The Female Athlete Triad: Is the Triad a Problem Among Division I Female Athletes?

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The purpose of the study was to determine prevalence rates of the female athlete triad (Triad), differences by sport category (aesthetic, endurance, and team/anaerobic), and the relationship between each of the components of the Triad. Female athletes (N = 451) from three Division I universities with an average age of 20 years completed the Menstrual History Questionnaire, Injury Assessment Questionnaire, and the Questionnaire for Eating Disorder Diagnoses (Q-EDD; Mintz, O’Halloran, Mulholland, & Schneider, 1997). Almost 7% of female athletes reported clinical eating disorders, and 19.2% reported subclinical disordered eating. Disordered eating was prevalent in all three sport categories with no significant differences between groups. Muscle injuries were more prevalent in team/anaerobic sports (77.4%) than the aesthetic (68.1%) and endurance groups (58.1%). Furthermore, those athletes with menstrual dysfunction more frequently reported clinical eating disorders (1.4%) and sustained more skeletal injuries (51%) during their athletic career than athletes with regular menstrual function. Clinical implications and further research directions are addressed.

Although sport participation is beneficial for most female athletes, some female athletes are at risk for developing disordered eating, menstrual dysfunction, and low bone mass (Beals & Hill, 2006). These three interrelated components are known as the female athlete triad (Triad), and each component exists along a continuum with varying degrees of severity. In 1997, the American College of Sports Medicine published a position stand on the female athlete triad, defining it as a “serious syndrome” that female athletes may develop during the course of their athletic careers (Otis, Drinkwater, Johnson, Loucks, & Wilmore, 1997, p. i).
More recently, the International Olympic Committee Medical Commission also published a position stand in 2005 to protect the health of female athletes, recognizing the seriousness of the Triad. Even though each component of the Triad has been studied individually, few studies have investigated all three components of the Triad simultaneously (Beals & Warner, 2005).

Development of the Triad is thought to begin with the female athlete’s belief that a low body weight will enhance her athletic performance. Whether the perception is accurate or not, this belief can lead her to engage in severe and unhealthy weight loss methods (Beals & Warner, 2005). Chronic dieting and generally poor eating patterns lead to energy restriction, which can predispose the female athlete to develop menstrual dysfunction. Subsequently, menstrual dysfunction leads to low bone mineral density (Beals & Warner, 2005), which places female athletes at risk for stress fractures during their athletic careers and post-competitive years (Otis et al., 1997).

**Disordered Eating**

The first component of the Triad is disordered eating. The terms *eating disorder* and *disordered eating* often are used interchangeably in the literature and in clinical practice (Beals, 2004), though they represent different levels and categories of disturbance. Eating disorders currently include three clinically diagnosed conditions (i.e., anorexia nervosa, bulimia nervosa, eating disorder not otherwise specified, NOS) as described in the *Diagnostic and Statistical Manual of Mental Disorders* (4th edition, text revision; DSM-IV-TR; American Psychiatric Association, APA, 2000). These psychological disorders have strict criteria that must be met for a diagnosis. Disordered eating is a broader term used to describe the spectrum of abnormal eating patterns, including subclinical conditions used to lose weight or maintain a below normal body weight (Beals, 2004).

For athletes, the prevalence of disordered ranges from 1-62% in female athletes across studies (Byrne & McLean, 2001). This large variability in prevalence findings can be attributed to methodological limitations, such as small sample sizes, inconsistent instruments, operational definitions of “eating disorders,” and widely disparate samples (e.g., using single sports, comparing sport groups, level of competition); however, consistent findings suggest that athletes in sports emphasizing low body weight or lean body, such as dance, cheerleading, and distance running, report more risk of developing disordered eating (Beals, 2004). The literature suggests that the pressure to obtain an ideal body weight and shape triggers body image concerns, which may lead to the development of disordered eating patterns (Otis et al., 1997; Sundgot-Borgen, 1993). The consequences of disordered eating behaviors include a decrease in metabolic rate, dehydration, anxiety, gastrointestinal problems, fatigue, musculoskeletal injuries, and menstrual dysfunction (Beals, 2004).

**Menstrual Dysfunction**

Menstrual dysfunction, the second component of the Triad, represents a range of menstrual irregularities, such as luteal suppression, anovulation, oligomenorrhea, and amenorrhea (Otis et al., 1997). These dysfunctions result from an inadequate
production of estrogen, thus compromising bone health and overall health of athletes (Beals & Warner, 2005). Luteal suppression is characterized by a shortened luteal phase. Anovulation is characterized by abnormal menstrual cycle lengths ranging from less than 20 days to 35-120 days. Menstrual cycles longer than 35 days are referred to as oligomenorrhea. Primary amenorrhea, or delayed menarche, is the absence of menstruation by the age of 15 years (Drinkwater, Loucks, Sherman, Sundgot-Borgen, & Thompson, 2005) and secondary amenorrhea is the absence of three or more consecutive menstrual cycles after menarche (Otis et al., 1997; Van De Loo & Johnson, 1995).

The prevalence range (6-79%) of menstrual dysfunction among female athletes is higher than for women in the general population (2-5%; Otis et al., 1997; Warren & Perlroth, 2001). This large variability in prevalence among athletes can be explained by sampling differences and how menstrual dysfunction is operationalized (Beals & Warner, 2005). A consistent finding, however, is that female athletes who participate in leanness-demand sports are at high risk for menstrual dysfunction. Beals and Manore (2002) found that 7.4% of 425 collegiate female athletes and 22.2% of athletes in aesthetic sports reported primary amenorrhea, whereas Torstveit and Sundgot-Borgen (2005) reported that 31.4% of elite female athletes experienced menstrual dysfunction. Although the specific mechanism is unclear, studies have shown that low energy availability, or energy intake minus exercise energy expenditure, may lead to menstrual dysfunction through disruption of the hypothalmic-pituitary-ovarian axis (Loucks & Thuma, 2003; Loucks & Verdun, 1998). Often coaches or athletes dismiss menstrual dysfunction because they believe that it is a natural result of strenuous training, but menstrual dysfunction may have serious health consequences such as infertility, endothelial dysfunction, and low bone mass (Otis et al., 1997; Zeni Hoch et al., 2003).

Musculoskeletal Injuries

Due to the decreased production of reproductive hormones, menstrual dysfunction may lead to the third component of the Triad, which is musculoskeletal injuries. This can result from decreased bone accretion or bone loss (Otis et al., 1997). The most serious medical condition associated with low bone mass is osteoporosis, defined as a bone mineral density of 2.5 standard deviations below normal peak values in young adults, leading to increased bone fragility (Kanis, 1994). Because fragile bones are more susceptible to skeletal fractures, fractures are often used as an indirect measure of bone mass. Although the etiology of stress fractures is multifactoral, these injuries can also result from an increase in bone remodeling, which occurs when estrogen levels are low (Bennell, Matheson, Meeuwisse, & Brukner, 1999; Romani, Gieck, Perrin, Saliba, & Kahler, 2002). Studies have revealed that menstrual history is the strongest predictor of stress fractures and current bone mineral density (Bennell et al., 1999; Drinkwater, Bruemner, & Chestnut III, 1990; Micklesfield, Lambert, Fataar, Noakes, & Myburgh, 1995). Athletes with menstrual dysfunction or disordered eating are 2.8 times more likely to suffer a stress fracture, whereas menstrual dysfunction in combination with disordered eating increases the risk to 4.6 (Jones, Bovee, Harris, & Cowan, 1993). The prevalence of female athletes with osteoporosis and osteopenia, a milder form of bone loss, is 0-10% and 1-50%, respectively (Young, Formica, Szmukler, & Seeman, 1994), and the
incidence of stress fractures in amenorrheic athletes are higher (24-61%) compared to their eumenorrheic counterparts (9-29%; Beals & Warner, 2005). Furthermore, bone loss may only be partially reversible upon the return of the normal menstrual cycle (Keen & Drinkwater, 1997).

Female Athlete Triad

Because the individual components of the Triad have been associated with each other as well as other adverse health and performance outcomes, it is expected that the presence of the Triad in its entirety would increase women’s risk of experiencing such negative consequences. Despite the need for prevalence data on the Triad, the majority of studies have failed to examine all three components of the Triad simultaneously, rather assessing only one or two of the Triad’s disorders (Beals & Warner, 2005). To date, only two studies have examined the prevalence of all three components of the Triad in collegiate athletes. For example, using a sample of female collegiate athletes (n = 425) who participated in aesthetic, endurance, and team sports, Beals and Manore (2002) found a low percentage of clinical eating disorders (i.e., 3.3% for anorexia nervosa, 2.3% for bulimia nervosa). However, 15.2% of the athletes reported “at risk” behaviors for an eating disorder, and this group of athletes most frequently reported menstrual irregularities and bone injuries. Overall, 31% of the athletes reported menstrual irregularities, and 65.9% and 34.4% of the athletes sustained muscle and bone injuries, respectively. In addition, athletes in the aesthetic group scored higher on measures of disordered eating and reported more muscle and bone injuries than the endurance and team sport athletes. More recently, Beals and Hill (2006) examined the prevalence of disordered eating, menstrual dysfunction, and low bone mineral density among 112 female collegiate athletes. Athletes exhibiting disordered eating and menstrual dysfunction numbered 25% and 25.9%, respectively. Thirteen athletes met the criteria for two of the three triad components, while three athletes experienced for disordered eating, menstrual dysfunction, and low bone mineral density (i.e., osteopenia, osteoporosis), meeting the full criteria for the Triad.

Both studies indicate a high prevalence of each individual component of the Triad in female collegiate athletes; however, Beals and Hill (2006) examined the prevalence of all three components, whereas Beals and Manore (2002) only examined the relationships among the components. Thus, due to the paucity of research examining the entire Triad, more research is warranted to examine the prevalence and interrelatedness of all three Triad components within the collegiate athletic population. Understanding the prevalence of the Triad as well as the relationship between the components will assist health professionals in adequately screening for the Triad’s components, providing the proper interventions to treat each disorder and preventing the development of the full triad. The current study focused on identifying different groups of athletes (i.e., aesthetic, endurance, and team) who were at risk for the Triad by determining the prevalence of and examining the extent to which these components occurred simultaneously. The current study defined the Triad as disordered eating, menstrual dysfunction, and musculoskeletal injuries.

The aims of this study were to (a) ascertain the prevalence of disordered eating, menstrual dysfunction, and musculoskeletal injuries among female Division I athletes; (b) examine differences in the Triad components between aesthetic,
endurance, and team sport categories; and (c) investigate the relationship between disordered eating, menstrual dysfunction, and musculoskeletal injuries among female Division I athletes. It was hypothesized that (a) female Division I athletes participating in aesthetic sports would have higher prevalence of disordered eating, menstrual dysfunction, and musculoskeletal injuries than female Division I athletes participating in endurance and team sports; and (b) there would be a positive relationship between disordered eating, menstrual dysfunction, and musculoskeletal injuries among female Division I athletes. No hypothesis was generated regarding the specific prevalence rates of the Triad’s components.

Method

Participants

Division I female athletes \((n = 451)\) with an average age of 19.96 years \((SD = 1.33)\) from three universities within the Midwest, Southwest, and Mountain West regions of the United States participated. Twenty-one sports were categorized into one of three groups: (a) aesthetic, (b) endurance, or (c) team/anaerobic. The aesthetic sports \((n = 64)\) were comprised of gymnastics, diving, synchronized swimming, and cheerleading. Endurance sports \((n = 214)\) included basketball, cross country, field hockey, rowing, soccer, swimming, ice hockey, lacrosse, and cross country skiing. Team/anaerobic sports \((n = 172)\) consisted of golf, softball, tennis, volleyball, fencing, rifle, track and field, and alpine skiing. The sports were categorized into these groups based on previous research by Beals and Manore (2002). The average number of years involved with the sport at the university was 1.71 \((SD = 1.27)\). Lifetime involvement with the sport was 8.89 years \((SD = 4.80)\). The race/ethnic composition of the sample was Caucasian (81.8%), African-American (10.9%), Hispanic/Latino/Mexican-American (4%), American-Indian (0.4%), Asian-American/Pacific Islander (1.6%), and Other (1.3%).

Measures

**Menstrual History Questionnaire.** For the purpose of the study, menstrual dysfunction was demonstrated by having 0-9 menstrual periods during the past year (Cobb et al., 2003), allowing researchers to include both amenorrhea and oligomenorrhea as types of menstrual dysfunction. The Menstrual History Questionnaire was a modified version of the Gynecological/Menstrual History section of the Student-Athlete Health Questionnaire from Ball State University to assess the risk for menstrual dysfunction associated with sport due to the lack of valid and reliable instruments available to measure these constructs. This questionnaire was characteristic of instruments used to assess menstrual dysfunction in previous research (Beals, 2004). Sample items on the measure included, “Have you ever had a menstrual period? If yes, how old were you when you had your first menstrual period?” and “How many menstrual cycles have you had in the past 12 months?”

**Injury Assessment Questionnaire.** Similar to the Menstrual History Questionnaire, the Injury Assessment Questionnaire was a modified version of the Musculoskeletal History section of the Student-Athlete Health Questionnaire from Ball State University, which has been used to ascertain musculoskeletal injuries associated with sport (e.g., stress fractures, sprains). The instrument included information
about when the injury occurred, the type of injury, whether it was diagnosed by a physician, and the type of activity that the individual was participating in when she suffered the injury (i.e., practice, competition). In addition to bone injuries, muscle injuries were also included in the questionnaire for the purpose of examining other potential consequences of the Triad.

**Questionnaire for Eating Disorder Diagnoses.** The Questionnaire for Eating Disorder Diagnoses (Q-EDD; Mintz, O’Halloran, Mulholland, & Schneider, 1997) was used to operationalize eating disorder criteria from the DSM-IV-TR and differentiate among three aspects of the continuum of eating behaviors: (a) eating disordered (anorexia nervosa, bulimia nervosa, and eating disorder not otherwise specified; ED-NOS); (b) symptomatic (subclinical eating problems); and (c) asymptomatic. Diagnoses were generated using a scoring manual composed of flow-chart decision rules in which items are dichotomized for meeting or not meeting specific DSM-IV-TR criteria. Convergent validity has been demonstrated between Q-EDD diagnoses and scores on the revised Bulimia Test (BULIT-R), \( t(133) = 6.67, p < .0001 \) and Eating Attitudes Test (EAT), \( t(104) = 3.65, p < .001 \). Criterion validity was established through clinical interviews with accuracy rates of 98% (eating disordered and non-eating disordered groups), 90% (eating disordered, symptomatic, asymptomatic), and 100% (anorexia and bulimia). Test-retest reliability (2 weeks) was calculated using contingency tables and kappa values and the results were \( k = .94 \) (eating-disordered and non-eating disordered groups) and \( k = .85 \) (eating-disordered, symptomatic, asymptomatic groups). Inter-rater reliability was \( k = 1.00 \). A sample item on the measure was, “Do you make yourself vomit to prevent weight gain?”

**Procedure**

Coaches, athletic trainers, and other athletic department personnel were contacted via e-mail, phone, or in person to recruit participants for the study. After scheduling a day and time to meet with the athletes, a trained research assistant met with each team in a college classroom or on the field or practice court. At two universities, participants read and signed consent forms prior to completing questionnaire packets. Due to the nature of the study, the Institutional Review Board at one university permitted a “waiver of consent” in lieu of a consent form. The research assistant informed the participants about the study and asked them to read the waiver of consent form. All participants were given a copy of the consent form. Athletes then anonymously completed the packet of questionnaires. The participants took 30-45 minutes to finish the questionnaire packets.

**Data Analysis**

Descriptive statistics were conducted to determine demographic information and the frequency of clinical and subclinical eating disorders, menstrual dysfunction, and musculoskeletal injuries among Division I female athletes and for each sport category. Chi-square analyses and analysis of variance (ANOVA) were used to examine differences in the Triad components between aesthetic, endurance, and team/anaerobic sport categories. Chi-square analyses were used to determine relationships between disordered eating, menstrual dysfunction, and musculoskeletal injuries for each of the sport categories.
Results

Frequency of Menstruation, Disordered Eating, and Musculoskeletal Injuries

Among Division I female athletes \((n = 447)\) who responded to the question, “Have you ever had a period?,” 100% responded “yes.” The average age at menarche was 13.15 years \((SD = 1.54)\) and the average number of menstrual cycles per year was 10.87 \((SD = 2.94)\). Table 1 lists the prevalence rates for eating-disordered and non-eating disordered diagnoses, menstrual dysfunction, and musculoskeletal injuries. The number of athletes with disordered eating (i.e., anorexia nervosa, bulimia nervosa, ED-NOS, symptomatic) and menstrual dysfunction, menstrual dysfunction and musculoskeletal injuries, and disordered eating and musculoskeletal injuries were 11, 30, and 22, respectively. One-third of the athletes who reported both menstrual dysfunction and injuries had suffered a stress fracture during their athletic career. Five athletes reported all three components of the Triad, and four of these five athletes reported that they experienced a stress fracture.

Differences Between Sport Categories

One-way analysis of variance was conducted and determined that age differed between aesthetic, endurance, and team/anaerobic sport categories, \(F(2, 443) = 3.26, p = .04\). Tukey Honestly Significant Difference post hoc test revealed that the aesthetic group reported a higher age at menarche \((M = 14.00; SD = 1.56)\) than the endurance \((M = 13.14; SD = 1.59)\) and team/anaerobic groups \((M = 12.85; SD = 1.37)\). The team/anaerobic group reported a significantly higher percent of muscle injuries \((77.4\%)\) than the aesthetic \((68.1\%)\) and endurance groups \((58.1\%)\), \(X^2 = 9.08, p < .05\). Other variables were non-significant (see Tables 2 and 3).

Table 1 Prevalence Rates of Eating Disordered and Non-Eating Disordered Diagnoses, Menstrual Dysfunction, and Musculoskeletal Injuries in Division I Female Athletes \((n = 451)\)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstrual dysfunction</td>
<td>17.3</td>
</tr>
<tr>
<td>Non-eating disordered, asymptomatic</td>
<td>76.0</td>
</tr>
<tr>
<td>Non-eating disordered, symptomatic</td>
<td>19.2</td>
</tr>
<tr>
<td>Eating disordered, anorexia nervosa</td>
<td>0.0</td>
</tr>
<tr>
<td>Eating disordered, bulimia nervosa</td>
<td>0.2</td>
</tr>
<tr>
<td>ED-NOS</td>
<td>6.7</td>
</tr>
<tr>
<td>Muscle injuries</td>
<td>65</td>
</tr>
<tr>
<td>Skeletal injuries</td>
<td>35</td>
</tr>
</tbody>
</table>

*Note. ED-NOS = eating disorder not otherwise specified*
Relationship Between Menstrual Dysfunction, Disordered Eating, and Musculoskeletal Injuries

A chi-square test was conducted to determine the relationship between menstrual dysfunction, disordered eating, and musculoskeletal injuries in Division I female athletes. Athletes with irregular menstrual cycles reported higher skeletal injuries and bulimia nervosa, $X^2 = 5.53, p < .02$ and $X^2 = 4.76, p < .03$, respectively. Other relationships were non-significant (see Table 4).

Table 2 Differences in Menstrual History for Each Sport Category

<table>
<thead>
<tr>
<th>Variables</th>
<th>Aesthetic ($n = 64$)</th>
<th>Endurance ($n = 214$)</th>
<th>Team/anaerobic ($n = 172$)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Menarche (yrs; mean ± SD)</td>
<td>14.0 ± 1.56*</td>
<td>13.14 ± 1.59</td>
<td>12.85 ± 1.37</td>
<td>$p = .00$</td>
</tr>
<tr>
<td>% Reporting Menarche &gt; 15</td>
<td>12.1</td>
<td>8.0</td>
<td>3.8</td>
<td>$p = .07$</td>
</tr>
<tr>
<td>% Irregular Cycles</td>
<td>14.1</td>
<td>21.8</td>
<td>13.5</td>
<td>$p = .10$</td>
</tr>
</tbody>
</table>

Note. *Aesthetic group is significantly different than team/anaerobic and endurance groups, $p < .05$; regular cycles = 10-12 menses per year; irregular cycles = 0-9 menses per year (Cobb et al., 2003).

Table 3 Differences in Eating Disordered and Non-Eating Disordered Diagnoses for Each Sport Category

<table>
<thead>
<tr>
<th>Variables</th>
<th>Aesthetic ($n = 64$)</th>
<th>Endurance ($n = 214$)</th>
<th>Team/anaerobic ($n = 172$)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Symptomatic</td>
<td>20.3</td>
<td>19.7</td>
<td>18.3</td>
<td>$p = .92$</td>
</tr>
<tr>
<td>% with Anorexia Nervosa</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>% with Bulimia Nervosa</td>
<td>0</td>
<td>.5%</td>
<td>0</td>
<td>$p = .58$</td>
</tr>
<tr>
<td>% with ED-NOS</td>
<td>4</td>
<td>7</td>
<td>7.7</td>
<td>$p = .67$</td>
</tr>
<tr>
<td>% Reporting Muscle Injury</td>
<td>68.1</td>
<td>58.1</td>
<td>77.4*</td>
<td>$p = .01$</td>
</tr>
<tr>
<td>% Reporting Bone Injury</td>
<td>43.8</td>
<td>34.8</td>
<td>33</td>
<td>$p = .43$</td>
</tr>
</tbody>
</table>

Note. *Team/anaerobic category was significantly different than aesthetic and endurance groups, $p < .05$.

Table 4 The Relationship Between Those Athletes Self-Reporting Regular and Irregular Menstrual Cycles and Disordered Eating and Musculoskeletal Injury

<table>
<thead>
<tr>
<th>Variables</th>
<th>Regular ($n = 72$)</th>
<th>Irregular ($n = 342$)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Symptomatic</td>
<td>18.8</td>
<td>19.4</td>
<td>$p = .90$</td>
</tr>
<tr>
<td>% with Anorexia Nervosa</td>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>% with Bulimia Nervosa</td>
<td>0</td>
<td>1.4*</td>
<td>$p = .03$</td>
</tr>
<tr>
<td>% with ED-NOS</td>
<td>4.8</td>
<td>10.6</td>
<td>$p = .12$</td>
</tr>
<tr>
<td>% Reporting Muscle Injury</td>
<td>67.7</td>
<td>61.0</td>
<td>$p = .45$</td>
</tr>
<tr>
<td>% Reporting Skeletal Injury</td>
<td>33</td>
<td>51*</td>
<td>$p = .02$</td>
</tr>
</tbody>
</table>

Note. *The athletes reporting irregular menstrual cycles were significantly different from those reporting regular menstrual cycles for bulimia nervosa and skeletal injuries, $p < .05$. 
Discussion

This current study examined the prevalence of all three components of the Triad (disordered eating, menstrual dysfunction, and musculoskeletal injuries) among female Division I athletes. The results from this study revealed that the prevalence of clinical eating disorders (i.e., anorexia nervosa, bulimia nervosa, ED-NOS) was lower compared to previous studies. Beals and Manore (2002) revealed that a sample of 425 female athletes self-reported 3.3% clinical diagnosis of anorexia nervosa and 2.3% bulimia nervosa; whereas, the current study revealed 0% and 0.2% of anorexia and bulimia, respectively. Although the sample sizes were similar, Beals and Manore did not use a measure (i.e., Q-EDD) to determine eating-disordered and non-eating disordered diagnoses based on the DSM–IV-TR. This suggests that Beals and Manore’s results may not reflect true clinical diagnoses of eating disorders based on the standard DSM–IV-TR criteria, which may indicate an overestimation of disordered eating. More recently, Sanford-Martens and colleagues (2005) conducted a study to determine prevalence rates of disordered eating among 158 female Division I athletes using the Q-EDD and found that 5.1% and 14.5% self-reported clinical and subclinical eating disorders (symptomatic), respectively. Carter and Rudd (2005) reported that 2% of female Division I athletes reported clinical eating disorders and 17% of females were classified as symptomatic based on the Q-EDD (n = 355). In comparison, the prevalence rate was higher for clinical (6.9%) and subclinical (19.6%) eating disorders in this study than the aforementioned studies.

The prevalence rate of menstrual dysfunction (i.e., 0-9 menses/year) in this study was 17.3%. Because menstrual dysfunction has not been consistently defined among previous studies, it is difficult to compare prevalence rates. For instance, Beals and Hill (2006) defined menstrual dysfunction as a history of secondary amenorrhea and delayed menarche, which does not indicate current menstrual dysfunction, and found that 26% of athletes reported menstrual dysfunction. Johnson, Powers, and Dick (1999) defined menstrual dysfunction as amenorrheic (one or fewer menstrual periods in six months), rather than including oligomenorrhea as well, and found that 6% of the athletes were amenorrheic. Excluding other types of menstrual dysfunction increases the risk for underestimating the prevalence. Because the present study considers both current amenorrhea and oligomenorrhea, the results may be more indicative of the prevalence of menstrual dysfunction than previous studies.

The prevalence of musculoskeletal injuries in the current study revealed that 65% of female athletes reported muscle injuries and 35% reported skeletal injuries. This supports previous research that found a similar prevalence of 66% and 34% of muscle and bone injuries among female athletes during their collegiate career (Beals & Manore, 2002). Furthermore, the prevalence of stress fractures within the current sample was 21.4% and, thus, comprised the majority of skeletal injuries. Beals and Manore did not report the frequency of stress fractures within their sample. Stress fractures are important to examine in that they result from increased bone remodeling, although bone mineral density may not necessarily be low, which is impacted by menstrual function (Romani et al., 2002).

Five athletes reported all three components of the Triad in this study, whereas, Beals and Hill (2006) found three athletes with all three components. The results
may have differed due to different sample sizes and criteria used to define each of the components. For example, they examined menstrual history, whereas the current study measured current menstrual function. In addition, Beals and Hill used a direct measure of bone mineral density (i.e., dual-energy x-ray absorptiometry), whereas the current study used an indirect measure of bone mineral density (i.e., stress fractures) as well as muscle injuries to define the third component of the Triad. Twenty-two athletes reported a combination of disordered eating and musculoskeletal injuries, 11 athletes reported both disordered eating and menstrual dysfunction, and 30 athletes indicated menstrual dysfunction and musculoskeletal injuries. In comparison, Beals and Hill found only one athlete with disordered eating and low bone mass, nine athletes with menstrual dysfunction and disordered eating, and no athletes with menstrual dysfunction and low bone mass. The latter finding is surprising in that the relationship between menstrual dysfunction and low bone mass has been well established in previous studies. However, Beals and Hill included both delayed menarche and past menstrual dysfunction in their analysis rather than solely current menstrual dysfunction, which may have impacted the results. As noted earlier, adverse effects of menstrual dysfunction, particularly stress fractures, may be due to increased bone remodeling; therefore, athletes with menstrual dysfunction may be at a higher risk for fractures even if they do not meet the criteria for osteopenia or osteoporosis.

The second purpose of the study was to compare the prevalence of Triad components between aesthetic, endurance, and team/anaerobic sport categories. There were no significant differences in eating disordered and non-eating disordered diagnoses and menstrual dysfunction, but there were significant differences in muscle injuries and age of menarche for between sport categories. The aesthetic group reported a higher age of menarche ($M = 14.00; SD = 1.56$) than the endurance ($M = 13.14; SD = 1.59$) and team/anaerobic sports ($M = 12.85; SD = 1.37$), supporting previous research (Beals & Manore, 2002). In addition, Beals and Manore (2002) found that the aesthetic group had experienced a significantly higher percentage of muscle and bone injuries, whereas the team/anaerobic group had significantly higher muscle injuries in the current study.

Finally, the third purpose of the study was to investigate the relationship between disordered eating, menstrual dysfunction, and musculoskeletal injuries among female Division I athletes. As discussed previously, there is a lack of published studies examining the inter-relatedness of the three components of the female athlete triad. Beckvid-Henriksson, Schnell, and Linden-Hirschberg (2000) found that 46% of female runners were “at-risk” of developing an eating disorder and those who had menstrual dysfunction had higher musculoskeletal injuries compared to their regularly menstruating counterparts. They did not investigate disordered eating in relation to menstrual dysfunction and musculoskeletal injuries, however. In the current study, female athletes with irregular menstrual cycles had a significantly higher prevalence of clinical bulimia nervosa and skeletal injuries. In comparison, Beals and Manore (2002) reported that athletes “at risk” for an eating disorder frequently reported menstrual irregularities. They did not find a higher prevalence rate of musculoskeletal injuries in irregular menstruating athletes, however. Thus, further studies are warranted to better understand the relationship between the three components of the triad.
Limitations

There were several limitations to the study. First, the menstrual history questionnaire did not include oral contraceptive information. Oral contraceptives are often used to regulate the menstrual cycle; therefore, the current study may have underestimated the prevalence of menstrual dysfunction. Secondly, the athletes completed the questionnaires at different times of their athletic training for the sport (i.e., in season, out of season), which may also impact the prevalence of disordered eating and menstrual dysfunction. Thirdly, bone mineral density was not directly measured. Although a high percentage of stress fractures were found among athletes with disordered eating or menstrual dysfunction, the extent to which other components of the Triad may have impacted bone health is unknown. Finally, the findings from this study can only be generalized to the Midwest and Southwest regions of the United States.

Clinical Implications

The current study measured prevalence rates and the relationship between each of the components of the Triad in order to determine group differences by sport category in female collegiate Division I athletes. Although a small percentage of female athletes in this study had clinical eating disorders, 19.2% reported subclinical disordered eating. This prevalence rate should not be taken lightly because subclinical eating disorders can lead to full blown eating disorders (Johnson, 1994). By creating screening tools that are appropriate for athletic populations, clinical sport psychologists can assess individuals who have not yet reached levels of severity that would warrant a clinical diagnosis but who are still “at risk” for developing Triad characteristics.

It should be noted that disordered eating was prevalent in all three sport categories with no significant differences between groups; therefore, athletes participating in any sport may be “at risk” of developing disordered eating. Muscle injuries were more prevalent in team/anaerobic sports than the aesthetic and endurance sports. Furthermore, those athletes with disordered eating more frequently reported menstrual dysfunction and sustained more skeletal injuries during their athletic career. Clinical sport psychologists should be prepared to treat or refer athletes who are determined to have disordered eating or other Triad components. It is recommended that an eating disorder specialist who is familiar with the athletic population work with these identified individuals. If an athlete continues to participate in Division I athletics while being active in her eating disorder, she will face immense treatment challenges. This athlete will likely receive conflicting messages from her clinical treatment team and coach and/or sport environment. Therefore, it is necessary that each athlete be treated on an individual case basis and that the coach should be encouraged to support the athlete by being actively involved with treatment objectives. Because of psychological and physiological consequences associated with menstrual dysfunction and disordered eating, clinicians and athletic programs should continue to develop better Triad screening tools and prevention programs for all athletes regardless of their sport. Thompson and Sherman (1993) emphasized the importance of prioritizing student-athletes’ health over their athletic performance, and nowhere is this emphasis more necessary than with the female athlete Triad.
Although research on the Triad is in the developmental stages, it appears that severe dieting is associated with potential damage to female athletes’ mental, physical, and reproductive health. Clinical sport psychologists need to join medical staff in educating female student-athletes about the dangers of severe dieting, in order to prevent such damage and allow for sport participation to be a source of strength for young women.

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