Disorders of the Female Athlete Triad
Among Collegiate Athletes

Katherine A. Beals and Melinda M. Manore

This study examined the prevalence of and relationship between the disorders of the female athlete triad in collegiate athletes participating in aesthetic, endurance, or team/anaerobic sports. Participants were 425 female collegiate athletes from 7 universities across the United States. Disordered eating, menstrual dysfunction, and musculoskeletal injuries were assessed by a health/medical, dieting and menstrual history questionnaire, the Eating Attitudes Test (EAT-26), and the Eating Disorder Inventory Body Dissatisfaction Subscale (EDI-BD). The percentage of athletes reporting a clinical diagnosis of anorexia and bulimia nervosa was 3.3% and 2.3%, respectively; mean (±SD) EAT and EDI-BD scores were 10.6 ± 9.6 and 9.8 ± 7.6, respectively. The percentage of athletes with scores indicating “at-risk” behavior for an eating disorder were 15.2% using the EAT-26 and 32.4% using the EDI-BD. A similar percentage of athletes in aesthetic, endurance, and team/anaerobic sports reported a clinical diagnosis of anorexia or bulimia. However, athletes in aesthetic sports scored higher on the EAT-26 (13.5 ± 10.9) than athletes in endurance (10.0 ± 9.3) or team/anaerobic sports (9.9 ± 9.0, p < .02); and more athletes in aesthetic versus endurance or team/anaerobic sports scored above the EAT-26 cut-off score of 20 (p < .01). Menstrual irregularity was reported by 31% of the athletes not using oral contraceptives, and there were no group differences in the prevalence of self-reported menstrual irregularity. Muscle and bone injuries sustained during the collegiate career were reported by 65.9% and 34.3% of athletes, respectively, and more athletes in aesthetic versus endurance and team/anaerobic sports reported muscle (p = .005) and/or bone injuries (p < .001). Athletes “at risk” for eating disorders more frequently reported menstrual irregularity (p = .004) and sustained more bone injuries (p = .003) during their collegiate career. These data indicate that while the prevalence of clinical eating disorders is low in female collegiate athletes, many are “at risk” for an eating disorder, which places them at increased risk for menstrual irregularity and bone injuries.

Key Words: anorexia nervosa, bulimia nervosa, amenorrhea, pathogenic weight control practices

Introduction

The female athlete driven to excel in her sport and willing to go to any lengths to achieve athletic success may be at risk for developing disordered eating behaviors,

K.A. Beals is with the Department of Family and Consumer Sciences at Ball State University, Muncie, IN 47304. M.M. Manore is with the Department of Nutrition & Food Management at Oregon State University, Corvallis, OR 97331.
which may lead to amenorrhea and subsequent premature osteoporosis. These three disorders are collectively known as the female athlete triad (Triad; 14, 23). To date, there are no studies documenting the prevalence of the Triad as a whole among female athletes, largely due to the difficulty of simultaneously and accurately assessing all three disorders that make up the Triad. Additional obstacles to conducting Triad prevalence studies include enlisting willing subjects, and securing honest and accurate responses. For these reasons, most of the current prevalence data are derived from studies with small sample sizes, obtained from single sports, examining either disordered eating or menstrual dysfunction (5, 12, 15–17, 21, 24).

Data from the few existing prevalence studies estimate that 1–62% of female athletes suffer from disordered eating and 6–79% from menstrual dysfunction (5, 14, 16, 17, 22, 24).

Few studies have investigated the prevalence of eating disorders and/or menstrual dysfunction among female collegiate athletes participating in a wide range of sports (6, 11, 16) and these studies were hampered by small or unrepresentative sample sizes, inappropriate eating disorder screening instruments, and/or a lack of control for oral contraceptive use. In the only large U.S. survey to date, Johnson et al. (10) examined the prevalence of disordered eating in 1445 collegiate athletes (n = 883 males and n = 562 females) from 11 NCAA Division I schools using a self-developed dieting and body image questionnaire and 3 subscales (body dissatisfaction, bulimia, and drive for thinness) of the Eating Disorder Inventory-2 (EDI-2; 7). The results indicated that 1.1% of the female athletes met the diagnostic criteria (American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders [DSM IV]; 2) for bulimia nervosa, 9.2% presented with subclinical bulimia, and 38% could be considered “at risk” for developing bulimia. While none of the female athletes met the DSM IV diagnostic criteria (2) for anorexia nervosa, 9.2% exhibited behaviors consistent with subclinical anorexia, and 35% were “at risk” for developing anorexia.

To date no study has examined the inter-relationship of disordered eating, menstrual dysfunction, and musculoskeletal injuries in a large, heterogeneous sample of female athletes. Thus, the aims of this study were to: (a) ascertain the prevalence of disordered eating, menstrual dysfunction, and musculoskeletal injuries in a large sample of female collegiate athletes using data collected anonymously; (b) identify differences in the prevalence of the disorders of the Triad among female athletes participating in aesthetic, endurance, and team/anaerobic sports; and (c) determine if there is an increased incidence of menstrual dysfunction and musculoskeletal injuries among female athletes identified with disordered eating.

**Methods**

**Subjects**

The subjects consisted of 425 female collegiate athletes from 7 universities with NCAA sponsored programs across the United States. Participation was voluntary, anonymous, and in accordance with university and federal guidelines for human subjects. A total of 15 different sports were represented. These sports were divided into three categories based on the physiological nature and competitive requirements of the sport:

- Aesthetic: cheerleading, diving, gymnastics
• Endurance: basketball, cross-country and track (middle distance & distance events), field hockey, crew, soccer, swimming, and water polo
• Team/Anaerobic: track (field events), golf, softball, tennis, and volleyball.

**Instruments**

Disordered eating behaviors were assessed by the Eating Attitudes Test-26 (EAT-26; 8) and the Body Dissatisfaction Subscale of the Eating Disorder Inventory (EDI-BD; 9). In addition, the athletes were asked if they had ever been clinically diagnosed and/or treated for an eating disorder. A self-developed weight and diet history questionnaire was used to determine current body weight and weight control practices (e.g., types and frequency of dieting methods employed over the past year), weight change and dieting history (frequency and amount of weight fluctuations and “diets” undertaken over the past year), eating patterns (e.g., frequency of meals/snacks consumed, restriction/limitation of amounts or types of foods, binging/purgative practices), and attitudes concerning body weight and shape (e.g., degree of body weight/shape satisfaction/dissatisfaction, self-defined ideal body weight, concern about weight gain and feelings of pressure to maintain a particular body weight). A health/medical history questionnaire was used to examine the type, frequency, and duration of musculoskeletal injuries sustained over the course of the athlete’s collegiate career. Menstrual function was assessed by a menstrual history questionnaire that included questions regarding age of menarche, frequency and regularity of menstrual cycles, training associated changes in cycle frequency and regularity, and oral contraceptive use. For the purposes of this study menstrual irregularity was used to describe irregular cycle lengths (cycles not occurring every 28–34 days), while menstrual dysfunction was used to describe the infrequency of menstrual periods (i.e., no menstrual periods and ≤6 menstrual periods) or an excess of menstrual periods (>12 menstrual periods) over the past year.

**Statistical Analyses**

Unless otherwise noted, results are reported as mean values with standard deviations (SD). Where comparisons between sport groups (aesthetic, endurance, and team/anaerobic) were made (e.g., demographic data, EAT-26 and EDI-BD scores, age of menarche), one-way analysis of variance (ANOVA) was used. When a significant F ratio was found, Tukey HSD post hoc tests were conducted to determine which groups differed. Unless otherwise stated, p values are reported for the initial ANOVA. χ² analyses were used to determine differences between the groups regarding frequency of weight reduction methods used, disordered eating risk, and menstrual cycle irregularity and dysfunction. The overall experimental-wise alpha was set at p < .05.

**Results**

**Description of the Sample**

The mean age for the whole sample and each of the three sport groups was 19 years (Table 1). Mean weight for the entire sample was 63.0 ± 10.4 kg, while mean “ideal” body weight was self-reported to be 60.1 ± 8.5 kg. Athletes in aesthetic sports weighed significantly less and reported a lower desired or “ideal” body weight than
athletes in endurance and team/anaerobic sports ($p < .01$) (Table 1). Muscle injuries sustained over the collegiate career were reported by 65.9% of all athletes, while 34.3% of athletes reported sustaining a bone injury. Significantly more athletes in aesthetic sports versus endurance and team/anaerobic sports reported sustaining a muscle injury ($p = .005$) and/or a bone injury ($p < .001$) over the course of their collegiate career (Table 1).

**Disordered Eating Behaviors**

**Whole Sample.** The percentage of athletes self-reporting a clinical diagnosis of anorexia nervosa and bulimia nervosa was 3.3% and 2.3%, respectively (Table 2). Mean EAT-26 and EDI-BD scores were $10.6 \pm 9.6$ and $9.8 \pm 7.6$, respectively, while the percentage of athletes scoring above the designated cut-off scores on the EAT-26 ($\geq 20$) and EDI-BD ($\geq 12$) (indicative of being “at risk” for disordered eating) was 15.2% and 32.4%, respectively (Table 2). Responses from the health, weight, and diet history questionnaire indicated that 67% of the athletes reported consciously

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole sample ($N = 425$)</th>
<th>Aesthetic ($n = 72$)</th>
<th>Endurance ($n = 257$)</th>
<th>Team/anaerobic ($n = 96$)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>$19 \pm 2$</td>
<td>$19 \pm 2$</td>
<td>$19 \pm 2$</td>
<td>$19 \pm 1$</td>
<td>NS</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>$63.0 \pm 10.4$</td>
<td>$55.2 \pm 5.8^a$</td>
<td>$64.1 \pm 11.0$</td>
<td>$65.8 \pm 8.6$</td>
<td>$p &lt; .001$</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>$22.5 \pm 8.1$</td>
<td>$21.3 \pm 2.3$</td>
<td>$22.7 \pm 10.1$</td>
<td>$22.8 \pm 3.1$</td>
<td>NS</td>
</tr>
<tr>
<td>Ideal weight (kg)*</td>
<td>$60.1 \pm 8.5$</td>
<td>$52.9 \pm 5.3^a$</td>
<td>$61.2 \pm 8.6$</td>
<td>$62.4 \pm 7.3$</td>
<td>$p &lt; .001$</td>
</tr>
<tr>
<td>% reporting a muscle injury during collegiate career</td>
<td>$65.9$ (N = 279)</td>
<td>$80.6^b$ (n = 58)</td>
<td>$65.2$ (n = 167)</td>
<td>$56.8$ (n = 54)</td>
<td>$p = .005$</td>
</tr>
<tr>
<td>% reporting a bone injury during collegiate career</td>
<td>$34.3$ (N = 144)</td>
<td>$57.1^c$ (n = 40)</td>
<td>$29.4$ (n = 75)</td>
<td>$30.5$ (n = 29)</td>
<td>$p &lt; .001$</td>
</tr>
</tbody>
</table>

Note. All data are self-reported and expressed as mean ± SD. *The athletes were asked to indicate what they felt was their “ideal body weight”.

*Aesthetic significantly different from endurance ($p < .001$) and team/anaerobic ($p < .001$; Tukey HSD). *Aesthetic significantly different from endurance and team/anaerobic ($p = .005$) using $\chi^2$ analysis. Aesthetic significantly different from endurance and team/anaerobic ($p < .001$) using $\chi^2$ analysis.
limiting food choices (e.g., eliminating red meats, severely restricting fat intake, and reducing carbohydrate intake), and 42% reported purposely restricting energy intake for weight control (Figure 1). Twenty-two percent of the athletes reported that they were extremely preoccupied with food and eating, while 6% indicated that they engaged in binge eating. Several athletes reported using pathogenic weight control methods in the past year including fasting (11%), very-low-calorie diets (15%), laxatives (4%), diet pills (8%), and vomiting (7%; Figure 1). Forty-three percent of the athletes reported feeling terrified of being or becoming overweight, and 55% reported experiencing pressure to achieve and/or maintain a particular body weight. Of those athletes reporting pressure to control their weight, most (63%) indicated that the pressure was “self-imposed.” Other sources of pressure included the coach (27%), teammates (17%), parents (11%), and society in general (9%).

### Table 2 Self-reported Disordered Eating Behaviors for the Whole Sample and Split By Sport Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole sample ($N = 425$)</th>
<th>Aesthetic ($n = 72$)</th>
<th>Endurance ($n = 257$)</th>
<th>Team/anaerobic ($n = 96$)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>% with current or past clinical diagnosis of Anorexia Nervosa *</td>
<td>3.3%</td>
<td>5.6%</td>
<td>3.5%</td>
<td>1.0%</td>
<td>NS</td>
</tr>
<tr>
<td>% with current or past clinical diagnosis of Bulimia Nervosa’</td>
<td>2.3%</td>
<td>5.6%</td>
<td>1.6%</td>
<td>2.1%</td>
<td>NS</td>
</tr>
<tr>
<td>EAT-26 (mean ± SD)</td>
<td>$10.6 ± 9.6$</td>
<td>$13.5 ± 10.9^c$</td>
<td>$10.0 ± 9.3$</td>
<td>$9.9 ± 9.0$</td>
<td>$p = .02$</td>
</tr>
<tr>
<td>EDI-BD (mean ± SD)</td>
<td>$9.8 ± 7.6$</td>
<td>$10.7 ± 7.5$</td>
<td>$9.1 ± 7.4$</td>
<td>$11.0 ± 8.1$</td>
<td>NS</td>
</tr>
<tr>
<td>% with EAT-26 scores ≥ 20</td>
<td>15.2%</td>
<td>27.7%</td>
<td>13.6%</td>
<td>14.6%</td>
<td>$p &lt; .01$</td>
</tr>
<tr>
<td>% with EDI-BD scores ≥ 12</td>
<td>32.4%</td>
<td>41.6%</td>
<td>32.2%</td>
<td>41.7%</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Note. EAT-26: Eating Attitudes Test–26; a score of ≥ 20 is indicative of being “at risk” for disordered eating (9). EDI-BD: Eating Disorder Inventory–Body Dissatisfaction subscale; a score ≥ 12 is considered an “elevated score” (9). *Clinical diagnosis determined by a medical doctor.

Aesthetic significantly different from endurance ($p = .02$) and team/anaerobic ($p = .04$; Tukey HSD). b Aesthetic significantly different from endurance and team/anaerobic ($p < .01$) using $\chi^2$ analysis.
Split by Sport Type. Analysis of the data by sport-type showed that athletes participating in aesthetic sports scored significantly higher on the EAT-26 (13.5 ± 10.9) than athletes participating in endurance (10.0 ± 9.3) or team/anaerobic sports (9.9 ± 9.0; p < .02; Table 2). In addition, significantly more athletes in aesthetic sports (27.7%) than endurance (13.6%) or team/anaerobic sports (14.6%) scored above the cut-off score on the EAT-26 (p < .01). Mean scores on the EDI-BD, however, were similar between the groups, and a similar percentage of athletes in each group scored above the designated cut-off (Table 2). A similar percentage of athletes in each sport group reported limiting food and restricting energy intake for weight control. However, significantly more athletes in aesthetic sports than endurance or team/anaerobic sports reported using very-low-calorie diets (<1000 kcal/d), fasting, vomiting, and laxatives for weight loss (p < .05). A similar percentage of athletes in each group reported using diet pills for weight loss (Figure 2).

Menstrual Function

The mean age of menarche for the whole sample was 13.2 ± 1.6 years. Athletes participating in aesthetic sports were significantly older than those in endurance and team/anaerobic sports when they reached menarche (p < .001; Table 3). Delayed menarche was reported by 7.4% of all athletes, and significantly more athletes in aesthetic versus endurance and team/anaerobic sports reported delayed menarche (p < .001; Table 3). Oral contraceptive use was reported by 26.7% of the athletes, and a similar percentage of athletes within each sport type reported using oral contraceptives (Table 3).

Because oral contraceptive use is known to regulate the menstrual cycle, this factor was controlled when investigating the percentage of athletes reporting menstrual irregularity as well as menstrual dysfunction. Thirty-one percent of athletes not using oral contraceptives reported experiencing irregular menstrual cycles, and
there were no differences between the sport groups in the prevalence of self-reported menstrual irregularity (Table 3). Athletes not using oral contraceptives were also asked to document the number of menstrual cycles that had occurred over the preceding 12 months to determine the prevalence of menstrual dysfunction. One percent of all of these athletes reported no menstrual cycle, while 11.9% reported having ≤ 6 cycles, and 8.4% reported having more than 12 cycles in the past year (Table 3). More athletes participating in aesthetics sports than endurance and team/anaerobic sports reported not having a menstrual cycle in the past year \((p = .05)\), while a similar percentage of athletes in endurance, aesthetic, and team/anaerobic sports reported having fewer than 6 cycles and exactly 12 cycles in the past year (Table 3). More athletes participating in aesthetic versus endurance and team/anaerobic sports reported experiencing between 7–11 cycles in the past year \((p = .02)\), while more athletes in endurance versus aesthetic and team/anaerobic sports reported experiencing more than 12 cycles in the past year \((p < .05)\).

**Relationship Between Disordered Eating and Menstrual Irregularity/Dysfunction**

The disorders of the Triad are considered distinct yet are hypothesized to be interrelated, such that the existence of one disorder may be linked, directly or indirectly, to the others. Thus, the associations between disordered eating, menstrual function, and bone injuries were investigated. Athletes reporting irregular menstrual cycles scored significantly higher on the EAT-26 \((p = .003; \text{Table } 4)\) and were more apt to...
Table 3  Self-reported Menstrual Function for the Whole Sample and Split By Sport Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole sample</th>
<th>Aesthetic</th>
<th>Endurance</th>
<th>Team/anaerobic</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 425)</td>
<td>(n = 72)</td>
<td>(n = 257)</td>
<td>(n = 96)</td>
<td></td>
</tr>
<tr>
<td>Age of menarche (years; mean ± SD)</td>
<td>13.2 ± 1.6</td>
<td>13.8 ± 3.4</td>
<td>12.9 ± 1.9</td>
<td>13.0 ± 1.4</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>% reporting menarche ≥ 16 years</td>
<td>7.4 (n = 31)</td>
<td>22.2&lt;sup&gt;a&lt;/sup&gt; (n = 16)</td>
<td>4.3 (n = 11)</td>
<td>4.3 (n = 4)</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>% reporting oral contraceptive (OC) use</td>
<td>26.7 (n = 113)</td>
<td>30.5 (n = 22)</td>
<td>25.8 (n = 66)</td>
<td>26.3 (n = 25)</td>
<td>NS</td>
</tr>
<tr>
<td>% reporting “irregular” cycles&lt;sup&gt;*&lt;/sup&gt;</td>
<td>31.0 (n = 95)</td>
<td>42.5 (n = 20)</td>
<td>30.7 (n = 58)</td>
<td>24.3 (n = 17)</td>
<td>NS</td>
</tr>
<tr>
<td>% reporting 0 cycles in the past year&lt;sup&gt;*&lt;/sup&gt;</td>
<td>1.0 (n = 3)</td>
<td>4.4&lt;sup&gt;b&lt;/sup&gt; (n = 2)</td>
<td>.5 (n = 1)</td>
<td>0 (n = 0)</td>
<td>p &lt; .05</td>
</tr>
<tr>
<td>% reporting ≤ 6 cycles in the past year&lt;sup&gt;*&lt;/sup&gt;</td>
<td>11.9 (n = 35)</td>
<td>8.3 (n = 4)</td>
<td>13.4 (n = 24)</td>
<td>10.1 (n = 7)</td>
<td>NS</td>
</tr>
<tr>
<td>% reporting 7–11 cycles in the past year&lt;sup&gt;*&lt;/sup&gt;</td>
<td>28.2 (n = 85)</td>
<td>43.9&lt;sup&gt;b&lt;/sup&gt; (n = 21)</td>
<td>27.0 (n = 50)</td>
<td>19.7 (n = 14)</td>
<td>p &lt; .02</td>
</tr>
<tr>
<td>% reporting 12 cycles in the past year&lt;sup&gt;*&lt;/sup&gt;</td>
<td>51.8 (n = 157)</td>
<td>41.7 (n = 20)</td>
<td>49.5 (n = 92)</td>
<td>65.2 (n = 45)</td>
<td>NS</td>
</tr>
<tr>
<td>% reporting &gt; 12 cycles in the past year&lt;sup&gt;*&lt;/sup&gt;</td>
<td>8.4 (n = 25)</td>
<td>6.3 (n = 3)</td>
<td>9.4&lt;sup&gt;c&lt;/sup&gt; (n = 19)</td>
<td>4.2 (n = 3)</td>
<td>p &lt; .05</td>
</tr>
</tbody>
</table>

Note. Irregular menstrual cycles were defined as cycles not occurring every 28–34 days.  
<sup>*</sup>Analyses were run that controlled for oral contraceptive use.  
<sup>a</sup>Aesthetic is significantly different from endurance (p < .001) and team/anaerobic (p < .001; Tukey HSD).  
<sup>b</sup>Aesthetic significantly different from endurance and team/anaerobic (p < .02) using χ² analysis.  
<sup>c</sup>Endurance significantly different from aesthetic and team/anaerobic (p < .05) using χ² analysis.
score above both the EAT-26 \((p = .004)\) and EDI-BD \((p = .05)\) cutoffs (considered indicative of eating disorder “risk”) than those with normal menses (Table 4). In addition, more athletes scoring above the EAT-26 cutoff versus those scoring below the cutoff reported a bone injury during their collegiate career (21.5\% vs. 13.8\%, respectively; \(p = .03\)), while muscle injuries were equally prevalent among athletes regardless of EAT-26 score. Although the difference failed to reach significance \((p = .09)\), athletes reporting menstrual irregularity suffered more bone and muscle injuries (40.0\% and 67.4\%, respectively) during their collegiate career compared to those with normal menses (31.4\% and 60.8\%, respectively; Table 4).

**Discussion**

This is the first study to examine the prevalence of disordered eating, menstrual dysfunction, and musculoskeletal injuries and the inter-relationship between these disorders in a large, heterogeneous sample of female collegiate athletes. It is also the first U.S. study to determine differences in the incidence of disordered eating among female collegiate athletes grouped by sport-type (i.e., aesthetic, endurance, and team/anaerobic sports). Only four other studies to date have examined the prevalence of disordered eating in female collegiate athletes participating in a range of sports (6, 10, 11, 17). However, each of these studies used somewhat different

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**Table 4 The Relationship Between Those Athletes Self-reporting Regular and Irregular Menstrual Cycles and Both Disordered Eating and Musculoskeletal Injuries**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regular ((n = 211))</th>
<th>Irregular ((n = 95))</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>% with EAT-26 scores ≥ 20</td>
<td>13.2</td>
<td>25.0(^a)</td>
<td>(p = .004)</td>
</tr>
<tr>
<td>% with EDI-BD scores ≥ 12</td>
<td>33.9</td>
<td>42.9(^a)</td>
<td>(p = .05)</td>
</tr>
<tr>
<td>EAT-26 (mean ± SD)</td>
<td>9.8 ± 9.3</td>
<td>12.9 ± 10.0(^b)</td>
<td>(p = .003)</td>
</tr>
<tr>
<td>EDI-BD (mean ± SD)</td>
<td>9.5 ± 7.6</td>
<td>10.9 ± 7.6</td>
<td>NS</td>
</tr>
<tr>
<td>% reporting a sport-related bone injury in the past year</td>
<td>31.4</td>
<td>40.0</td>
<td>NS</td>
</tr>
<tr>
<td>% reporting a sport-related muscle injury in the past year</td>
<td>60.8</td>
<td>67.4</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Note.* EAT-26: Eating Attitudes Test–26; a score of ≥ 20 is indicative of being “at risk” for disordered eating (9). EDI-BD: Eating Disorder Inventory–Body Dissatisfaction subscale; a score ≥ 12 is considered an “elevated score” (9).

\(^a\) Those athletes reporting irregular menstrual cycles were significantly different from those reporting regular menstrual cycles using CHI \(^2\) analysis. \(^b\) Those athletes reporting irregular menstrual cycles were significantly different from those reporting regular menstrual cycles using one-way ANOVA.
methodology (i.e., different athletic populations, definitions of disordered eating, and screening instruments were used). Moreover, none of the previous studies examined the prevalence of menstrual dysfunction, investigated oral contraceptive use, nor analyzed the data based on sport-type (i.e., aesthetic, endurance, and team/anaerobic); thus, direct comparisons to the data derived from the present study are difficult.

**Disordered Eating and Menstrual Dysfunction**

The percentage of athletes in the present study self-reporting a clinical diagnosis of anorexia nervosa was 3.3%, which is slightly higher than the prevalence estimates found by both Johnson et al. (10; 1.96%) and Kurtzman et al. (11; 0%), but similar to that found in the general public (2). A clinical diagnosis of bulimia nervosa was self-reported by 2.3% of the athletes in our study compared to 5.5% and 1.0% reported by Johnson et al. (10) and Kurtzman et al. (11), respectively. We found that 15.2% of the athletes scored above the designated cut-off scores on the EAT-26 (indicative of being “at risk” for disordered eating), and 32.4% scored above the designated cut-off score on the EDI-BD. Johnson et al. (10) found a similar percentage of athletes to be “at risk” for anorexia (25%) and bulimia (38%) albeit using somewhat different criteria (at risk for bulimia: >6 bulimic episode over the last 3 months or a score on the EDI-2 Drive for Thinness [DT] subscale ≥10 or Body Dissatisfaction [BD] ≥12; at risk for anorexia: BMI ≤20 kg/m², or amenorrhea, or a score on the EDI-2 DT ≥10 or BD ≥12).

Nearly 50% of the athletes in our study indicated that they were terrified of being overweight. Not surprisingly, a similar percentage of athletes reported restricting energy intake and/or limiting food choices for the purposes of weight control. These percentages are significantly higher than the 17% of athletes in the Kurtzman et al. (11) study who reported feeling terrified of being or becoming fat.

Despite the high incidence of weight concerns and food restriction, the prevalence of pathogenic weight control behaviors in the current study was lower than that reported in other studies. Purging behaviors such as self-induced vomiting and laxative use were reported by 7% and 4% of the athletes in our study, respectively. Rosen et al. (17) found that self-induced vomiting was reported by 14% of athletes, while 16% reported using laxatives to control their weight. Similarly, 9% of the athletes in the Kurtzman et al. (11) study indicated that they had used laxatives and/or vomited at least once in the past year for weight control. We found that diet pills were used by 8% of the athletes, while 11% reported fasting and 15% reported severe (100 kcal) energy restriction. These prevalence estimates are similar to those reported by Kurtzman et al. (11) who found that 13% of their athletes engaged in deliberate and/or excessive energy restriction for weight loss.

We found that 22% of the athletes reported being preoccupied with food, yet only 6% indicated that they had gone on “uncontrolled” eating binges. In contrast, almost 17% of the athletes in the Kurtzman et al. (11) study reported problems with binge eating. Similarly, approximately 34% of the athletes in the Burkes-Miller and Black (6) study reported that they “binged” occasionally, and 12% indicated that they lost control once they began a “binge” and could not voluntarily stop. Johnson et al. (10) found that 16.2% of the athletes reported a monthly binge, 8.36% reported a weekly binge, and 2.5% reported daily binges over the last 3 months. In addition, 81% of the athletes reported that they felt “out of control” during a given episode of overeating.
Research suggests that the prevalence of disordered eating is higher in sports that emphasize a lean physique and/or a low body weight. It has been hypothesized that the body weight demands of these sports, and the pressure to achieve the “ideal body weight” whether real or perceived, causes the female athlete to become overly concerned with her body weight and develop disordered eating behaviors. Our data support this hypothesis. Analysis of the disordered eating data by sport type revealed that a similar percentage of athletes in aesthetic, endurance, and team/anaerobic sports reported a clinical diagnosis of anorexia or bulimia nervosa. However, female athletes participating in aesthetic sports (e.g., gymnastics, diving, cheerleading) demonstrated more body weight concerns and disordered eating behaviors than those in either endurance or team/anaerobic sports. These results are consistent with those of Sundgot-Borgen (20) who found that disordered eating (including anorexia athletica, anorexia nervosa, and bulimia nervosa) was significantly more prevalent among elite Norwegian athletes participating in aesthetic and weight-dependent sports (e.g., gymnastics, figure skating, diving, long-distance running, cross-country skiing, and light weight rowing) compared to those competing in sports that did not emphasize a particular body weight (e.g., ballgame, power, and technical sports; 20). Although Sundgot-Borgen (20) did not further separate the weight-dependent sport group for statistical analysis (i.e., aesthetic vs. endurance), it should be noted that the prevalence of pathogenic weight control behaviors among aesthetic sports (34%) and sports with weight classes (32%) was higher than that for endurance sports (20%).

Few studies have examined the prevalence of menstrual dysfunction, particularly relative to oral contraceptive use, in a large and diverse group of athletes; thus comparison of the results of our study to those of others is difficult. Most prevalence estimates of menstrual dysfunction among athletes are derived from studies examining a small number of athletes competing in a single sport. Data derived from these studies suggest a prevalence range of 6–79% with the highest prevalence among ballet dancers and distance runners and a somewhat lower prevalence among cyclists and swimmers (1, 3, 4, 18, 19). Johnson et al. (10) reported that 6% of the collegiate athletes self-reported amenorrhea; however, the authors did not control for oral contraceptive use nor did they examine the spectrum of menstrual dysfunction relative to sport type. In the present study, delayed menarche was reported by 7.4% of the athletes and was significantly more prevalent among athletes in aesthetic sports compared to endurance and team/anaerobic sports. After controlling for oral contraceptive use, it was found that 31% of the athletes suffered from menstrual irregularity. While the prevalence of menstrual irregularity was similar among the three sport groups, more athletes in aesthetic versus endurance and team/anaerobic sports reported menstrual dysfunction (i.e., an abnormal number of cycles per year).

The Inter-relatedness of the Disorders of the Triad

Much has been written about the Triad; however, few studies have examined the prevalence of more than one of the disorders of the Triad concurrently. Moreover, to date, no study has examined the inter-relationship of the disorders of the Triad in athletes participating in a wide range of sports. Beckvid-Henriksson et al. (3) recently examined the prevalence of disordered eating and the relationship between menstrual dysfunction and musculoskeletal injuries in 127 Swedish female middle/
long-distance runners. Almost half (46%) of the runners were classified as “at risk” for developing an eating disorder and those with menstrual dysfunction were found to have a longer interruption in training due to musculoskeletal injuries compared to those with regular cycles. The authors did not, however, examine eating disorder risk relative to either menstrual dysfunction or musculoskeletal injuries. In the present study, athletes reporting menstrual irregularity had significantly higher mean EAT-26 scores and were more apt to score above both the EAT-26 ($p = .004$) and EDI-BD ($p = .05$) cutoffs compared with those reporting normal menses. In addition, athletes scoring above the EAT-26 cutoff reported more bone injuries during their collegiate careers than those scoring below the EAT-26 cutoff. Nonetheless, we did not find a higher prevalence of musculoskeletal injuries among athletes reporting menstrual irregularity. This finding may be due in part to the confounding effect of controlling for oral contraceptive use. That is, often oral contraceptives are prescribed to athletes after a bone injury has occurred, because the bone injury is frequently the impetus for the athlete to seek medical attention and subsequent treatment for her menstrual dysfunction. In this way then, those athletes reporting oral contraceptive use in this study may have begun taking them subsequent to a bone injury, thus confounding the interpretation of the results.

**Conclusion**

Between 2 and 3% of the female athletes in this study reported a clinical diagnosis of anorexia and/or bulimia nervosa, which is similar to that reported for the general female population. However, 15–30% of the athletes demonstrated attitudes and behaviors consistent with disordered eating, depending on the measure used. Disordered eating behaviors were more prevalent among athletes participating in aesthetic sports; however, the prevalence of a clinical diagnosis of anorexia nervosa or bulimia nervosa was similar among the three sport groups. Menstrual irregularity was reported by almost one third of the female athletes not currently using oral contraceptives, and appeared to be equally prevalent across sports. Musculoskeletal injuries sustained over the course of the collegiate career were prevalent and were significantly more prevalent among athletes in aesthetic sports. Moreover, those athletes displaying disordered eating behaviors more frequently reported menstrual irregularity and sustained more bone injuries during their collegiate career.

Because of the potentially severe physiological and psychological consequences associated with eating disorders and menstrual dysfunction, collegiate athletic programs need to develop comprehensive Triad screening and prevention programs. Particular attention should be paid to those female athletes competing in sports that emphasize leanness.

**References**


