results	Supporting research
4. Significantly greater risk of the female athlete triad in female non-athletes that spend excessive amounts of time exercising.	Female non-athletes that exercise for excessive amounts of time were not found to be at a significant greater risk of the female athlete triad.	No previous research
5. Significantly greater risk of the female athlete triad in female athletes involved in lean sports compared to those involved in non-lean sports.	When comparing female athletes that participate in lean sports to female athletes that participate in non-lean sports statistical significant was found with the non-lean athletes were found to be at greater risk of the female athlete triad.	No previous research

Discussion

Research Question One

The first research question addressed in this current study was to examine if both athletes and non-athletes at a division I university were at risk of the female athlete triad. This was determined by the combination of the EAT-26, menstrual cycle questionnaire, and the osteoporosis questionnaire. Both female athletes and non-athletes were found to be at risk of the female athlete triad. Yet, the results were not found to be significant at an alpha level of .05. The results are consistent with those found by Thompson and Gabriel (2004) in their study of 37 athletes and 18 non-athletes. They found the female athlete triad in both the female athletes and the female non-athletes. Female athletes reported 8.6% at risk for disordered eating, 67.6% with performance related injuries, and 33.4% with menstrual cycle dysfunction. As for the non-athletes it was reported that 11.1% were at risk for disordered eating, 27.9% experienced performance related injuries, and 16.7% had menstrual cycle dysfunction. Torstveit and Sundgot-Borgen (2005) also found similar results with 938 athletes and 900 non-athletes. They found that both groups to have over 60% at risk of the female athlete triad.

As mentioned previously the results of the current study were found to not be significant with a small odds ratio (OR = 0.684, p = .0610) of a female college student developing the female athlete triad. This could be due to meeting the criteria for all three components of the female athlete triad. For this study a female had to be at risk for disordered eating, menstrual cycle dysfunction, and osteoporosis in order to be considered at risk for the female athlete triad. The current study did not consider one to

be at risk if she was found to be at risk for one or two of the components for the female athlete triad.

Additional statistical analysis was conducted to determine if there was significance when each component of the triad was observed separately. Significance was not found in disordered eating or menstrual cycle dysfunction at the alpha level of .05. However, the osteoporosis scale alone was statistically significant ($p < .05$) in the logistic regression equation. These results with osteoporosis could have occurred due to the instrument used to determine if a participant was at risk of osteoporosis. The questionnaire questioned the participants' habits, family history, and their own health history. Prior research has nearly always asked about their history of stress fractures, while other factors that make a female at risk of osteoporosis were not considered.

Research Question Two

The second research question addressed by the current study examined if athletes were at a greater risk of the female athlete triad compared to non-athletes. The same three instruments that were mentioned previously in research question one were also used to address this research question. Statistical significance was found when a chi-square analysis was conducted to determine if female athletes were at a greater risk of the female athlete triad compared to non-athletes. The results of this study were consistent with those found by Thompson and Gabriel (2004). They found female athletes to have an 8.6% risk for disordered eating, 67.6% had performance related injuries, and 33.4% had menstrual cycle dysfunction. As for the non-athletes, it was found that 11.1% were at risk for disordered eating, 27.9% experienced performance related injuries, and 16.7% experienced menstrual cycle dysfunction. While Torstveit and Sundgot-Borgen (2005)

found non-athletes (69.2%) to have a higher percentage of those at risk of the female athlete triad compared to female athletes (60.4%). Due to the results of this study and previous studies, the female athlete triad has been found in both female athletes and female non-athletes (Thompson & Gabriel; Torstveit & Sundgot-Borgen). In summary, it could be said that whether female athletes or female non-athletes are at greatest risk depends on the particular sample being studied.

Additional analysis were also conducted on research question two to determine if a difference was found between the female athletes and the female non-athletes, and their risk of disordered eating, menstrual cycle dysfunction, and osteoporosis. Statistical significance was found in disordered eating and osteoporosis with non-athletes at a greater risk.

Similar results for disordered eating behavior in non-athletes were found by Hopkinson and Lock (2004). They found collegiate athletes to have a 7.8% risk and recreation athletes to have a 10.3% risk of developing disordered eating behaviors. Torstveit and Sundgot-Borgen (2005) also found female non-athletes (27.6%) to be at risk of developing an eating disorder compared to female athletes (14.7%) in their study observing the female athlete triad in both athletes and non-athletes. Another study by Reinking and Alexander (2005) also found female non-athletes (12.9%) to have a higher percentage of those at risk for disordered eating compared to female athletes (7.1%).

As for osteoporosis, prior research has not found the same results as those of the present study. As mentioned previously, the results from this study could be due to the instruments used to determine if one is at risk of osteoporosis. To determine if an individual is at risk of osteoporosis prior research has merely asked for history of stress

fractures, where this study had an entire questionnaire designed to determine if an individual is at risk of osteoporosis. However, using a bone scan would improve this aspect of the research.

The current study also found female athletes to have a higher percentage of menstrual cycle dysfunction compared to non-athletes. However, there was no statistical significance found between female athletes and female non-athletes. Interestingly, the two groups were actually very similar with athletes having 51% and non-athletes having 43.8% of the participants with menstrual cycle dysfunction. The results found in the current study with athletes at a greater risk are similar to those found by Hopkinson and Lock (2004). They found 42.9% of athletes and 13.4% non-athletes with irregular periods. Thompson and Gabrial (2004) also found similar results with 33.4% of athletes and 16.7% of non-athletes with menstrual cycle dysfunction in their study.

The reason for menstrual cycle dysfunction is not known for some females but many variables may contribute to this dysfunction. In an article by Hillard and Deitch (2005) some possible reasons for irregular menstrual cycles could include: polycystic ovarian syndrome, thyroid disease, undiagnosed disease, eating disorders, and drug induced disruption. Although the reason for the females in the current study who experience irregular menses is not known as mentioned previously there are many factors that could contribute to irregular menses. The present study did not investigate these possible causes except eating disorder behavior.

Research Question Three

The third research question addressed by the current study examined athletes that spent an excessive amount of time in exercise and their risk of the female athlete triad.

This research question used the three instruments mentioned in the previous two research questions along with another instrument used to determine how much time a participant spent in exercise (see Appendix C) per week. A significant correlation ($p < .05$) between the amount of time spent in exercise and the risk of the female athlete triad was not found. It was also observed that of the eight who were at risk of the female athlete triad two athletes were also considered excessive exercisers as defined as exercising over 679 minutes a week.

When each component of the female athlete triad was observed separately there was also no significant correlation between the three components and the time spent in exercise. With the only positive relationship found was between disordered eating and excessive exercising ($r = .118$, $p = .237$). Prior research has not taken into account the amount of time spent in exercise and the risk of the female athlete triad. However, Manore (2002, p. 888) stated that "The mechanisms behind athletic menstrual dysfunction have been primarily associated with energy drain (inadequate energy to cover the energy demands of the body)." So, the reason for the female athlete triad and each of its components could be related to the inadequate caloric intake for the amount of exercise being performed. Therefore, more research is needed with larger samples to determine the nutritional aspect of the female athlete triad.

Research Question Four

The fourth research question addressed in the current study examined non-athletes that spent an excessive amount of time in exercise and the risk of the female athlete triad. The same four questionnaires that were used in research question three were also used in this research question. There was also no significant correlation between the amount of

time spent in exercise and the risk of the female athlete triad (r = -.041, r = .706) with an alpha level of .05. An explanation could be that only having one participant out of the 89 non-athletes that was classified as an excessive exerciser and interestingly, she was not found to be at risk of the female athlete triad.

A Spearman correlation was also run on each component of the female athlete triad to examine if there was a correlation between disordered eating (r = -.077, p = .472), menstrual cycle dysfunction (r = -.195, p = .069), and osteoporosis (r = .041, p = .706) to the risk of the female athlete triad. Similar to research question three, no significant correlation was found. The results from this research question and question three could mean that excessive exercise did not put a female college student at greater risk of the female athlete triad for this sample.

As mentioned in research question three, no prior research has been preformed on excessive exercising and the risk of the female athlete triad. Malinauskas, Cucchiara, Aeby, and Bruening (2007) conducted a study of 115 female college students and the relationships between physical activity, disordered eating risk, and anthropometric measurements. They found that the women with low physical activity levels had the greatest body dissatisfaction and body fat. These two factors were found to be 71-74% predictive of psychological disordered eating risk. The results from the study by Malinausas and colleagues (2007) could help explain why the present study found female non-athletes to have a higher percentage of risk for disordered eating and why excessive exercise was only found in one non-athlete.

Research Question Five

The fifth research question in the current study examined athletes involved in lean sports compared to athletes involved in non-lean sports. This research question used the same instruments used in questions one and two to determine if being involved in a lean sport put a female athlete at greater risk of the female athlete triad compared to the female athlete involved in non-lean sports. It was found that 5% of lean athletes and 17.4% of non-lean athletes were at risk of the female athlete triad in the present study. Statistical significance was found with $p < .01$. From the percentages mentioned above it was determined that those involved in non-lean sports were found to be at significantly greater risk of the female athlete triad compared to those involved in lean sports.

When observing all three components of the female athlete triad no prior research has found non-lean athletes to be at greater risk compared to lean athletes. As will be discussed later in this section when disordered eating is observed separately similar results have been found by past student researchers at Utah State University. A possible reason for the results in the current study and those by the other researchers (Fellows, 1999; Stella, 2006) at Utah State University could be that at Utah State University there were only two varsity athletic teams cross county and gymnastics which are classified as lean so there were only 20 lean athletes and 83 non-lean athletes in the final sample of the present study.

Additional statistical analysis was also conducted to determine if each component of the female athlete triad had a significant difference found between female athletes and non-athletes. There was a statistical significance found between disordered eating and osteoporosis ($p < .01$) and between lean or non-lean athletes. The disordered eating

component had a higher percentage of being at risk with the non-lean athletes (*n* = 20, 8.4%) as compared to lean athletes (*n* = 83, 5%).

Prior research at Utah State University has found non-lean athletes to be at a greater risk of disordered eating compared to lean athletes. Fellows (1999) study of 42 lean athletes who participated in gymnastics, cross country, and tennis and 69 non-lean athletes who participated in basketball, softball, soccer, volleyball, and track and field found no statistical significance between lean and non-lean athletes when observing behaviors of disorder eating. However, she did find female non-lean athletes to have a higher mean of binging and purging practices compared to lean athletes. By administering questionnaires to 21 lean athletes who participated in gymnastics and cross country and 36 non-lean athletes who participated in soccer and softball Stella (2006) also found no statistical significance between lean and non-lean athletes when observing eating disorders behaviors at Utah State University. Yet, Stella also found non-lean athletes to have a higher mean for being at risk for anorexia when compared to lean athletes.

Risk of osteoporosis was found to occur at greater frequency in lean-athletes as compared to non-lean athletes. For the present study it was found that all the lean athletes were at an increased risk of osteoporosis when compared to non-lean athletes. Similar results were found by Beals and Manore (2002). They found significantly more athletes involved in aesthetic sports compared to endurance and team/anaerobic sports to sustain a muscle or bone injury during their collegiate career. Another possible reason for this result could include the size of the athlete and the heavy loading demand on their bodies.

Many of these athletes have a smaller body frame and the repeatedly send forces through their bodies.

When menstrual cycle dysfunction was observed it was found that 80% of the lean athletes experienced menstrual cycle dysfunction and almost 45% of the non-lean athletes experienced menstrual cycle dysfunction. Menstrual cycle dysfunction was also found to be greater in lean athletes (42%) compared to non-lean athletes (25.8%) in a study by Torstveit and Sundgot-Borgen (2005). As mentioned in research question two, it is unknown why a female may experience irregular menses for the present study. Yet, it is known that many factors may contribute to such dysfunctions.

Additional Analysis

It is not known if being at risk with just one of the components of the female athlete triad puts a female at an increased risk of developing the risk of all three components of the triad. A significant positive correlation was found between disordered eating and risk of the female athlete triad. Also, menstrual cycle dysfunction was found to have a significant correlation with the risk of the female athlete triad. Another significant correlation was found between menstrual cycle dysfunction and osteoporosis.

From the findings of the current study it could be stated that those who were at risk of disordered eating or had menstrual cycle dysfunction were at a greater risk of developing the female athlete triad. It could also be said that those with menstrual cycle dysfunction were at a greater risk of osteoporosis. No prior research has observed a correlation of disordered eating, menstrual cycle dysfunction, and osteoporosis. However, when observing mean scores, Williams and colleagues (2006) found that

female athletes who experienced irregular menses had a significantly higher risk of an eating disorder when compared with athletes with regular menses.

Through the Spearman correlation it was found that a relationship exists between risk of disordered eating and risk of the female athlete triad. A relationship also exists between menstrual cycle dysfunction and the risk of the female athlete triad. A relationship also exists between menstrual cycle dysfunction and risk of osteoporosis. Though it cannot be said that one causes the other to occur a relationship does exists between the variables.

Study Limitations

Several limitations should be noted in the current study that should be addressed to assist in further research. First, the study utilized self reported data, which relies on the limitation of honest and non-biased answers from the participants. Athletes at risk for any of the components of the female athlete triad may not be honest in their answers for fear of it interfering with participation in their sport. The student researcher was an athletic trainer for the university, thus the student researcher may also be seen as too close to those making such decisions to be honest in their responses.

Another limitation of this study includes participation of those at risk of the female athlete triad. Some females that could be at risk for the triad may have chosen to not participate since participation was voluntary. Also, the present study did not use a randomized sample so it can not be applied to other groups beyond the study sample. By using a random sample the results could have improved generalization of this study. Also, by using a random sample, representation of the non-athletes might be improved.

Another limitation could include the cross-sectional design of this study. A cross-sectional design is more convenient for a student researcher but a longitudinal study may have found different results. This could occur due to the seasons of athletes and the events occurring at the time of data collection. If a team is in what is classified as out of season they may not have the training level that they would have during their season. Also, the data for this study was collected at the beginning of a new school year so adjustments in training are being made especially for the freshman class.

Recommendations and Changes for Future Research

Although the current study found significance in some areas that were studied there are recommendations for future research on the female athlete triad in athletes and non-athletes. First, using a random sample may improve the variety of non-athlete students which may have a greater representation of the student body. Also, by using a random sample the results could show a generalization of the population being studied.

Another recommendation would include surveying multiple universities from around the nation to gain a greater insight to a more diverse sample and different athletic programs. The level of competition varies from university to university depending on the conference they are included in. So, by randomly selecting universities from around the nation the results may be a better representation of the female college student population.

The third recommendation would include using medical testing instead of self-reported data. This would improve the limitation of accuracy of results reported. The fourth recommendation would include using a longitudinal design instead of a cross-sectional design. By collecting data throughout a students career at a university may give

an insight into how a female students' risk of the female triad may differ depending on the season and on their age.

Another recommendation would include improving the instrument used to determine if a participant is at risk for osteoporosis. The present study designed a new instrument to determine the risk for osteoporosis. However, more research is needed to improve the questionnaire. It needs to be used with a larger sample to help determine its reliability.

The last recommendation would include a questionnaire on nutrition with the amount of calories one eats in one day. By including the nutritional aspect the reason the female athlete triad occurs may be closer to being determined.

There are some changes in the way this study was conducted that would be helpful in future research. One of the things the student researcher would do differently would be to inform the coaches and professors more about the subject being studied so they would encourage their students or athletes to return the questionnaires. The student researcher found this to be positive with the coaches that knew more about the subject being studied. The student researcher would have also decreased the amount of time between distributing the questionnaires and picking them up. This study allowed a week to complete the questionnaires for non-athletes. A higher return rate may occur if the time allowed was fewer days so the participant would not forget about the questionnaires.

Prevention

While few variables proved to be significant in the present study, past research has found college age women to be at risk of the female athlete triad (DiBartolo et al.,

2002; Reinking & Alexander, 2005; Thompson & Gabriel, 2004; Torstveit & Sundgot-Borgen, 2005). Therefore, prevention is critical to assists those that may be at risk of the female athlete triad. Those that are at risk of developing the female athlete triad or one or more of its components include physically active girls and women. Variables that contribute to the risk of the female athlete triad may not be changed by the female such as genetics but other factors can be changed including eating habits, their exercise habits, and weight management. Past research indicated that factors that could lead to such habits include biological changes, peer pressure, societal drive for thinness, and preoccupation with body image during puberty (ACSM, 1997). Sports that emphasize low body weight may increase the risk. These sports include those in which performance is subjectively scored, endurance sports, sports requiring revealing clothing for competition, sports with weight categories for participation, and sports emphasizing pre-pubertal body habits (ACSM, 1997).

Bone loss is a factor that could contribute to those at risk of the female athlete triad. Those with bone loss can prevent further bone loss by early recognition and diagnosis of the female athlete triad. Appropriate screening in disordered eating, menstrual cycle dysfunction, and osteoporosis can be done to assist in diagnosing the triad. One way to screen for athletes may be to distribute a questionnaire before a pre-participation physical examination. This allows the physician to target the athletes at greatest risk of developing the female athlete triad. Reviewing the questionnaire before the physical examination may allow the physician to focus on the issues the patient might be experiencing allowing for earlier intervention (Lo et al., 2003). If Amenorrhea is

present this should be seen as a “red flag” and the athlete should be further evaluated (Golden, 2002).

Rust (2002) proposed that prevention of the female athlete triad should be conceptualized in three areas for all females whether athletes or not. The first of these categories is termed primary prevention. This involves preventing occurrence of any of the three components of the female athlete triad in order to keep healthy young females healthy. This can be done by school personnel dispelling body fat myths, providing sound nutrition education, and addressing ways to cope with stress. The second category, termed secondary prevention, involves promoting treatment of any of the triad components. This could include a physician recommending oral medications to regulate their menstrual cycle and encouraging them. The third category is termed tertiary prevention. This is aimed to reduce the impairments that the triad may cause. This could include medication to help one lesson the effect of their previous behavior such as hormone replacements.

Some questions that Rust (2002) suggested to ask the female athlete who is at risk of developing the female athlete triad include:

> Is the female dieting excessively to loose weight or experiencing large weight fluctuations, or does she appear to be losing too much weight?
>
> Are menstrual cycles irregular or absent?
>
> Has she had a stress fracture?
>
> Are her mood and self-esteem determined primarily by her weight?
>
> Is she a compulsive over exerciser? (p. 304)

Many individuals should be involved to assist in the educating the female athlete on the risk of the female athlete triad. The practitioner can educate the athletes, parents, coaches and athletic trainers of the dangers of the triad. Coaches should be educated that optimal weight for appearance, peak performance, and good health are not synonymous. Parents, athletes, and coaches should also be educated on nutritional requirements for normal growth and development during adolescence (Golden, 2002).

Conclusion

This study found both female athletes and female non-athletes to have health concerns related to their gender. It was found when all three components of the female athlete triad were observed the female athlete was at significant greater risk of the triad. When disordered eating and osteoporosis were observed separately female non-athletes were found to be at a greater risk. While menstrual cycle dysfunction was found more often in athletes with almost all lean athletes experiencing menstrual cycle dysfunction. Lean athletes were found to be at greater risk for osteoporosis too. Risk of disordered eating and the female athlete triad was found to be greater in the athletes who did not participate in lean sports.

When additional analysis was ran it was found that there is a high correlation between those at risk for disordered eating and those at risk for the female athlete triad. Another significant correlation was found those with menstrual cycle dysfunctions and those at risk for the female athlete triad. So, it could be said that those at risk for disordered eating or have menstrual cycle dysfunction are at an increase risk of developing the female athlete triad.

This study hypothesized that the amount of time spent in exercise where an individual would break a sweat or have increased breathing would be at a greater risk of the female athlete triad. This was not found to be a significant explanation for an individual to become at risk of the female athlete triad. A possible explanation for an increased risk of the female athlete triad could be determined by the caloric intake compared to the caloric expenditure. This is an area that should be studied in future studies of the female athlete triad.

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APPENDICES

Appendix A. Permission Letter

Dear Ms. Bellows,

Thank you for your request to use the EAT-26. You have my permission to reproduce the EAT-26 with my permission and I have attached a copy of the test as well as information on scoring and interpretation.

The EAT and EAT-26 are protected under copyright; however, because it has been our wish for others to have free access to the test, all fees and royalties have been waived. Permission to reproduce the work is granted as long as the original publication source is identified. You are free to use it for the purpose specified.

The correct citation for the EAT-26 (26-item version) is:

The EAT-26 has been reproduced with permission. Garner, D.M., Olmsted, M.P., Bohr, Y., and Garfinkel, P.E. (1982). The Eating Attitudes Test: Psychometric features and clinical correlates. Psychological Medicine, 12, 871-878.

or

The EAT-26 has been reproduced with permission. Garner et al. (1982). The Eating Attitudes Test: Psychometric features and clinical correlates. Psychological Medicine, 12, 871-878.

I would be very interested in the results from your study.

Best wishes,

David M. Garner, Ph.D.

Clinical Psychologist

President and CEO

River Centre Clinic

5465 Main Street

Sylvania, OH 43560

Phone: 419.885.8800

Fax: 419-885-8600

e-mail: garner@river-centre.org

website: www.river-centre.org

Appendix B. Eating Attitude Test-26

Instructions: This is a screening measure to help you determine whether you might have an eating disorder that needs professional attention. This screening measure is not designed to make a diagnosis of an eating disorder or take the place of a professional consultation. Please fill out the below form as accurately, honestly and completely as possible. There are no right or wrong answers. All of your responses are confidential.

Eating Attitudes Test (EAT-26)©

Part A: Complete the following questions:

1) Birth Date Month: Day: Year: 2) Gender: Male Female

3) Height Feet : Inches: ☐ ☐

4) Current Weight (lbs.): 5) Highest Weight (excluding pregnancy):

6) Lowest Adult Weight: 7: Ideal Weight:

Part B: Please check a response for each of the following statements:		Always	Usually	Often	Some times	Rarely	Never
1.	Am terrified about being overweight.	☐	☐	☐	☐	☐	☐
2.	Avoid eating when I am hungry.	☐	☐	☐	☐	☐	☐
3.	Find myself preoccupied with food.	☐	☐	☐	☐	☐	☐
4.	Have gone on eating binges where I feel that I may not be able to stop.	☐	☐	☐	☐	☐	☐
5.	Cut my food into small pieces.	☐	☐	☐	☐	☐	☐
6.	Aware of the calorie content of foods that I eat.	☐	☐	☐	☐	☐	☐
7.	Particularly avoid food with a high carbohydrate content (i.e. bread, rice, potatoes, etc.)	☐	☐	☐	☐	☐	☐
8.	Feel that others would prefer if I ate more.	☐	☐	☐	☐	☐	☐
9.	Vomit after I have eaten.	☐	☐	☐	☐	☐	☐
10.	Feel extremely guilty after eating.	☐	☐	☐	☐	☐	☐
11.	Am preoccupied with a desire to be thinner.	☐	☐	☐	☐	☐	☐
12.	Think about burning up calories when I exercise.	☐	☐	☐	☐	☐	☐
13.	Other people think that I am too thin.	☐	☐	☐	☐	☐	☐
14.	Am preoccupied with the thought of having fat on my body.	☐	☐	☐	☐	☐	☐
15.	Take longer than others to eat my meals.	☐	☐	☐	☐	☐	☐
16.	Avoid foods with sugar in them.	☐	☐	☐	☐	☐	☐
17.	Eat diet foods.	☐	☐	☐	☐	☐	☐
18.	Feel that food controls my life.	☐	☐	☐	☐	☐	☐
19.	Display self-control around food.	☐	☐	☐	☐	☐	☐
20.	Feel that others pressure me to eat.	☐	☐	☐	☐	☐	☐
21.	Give too much time and thought to food.	☐	☐	☐	☐	☐	☐
22.	Feel uncomfortable after eating sweets.	☐	☐	☐	☐	☐	☐
23.	Engage in dieting behavior.	☐	☐	☐	☐	☐	☐
24.	Like my stomach to be empty.	☐	☐	☐	☐	☐	☐
25.	Have the impulse to vomit after meals.	☐	☐	☐	☐	☐	☐
26.	Enjoy trying new rich foods.	☐	☐	☐	☐	☐	☐

Part C: Behavioral Questions: In the past 6 months have you:		Never	Once a month or less	2-3 times a month	Once a week	2-6 times a week	Once a day or more
A	Gone on eating binges where you feel that you may not be able to stop?	☐	☐	☐	☐	☐	☐
B	Ever made yourself sick (vomited) to control your weight or shape?	☐	☐	☐	☐	☐	☐
C	Ever used laxatives, diet pills or diuretics (water pills) to control your weight or shape?	☐	☐	☐	☐	☐	☐
D	Exercised more than 60 minutes a day to lose or to control your weight?	☐	☐	☐	☐	☐	☐
E	Lost 20 pounds or more in the past 6 months	Yes ☐		No ☐			

* Defined as eating much more than most people would under the same circumstances and feeling that eating is out of control

EAT-26: Garner et al. 1982, *Psychological Medicine*, *12*, 871-878); adapted by D. Garner with permission.

Appendix C. Menstrual Cycle History & Time Spent in Exercise

Menstrual Cycle

Age (in years) at onset of first menstrual cycle _____

History of prior year menstrual cycle (mark one).

____ 0 cycles in past year

____1-3 cycles in past year

____4-6 cycles in past year

____ 7-9 cycles in past year

____10-12 cycles in past year

____>12 cycles in past year

Have you taken oral medications or hormonal replacements to regulate your menstrual cycle? YES NO

Exercise

Number of days per week that you exercise to a point where you break a sweat or increase breathing._____

Amount of time in minutes per day _____

Appendix D. Osteoporosis Risk Questionnaire

Osteoporosis Risk Questionnaire

1.Do you smoke cigarettes or use smokeless tobacco?	Yes	No
2. Do you have 3 or more cups (8oz) of coffee a day – or an equivalent amount (5 cups of 8oz)of caffeine from other sources, such as cola-type beverage (Mt. Dew, Tea, Red Bull)?	Yes	No
3. Do you drink alcoholic beverages?	No	
	Yes, 1-2 ounces per day	
	Yes, 3 or more ounces per day	
4. Do you avoid milk and other dairy products and Do not take a calcium supplement daily?	Yes	No
5. Do you exercise regularly? (20 to 30 minutes of weight bearing exercise 2-3 times a week)	Yes	No
6. Are you a female who exercises a great deal, (more than 30 minutes a day four times a week) with irregular (less than 9 menses per year)or no menstruation?	Yes	No
7. Do you feel that you have an eating disorder or consume too little nutritious food?	Yes	No
8. Do you have high amounts of fiber in your diet? (More than 5 servings of fruit and/ or vegetables. Plus 6-11 servings of whole grains bread and cereals?	Yes	No
9. Is your diet high in animal protein, such as red meats or chicken? More than 8 ounces per day (A deck of cards is 3oz).	Yes	No
10. Do you add salt to foods at the table?	Yes	No
11. Are you vegetarian, or have a diet heavily weighted toward vegetables?	Yes	No
12. Are you female?	Yes	No
13. Are you white, northern European, or Asian?	Yes	No
14. Do you have a fair complexion?	Yes	No
15. Do you have a small bone frame?	Yes	No

Determined by: height < 5’2” wrist circumference 5.5in
Height 5’2”-5’5”, wrist circumference 6in
Height > 5’5”, wrist circumference 6.25in
MEN: height > 5’5” wrist circumference 5.5-6.5 in

16. Are you over 40 years of age? Yes No

17. Have you been diagnosed with a stress fracture? Yes No
If yes, how many? _____

18. Has anyone in your family been diagnosed with osteoporosis? Yes No

19. Have you had children? Yes No

20. Have you breast-fed at least one child?
No
Yes, while taking calcium supplements
Yes, without calcium supplements

21. Have you had both your ovaries removed? Yes No

22. Did your menopause occur before age 45? Yes No

23. Have you had arthritis or curvature of the spine (but NOT scoliosis)? Yes No

24. Have you ever been prescribed steroids (cortisone) drugs for a period of time due to asthma or another illness? Yes No

25. Have you been diagnosed with an overactive thyroid gland with symptoms such as a fast pulse and heart rate, loss of weight, and "hyped up" body metabolism or hyperthyroidism? Yes No

26. Have you been diagnosed with hyperparathyroidism, an excessive secretion of the parathyroid glands, which causes loss of calcium from the bones, formation of cysts in the bones, and kidney stones for longer than 3 months? Yes No

27. Do you have recurrent kidney stones? Yes No

28. Have you ever been prescribed anticonvulsants for a seizure disorder? Yes No

29. Have you had stomach or small-bowel disease (ex. Crohn's disease)? Yes No

30. Do you take medication for indigestion such as Zantac, Prilosec, Tagamet, etc.? Yes No

31. Are you allergic to milk or other dairy products? Yes No

Appendix E. Instrument Validity

February 26, 2007

Dear ,

Thank you for your help in evaluating the instruments for this study. The study will look at the risk of the female athlete triad (disordered eating, amenorrhea, and osteoporosis) and the amount of time spent in exercise in the female athletic population at Utah State University and the general college female population at Utah State University for a master's thesis in Exercise Science. Attached are four questionnaires regarding the three factors of the female athlete triad and the amount of time spent in exercise.

The instruments include the Eating Attitude Test (EAT-26) by David Garner, menstrual cycle history, exercise patterns, and osteoporosis risk questionnaire. The menstrual cycle history and exercise patterns questionnaires were determined by my literature review on the subjects and the osteoporosis questionnaire is revised from a questionnaire by The Osteoporosis Evaluation Program University Hospital, Syracuse New York.

In an attempt to establish the content validity of the enclosed questionnaire I am contacting health professionals, requesting them to critique the instruments to be used in this study. Following each question is a space to make comments and recommendations concerning the content validity of each instrument except for the EAT-26, which has had validity determined.

I would appreciate it if you could complete the enclosed instruments evaluations prior to March 7, 2007.

Sincerely,

Carla Bellows

(435)764-3261
cjbellows@hotmail.com

Eating Attitudes Test© (EAT-26): Scoring and Interpretation

David M. Garner, Ph. D.

The Eating Attitudes Test (EAT-26) is probably the most widely used standardized measure of symptoms and concerns characteristic of eating disorders (Garner & Garfinkel, 1979; Garner, Olmsted, Bohr, & Garfinkel, 1982). The original EAT appeared as a Current Contents Citation Classic in 1993 (Garner, 1993). The 26-item version (Garner et al., 1989) is highly reliable and valid (Garner, Olmsted, Bohr, & Garfinkel, 1982; Lee et al., 2002; Mintz & O'Halloran, 2000). The EAT-26 alone does not yield a specific diagnosis of an eating disorder (neither the EAT-26, nor any other screening instrument, has been established as highly efficient as the sole means for identifying eating disorders).

Nevertheless, many studies have used the EAT-26 as an economical first step in a two-stage screening process. According to this methodology, individuals who score 20 or more on the test should be interviewed by a qualified professional to determine if they meet the diagnostic criteria for an eating disorder (Dotti & Lazzari, 1998; Patton, Johnson-Sabine, Wood, Mann, & Wakeling, 1990). If you have a low score on the EAT-26 (below 20), you still could have a serious eating problem, so do not let the results deter you from seeking help. The EAT-26 can be used in group or individual settings and is designed to be self-administered or be administered by health professionals, school counselors, coaches, camp counselors, and others with interest in gathering information to determine if an individual should be referred to a specialist for evaluation for an eating disorder.

The EAT-26 has been particularly useful a screening tool to assess "eating disorder risk" in high school, college and other special risk samples such as athletes (Garner, Rosen and Barry, 1998). Screening for eating disorders is based on the assumption that early identification of an eating disorder can lead to earlier treatment, thereby reducing serious physical and psychological complications or even death.

The EAT-26 items form three subscales (i.e. Dieting, Bulimia and Food Preoccupation and Oral Control) and subscale scores are computed by summing all items assigned to that particular scale (*Dieting scale items*: 1, 6, 7, 10, 11, 12, 14, 16, 17, 22, 23, 24, 25; *Bulimia & Food Preoccupation scale items*: 3, 4, 9, 18, 21, 26; *Oral Control subscale items*: 2, 5, 8, 13, 19, 20).

Because denial can be a problem on self-report screening instruments, low scores should not be taken to mean that either clinically significant eating disorders symptoms or a formal eating disorder is not present. Collateral information from parents, teammates, and coaches is useful information that can correct for denial, limited self-disclosure, and social desirability. High scores on self-report measures do not necessarily mean the respondent has an eating disorder; however, it does denote concerns regarding body weight, body shape, and eating. However, if you do have a high score, do not panic. It does not necessarily mean that you have a life-threatening condition and that you will have to immediately seek a form of treatment that may be uncomfortable. If you have a score of 20 or higher, this simply means that you should seek the advice of a qualified mental health professional who has experience with treating eating disorders.

In addition to the EAT-26 questions, identification of those at risk for eating disorders is based on information on the individual's body mass index (BMI) and behavioral symptoms reflective of an eating disorder. Following the methodology described for the Eating Disorder Inventory Referral Form (EDI-RF; Garner, 2004) four behavioral questions are included on this version of the EAT-26 aimed at determining the presence of extreme weight-control behaviors as well as providing an estimate of their frequency. These questions assess self-reported binge eating, self-induced vomiting, use of laxatives, and treatment for an eating disorder over the preceding 6 months. Although these content areas could be assessed in the same format as other items, this would not provide the type of frequency data required to evaluate the extent of the problem. Body Mass Index (BMI) is also computed and used to determine if the person is "significantly underweight" compared to age-matched norms. Generally a referral is recommended if a respondent scores "positively" on the EAT-26 items or meets the threshold on one or more of the behavioral criteria.

All self-report measures require open and honest responses in order to provide accurate information. The fact that most people provide honest responses means that the EAT-26 usually provides very useful information about the eating symptoms and concerns that are common in eating disorders.

Menstrual Cycle

Age in years of first menstrual cycle _____

Is the above question appropriate for this study? Are there changes to this question you would recommend?

History of prior year menstrual cycle (mark one).

____ 0-3 cycles in past year

____3-6 cycles in past year

____ 6-9 cycles in past year

____9-13 cycles in past year

Is the above question appropriate for this study? Are there changes to this question you would recommend?

Do you feel this questionnaire has content validity?

Exercise

Number of days per week that you exercise to a point where you break a sweat._____

Is the above question appropriate for this study? Are there changes to this question you would recommend?

Amount of time in minutes per day _____

Is the above question appropriate for this study? Are there changes to this question you would recommend?

Do you feel this questionnaire has content validity?

Osteoporosis Risk Questionnaire

All are positive points for yes responses except for question #5.

1.Do you smoke cigarettes? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

2. Do you have 3 or more cups of coffee a day –
or an equivalent amount of caffeine from other
sources, such as cola-type beverage? Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

3. Do you drink alcoholic beverages? No

Yes, 1-2 oz per day 2pts

Yes, 3 or more oz per day

4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

4. Do you avoid milk and other dairy products? Yes No 3pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

5. Do you exercise regularly? (20 to 30 minutes of
weight bearing exercise 2-3 times a week) Yes No (no is 3pts)

Is the above question appropriate for this study? Are there changes to this question you would recommend?

6. Are you a female who exercises a great deal,
with irregular or no menstruation? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

7. Do you have an eating disorder or consume too
little nutritious food? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

8. Do you have high amounts of fiber in your diet?
(More than 5 servings of fruit and/ or vegetables.
Plus 6-11 servings of whole grains bread and cereals). Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

9. Is your diet high in animal protein, such as red meats,
cheese, or chicken? More than 8 oz per day.
(A deck of cards is 3oz) Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

10. Do you add salt to foods at the table? Yes No 3pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

11. Are you vegetarian, or have a diet heavily weighted toward vegetables? Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

12. Are you female? Yes No 3pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

13. Are you white, northern European, or Asian? Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

14. Do you have a fair complexion? Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

15. Do you have a small boned frame? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

16. Are you over 40 years of age? Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

17. Have you had a stress fracture? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

18. Do you have a family history of osteoporosis or other bone disease? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

19. Have you had children? Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

20. Have you breast-fed at least one child?

No

Yes, while taking calcium supplements

Yes, without supplements 1pt

Is the above question appropriate for this study? Are there changes to this question you would recommend?

21. Have you had both your ovaries removed? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

22. Did your menopause occur before age 45? Yes No3pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

23. Have you had arthritis or curvature of the spine? Yes No1pt

Is the above question appropriate for this study? Are there changes to this question you would recommend?

24. Have you ever used steroids(cortisone) drugs? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

25. Have you had an overactive thyroid gland with symptoms such as a fast pulse and heart rate, loss of weight, and "hyped up" body metabolism? Yes No 4pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

26. Have you had hyperparathyroidism, an excessive secretion of the parathyroid glands, which causes loss of calcium from the bones, formation of cysts in the bones, and kidney stones? Yes No 3pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

27. Do you have chronic kidney stones? Yes No 3pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

28. Have you ever used anticonvulsnats?
(medication designed to prevent convulsions or fits)? Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

29. Have you had stomach or small-bowel disease? Yes No 2pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

30. Do you take stomach acid blockers such as
Zantac, Prilosec, Tagamet, etc.? Yes No 3pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

31. Are you allergic to milk or other dairy products? Yes No 3pts

Is the above question appropriate for this study? Are there changes to this question you would recommend?

Point System

0-8 pts—low risk

9-16pts—moderate risk

17-25—high risk

Does the above point system represent the levels of developing osteoporosis?

Do you feel this questionnaire has content validity?

Do you feel the risk of developing the female athlete triad is determined by the questionnaires?

Appendix F. Letter of Information

Date Created: August 13, 2007
USU IRB Approved 08/13/2007
Approval terminates 08/12/2008
Protocol Number 1860
IRB Password Protected per IRB Administrator

Health, Physical Ed., and Recreation
7000 Old Main Hill
Logan UT 84322-7000
Telephone: (435) 797-1497
Fax: (435) 797-3759

LETTER OF INFORMATION: Risk of the Female Athlete Triad

Introduction. Professor Julie Gast in the Department of Health, Physical Education, and Recreation at Utah State University (USU) and Carla Southwick, a graduate student in the Department of Health, Physical Education, and Recreation are conducting a study to find out more about risk for exercise related health problems.

Purpose: You have been asked to participate in this research because you are enrolled in a large general education class at USU or you are a member of a university varsity team. There will be approximately 150 USU female athletes and 150 USU female non-athletes participating in this study. The female athlete triad is a condition that can occur in both female athletes and non-athletes. It consists of disordered eating, amenorrhea (loss of menstrual cycle), and osteoporosis. This study will not diagnose one of the female athlete triad but determine whether on is at risk of developing the female athlete triad. If you are pregnant, you will be excluded from this study because your eating habits and menstrual cycle will have been altered.

Procedures: If you agree to be in this study, you will be asked to complete four questionnaires which may take about 20 minutes to complete. Surveys will be distributed in class and you will complete them at home. Then in one week return the surveys to the student researcher at your regular class time or at a team meeting as preferred by your professor or coach. This time will be given when the questionnaires are distributed. Please do not put your name or any personal identifiable information on the questionnaires to keep this study anonymous.

Risks: There is minimal risk in participating in this study. However, participation in this study may include feeling uncomfortable reporting your exercise habits and some personal health information.
Benefits: There may not be any direct benefits to you at this time in participating in this study. However, the researchers may learn more about the possible risk of exercise and those at risk of the female athlete triad in college age females which could lead to better intervention.

Voluntary nature of participation and right to withdrawal without consequences: Participation in this research is entirely voluntary. You may refuse to participate or withdraw at any time without consequences.

Confidentiality: All research records will be kept confidential, consistent with federal and state regulations. Only the student researcher will have access to the data which will be kept in a locked file cabinet in a locked room. The surveys are anonymous; no names or personal identifiable information is being requested.

IRB approval statement: The Institutional Review Board for the protection of human participants at USU has approved this research study. If you have any questions or concerns about your rights you may contact them at (435) 797-1821.

_____	_____	_____	_____
Dr. Julie Gast Principal Investigator (435) 797-1490	Date	Carla Southwick Student Researcher (435) 764-3261	Date