Eating Disorders, Energy Intake, Training Volume, and Menstrual Function in High-Level Modern Rhythmic Gymnasts

Jorunn Sundgot-Borgen

This study examined clinical and subclinical eating disorders (EDs) in young Norwegian modern rhythmic gymnasts. Subjects were 12 members of the national team, age 13–20 years, and individually matched nonathletic controls. All subjects participated in a structured clinical interview for EDs, medical examination, and dietary analysis. Two of the gymnasts met the DSM-III-R criteria for anorexia nervosa, and 2 met the criteria for anorexia athletica (a subclinical ED). All the gymnasts were dieting in spite of the fact that they were all extremely lean. The avoidance of maturity, menstrual irregularities, energy deficit, high training volume, and high frequency of injuries were common features among the gymnasts. There is a need to learn more about risk factors and the etiology of EDs in different sports. Coaches, parents, and athletes need more information about principles of proper nutrition and methods to achieve ideal body composition for optimal health and athletic performance.

Key Words: young athletes, maturity fears, anorexia nervosa

Eating disorders (EDs) in the female athletic population are receiving increasing attention (4). The prevalence of subclinical and clinical EDs is high among female athletes, and studies indicate that the prevalence is higher among female athletes than nonathletes (4, 24). Athletes competing in sports that require leanness and/or a specific body weight are more prone to develop EDs than athletes competing in sports where these factors are considered less important (24). The exact causes of EDs are not known. Psychological, biological, and social factors are implicated in the development of anorexia nervosa (AN) (10). It has been claimed that female athletes appear to be more vulnerable to EDs than the general female population because of stresses associated with the athletic environment (6, 27). Among the reasons proposed for the high frequency of subclinical and clinical EDs among female athletes are the “attraction-to-sport” hypothesis (26),

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exercise-induced AN (8, 9), early start of sport-specific training (25), dieting and body weight cycling (4), personality factors (29, 30), traumatic events (25), and the impact of coaches and trainers (13, 19, 25). For athletes competing in aesthetic sports, the pressure to reduce weight has been the general explanation for the high number of athletes within these sports practicing pathogenic weight control methods (4). A number of investigations report that athletes started dieting after coaches had advised a reduction in body weight (19, 23). However, few have studied the prevalence of true EDs.

The prevalence of EDs was examined for all the national teams in Norway in 1990. Published results focused on prevalence in different sport groups (24), but a further analysis of data showed that 34% of the gymnasts representing the national team in modern rhythmic gymnastics met the criteria for AN, bulimia nervosa (BN), or anorexia nervosa (AA). A number of elite Norwegian athletes have told “their story” regarding EDs to the media during recent years. Some coaches and administrators claim that EDs are only a problem in society in general and are not a problem in their sport, and therefore intervention is not needed. However, health care personnel as well as other leading coaches and administrators hold that gymnasts exhibit symptoms of weight disorders and EDs; these professionals are therefore concerned about the health of their gymnasts and the reputation of their sport. Due to these conflicting opinions and the concern expressed from health care personnel and some coaches, I was asked to investigate the possible existence of EDs in this sport. The purposes of this study were to determine the prevalence of EDs as well as energy intake, menstrual function, and training volume among gymnasts representing the national team in rhythmic gymnastics.

Methods

Subjects

This study took place in three phases: initial screening, identification of gymnasts at risk, and a detailed clinical interview, dietary recall, and medical examination. Subjects were females aged 13–20 years, comprising the total population of elite gymnasts representing the Norwegian team (senior and junior) in individual modern rhythmic gymnastics. Twelve nonathletes were individually matched to the gymnasts for age and height (only 7 controls were weight matched to the gymnasts due to the gymnasts’ low weights).

All subjects were sent a battery of assessment questionnaires and were required to complete a consent form; written parental consent was required from all except those (1 athlete and 1 control) older than 18 years. All gymnasts and controls agreed to participate. In the second phase of the study, all athletes and controls participated in the clinical interview. Thus, 24 gymnasts and controls were involved in the clinical examination described below.

Assessment Procedures

General Survey. A questionnaire was developed to assess weight history, menstrual history, physical activity patterns, dietary history, nutritional habits, bingeing and purging frequency, and ED history.
Eating Disorder Inventory. This 64-item test was developed by Garner and colleagues (11) to assess attitudes and behaviors in individuals with EDs. The psychometric properties of the EDI have been established, and the instrument has good validity and reliability (4, 11). A Swedish version of the EDI has been developed and tested for psychometric properties (17) and was used in this study (after translation to Norwegian). There are few cultural differences between Sweden and Norway; hence, this instrument was considered culturally appropriate. The EDI has eight subscales: Drive for Thinness (DT), Bulimia (B), Body Dissatisfaction (BD), Ineffectiveness (I), Perfectionism (P), Interpersonal Distrust (ID), Interoceptive Awareness (IA), and Maturity Fears (MF). The EDI was used as a screening test. Gymnasts at risk for EDs were defined as those with elevated scores on the DT and BD subscales (>15 and >10, respectively). A conservative cutoff point for identifying college women as weight preoccupied is a score at or above the mean for anorexic patients on the DT subscale (i.e., a score >15) (11). Subjects were told that they would be asked to participate in a clinical interview. Examples of questions from the two subscales DT and BD are, “I am preoccupied with the desire to be thinner,” “If I gained a pound, I worry that I will keep gaining,” and “I think my thighs are too large.”

Interview and Clinical Examination. All subjects were interviewed (12 gymnasts and 12 controls). The interview protocol was developed as part of the Diagnostic Survey for Eating Disorders (12), a standardized instrument used to characterize various aspects of AN and BN. The interview is divided into 12 sections: demographic factors, weight history and body image, dieting history, binge eating and purging, training routines, affective disorders, sexual functioning, life adjustment, menstrual history, medical history, psychiatric history, and family history of EDs. Sport-specific questions were also asked, and gymnasts were questioned about their ideas on the development of disordered eating. The interviews required from 40 min to 3 hr, and all were taped. DSM-III-R criteria (1) were used to define AN and BN. Anorexia athletica (AA) was defined using the criteria in Table 1. The clinical examination included an extensive medical evaluation. Relative fat was calculated on the basis of skinfold measurements (22).

Food Intake Records. All subjects were asked to keep 4-day food intake records (weighing all food and liquid for 4 successive days). It was stressed that their “usual” diet was being investigated and that they should not, for example, restrict energy intake or fail to report binges. All subjects were given written and oral instructions as well as demonstrations of how food should be weighed. The record book was explained in detail. Subjects were asked to select 1 day of the weekend and 3 weekdays. Nutrient, vitamin, and mineral status was also calculated but will not be reported in this paper. The dietary data were analyzed using the Norwegian Nutritional Analysis Program (16), which is based on the Norwegian Food Composition Tables (15).

Statistical Methods

Values are expressed as mean and total range for each group. T tests were used to compare interval data, and Fisher’s exact test was used to compare frequencies. Values are expressed as mean and total range for each group.
Table 1  The Criteria for Anorexia Athletica

<table>
<thead>
<tr>
<th>Common features</th>
<th>Anorexia athletica</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weight loss(a)</td>
<td>+</td>
</tr>
<tr>
<td>2. Delayed puberty(b)</td>
<td>(+)</td>
</tr>
<tr>
<td>3. Menstrual dysfunction(c)</td>
<td>(+)</td>
</tr>
<tr>
<td>4. GI complaints</td>
<td>+</td>
</tr>
<tr>
<td>5. Absence of medical illness or affective disorder explaining weight reduction</td>
<td>+</td>
</tr>
<tr>
<td>6. Disturbance in body image(d)</td>
<td>(+)</td>
</tr>
<tr>
<td>7. Excessive fear of becoming obese</td>
<td>+</td>
</tr>
<tr>
<td>8. Restriction of caloric intake(e)</td>
<td>+</td>
</tr>
<tr>
<td>9. Use of purging methods(f)</td>
<td>(+)</td>
</tr>
<tr>
<td>10. Binge eating(d)</td>
<td>(+)</td>
</tr>
<tr>
<td>11. Compulsive exercising(d)</td>
<td>(+)</td>
</tr>
</tbody>
</table>

Note. Modified from Pugliese et al., 1983 (18).
+ Criteria that all had to meet. (+) AA athletes met one or more of these (relative) criteria.
\(a\) >5% of expected body weight. \(b\) No menstrual bleeding at age 16 (primary amenorrhea).
\(c\) Primary amenorrhea, secondary amenorrhea, oligomenorrhea. \(d\) Defined in DSM-III-R(1).
\(e\) To initiate the weight loss, subjects all reported the use of “diets” at or below 1,200 kcal (duration of period not defined). \(f\) Self-induced vomiting, laxatives, and diuretics.

Results

Descriptive data on the gymnasts and the controls are provided in Table 2. Both gymnasts and controls had a significantly lower self-defined “ideal” body weight than their present weight (\(p < .05\)). Gymnasts were significantly leaner and trained significantly more, and their energy intake was significantly lower than the intake of controls (\(p < .05\)). As a group they started sport-specific training at a mean age of 9 years (6–13). All gymnasts were dieting to enhance performance. Furthermore, coaches, judges, and parents were referred to as reasons for dieting (Table 3). Two of the controls were dieting due to cosmetic reasons.

Two gymnasts met the DSM-III-R criteria for AN and 2 met the criteria for AA. Two other gymnasts reported the regular use of laxatives, vomiting, and/or fasting (Table 4). One had been anorexic for 3 years, and the remaining 3 who were diagnosed had developed an ED during the last 14 months.

Four of the gymnasts had reached menarche (mean menarcheal age 14 years, range 13–15). Two of these had amenorrhea and 2 had irregular cycles. An additional gymnast was diagnosed with primary amenorrhea and stress fracture. All controls had reached menarche (mean menarcheal age 12.4 years, range 12–14) and menstruated regularly. Eight gymnasts reported injuries, with the main type being overuse injuries.
### Table 2  Characteristics of Athletes Representing the National Team in Rhythmic Gymnastics

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Ideal weight (kg)</th>
<th>Body fat (%)</th>
<th>Training vol. (hr/week)</th>
<th>Intake (kcal/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athletes</td>
<td>15.3</td>
<td>1.61</td>
<td>42</td>
<td>40.4</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>14–20</td>
<td>1.50–1.74</td>
<td>33–58</td>
<td>31–54</td>
<td>6–17</td>
<td>16–26</td>
</tr>
<tr>
<td>Controls</td>
<td>15.3</td>
<td>1.61</td>
<td>54</td>
<td>50.0</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>14–20</td>
<td>1.50–1.74</td>
<td>35–68</td>
<td>35–66</td>
<td>14–27</td>
<td>0–4</td>
</tr>
</tbody>
</table>

*Note.* Values are given as means with ranges.

aSubjective ideal weight

### Table 3  Reasons for Dieting

<table>
<thead>
<tr>
<th>Reason</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>To enhance performance</td>
<td>12</td>
<td>100</td>
</tr>
<tr>
<td>Coach thinks I’m too fat</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>Judges will give me a better score</td>
<td>5</td>
<td>42</td>
</tr>
<tr>
<td>Recommended by parents</td>
<td>2</td>
<td>17</td>
</tr>
</tbody>
</table>

*Note.* Multiple answers were allowed.

### Table 4  Number of Athletes Who Met Diagnostic Criteria or Used One or More Pathogenic Weight-Control Methods

<table>
<thead>
<tr>
<th>Criteria</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anorexia nervosa</td>
<td>2</td>
</tr>
<tr>
<td>Anorexia athletica</td>
<td>2</td>
</tr>
<tr>
<td>Laxative use</td>
<td>2</td>
</tr>
<tr>
<td>Vomiting</td>
<td>2</td>
</tr>
<tr>
<td>Fasting</td>
<td>2</td>
</tr>
<tr>
<td>Bingeing</td>
<td>0</td>
</tr>
</tbody>
</table>
All athletes received individual feedback on their dietary registration. During that session, a number of nutritional myths were reported:

- Never eat after 5 p.m.
- 800 kcal/day is enough for rhythmic gymnasts.
- Eat only cold food.
- Do not eat meat, bread, or potatoes.
- Drinking during training will destroy your practice.

Eight out of 12 gymnasts had elevated scores on the DT and BD subscales, as did 2 of the controls. When gymnasts and controls were compared on mean scores on the subtests, there was a significant difference for gymnasts and controls, respectively on the DT (11.8 [5–18], 4.3 [2–17]); BD (8.6 [4–17], 3.9 [4–9]); P (8 [5–9], 3 [1–6]); and MF (6.9 [2–8], 1 [0–3]). A significantly higher number of gymnasts than controls had elevated scores on these subtests ($p > .05$). The subtest scores on the EDI for the two gymnasts (A1 and A2) who met the AA criteria are exhibited in Figure 1. The two gymnasts who met the criteria for AA exhibited EDI subtest scores similar to anorexic patients (11) on all subscales except for B, I, and IA. The figure also illustrates the difference between the two eating-disordered athletes and age-matched controls on the DT, BD, P, and MF subtests.

**Discussion**

This study underscores the fact that clinical and subclinical EDs are common among young girls competing in modern rhythmic gymnastics. The number of gymnasts who met the criteria for EDs was the same in this study in 1995 (33%) as the number suffering in 1990 (34%), although the team members were not the same. In spite of...
the fact that most of these gymnasts had a percentage of fatness below the level considered healthy for females (21), almost all were dieting and were extremely dissatisfied with their body weight and shape.

For athletes, the diagnosis of ED may result in their losing a place on the team. However, because thinness seems to be a requirement for success in the world of gymnastics, particularly modern rhythmic gymnastics, such disordered eating may be considered normative in this sport. An individual’s natural body type usually steers the athlete to specific sports, and body type dictates in part whether the athlete will be successful (5). Some of the international-level gymnasts who look anorexic may be naturally selected to this sport, but since all members of the Norwegian team reported dieting in spite of their extreme leanness, at least some are fighting their natural body weight.

Beginning training for a target sport before the body matures, as reported in this study, might hinder these gymnasts in choosing a suitable sport for their adult body type. This could provoke a conflict in which the gymnasts struggle to prevent or counter the natural physical changes precipitated by growth and maturity.

It is difficult to explain how these gymnasts with EDs can continue to compete at their high performance level in spite of undernutrition. Poor growth and impaired maturation have been reported in children and adolescents who regularly restrict calories because they are afraid of becoming obese (14, 18). The fact that these gymnasts can compete at a high performance level could suggest that their bodies have become metabolically more efficient in an attempt to conserve energy stores. That is, their resting metabolic rate and thermic response to food are attenuated, and therefore they may be able to perform physical activity with exceptionally low energy expenditure (5). Although it is tempting to attribute these low intakes to underreporting of food intake or undereating during the diet record period, low caloric intakes have been observed for a variety of sports and appear to be consistent across a number of studies (20). The athletes were weight stable during the period they completed food intake records. The reported myths concerning food and liquid intake indicate the need for education among both athletes and coaches.

Only 4 of the gymnasts (mean age of 15.1 years) had reached menarche. This could be due to a natural selection of late maturers, or it could be explained by restrictive energy intake combined with low percent body fat, the use of pathogenic weight control methods, high training volume, and psychological pressure to perform and keep weight low (3, 24). Of those who had reached menarche, all had amenorrhea or irregular periods. In addition, 1 had primary amenorrhea at age 18 years. Gymnasts scored significantly higher than controls on the Maturity Fears subscale. Both the 2 gymnasts who met the AN criteria and the 2 who met the AA criteria had scores on the MF subtest (Figure 1) within the pathological range (11). This test measures one’s wish to retreat to the security of the preadolescent years (11). Crisp and others have contended that the central psychopathology in AN is rooted in the biological and psychological experiences associated with an adult weight (7). Starvation becomes the mechanism for avoiding psychobiological maturity because it results in a return to prepubertal appearance in hormonal status (7). For these gymnasts, avoidance of maturity seems to be important due to the “demands” in their sport. Those gymnasts who had reached menarche felt burdened because they compete in a sport where late menarche is more common and extra weight is thought to impair performance and detract from appearance in the eyes of judges. This provides another incentive for extreme dieting. Hence, feelings of
reaching menarche and developing secondary sex characteristics “too early” may be a warning sign as well as a risk factor for the development of EDs (22).

The high frequency of reported injuries among the gymnasts could be explained by a number of factors such as energy deprivation, extreme leanness, hypoestrogenic amenorrhea, and high training volume. Warren (28) suggested that menarcheal delay and prolonged intervals of hypoestrogenic amenorrhea may predispose ballerinas to scoliosis and stress fractures. Increased susceptibility to musculoskeletal injuries among amenorrheic athletes has been reported (21), and results from this study indicate that rhythmic gymnasts also are highly susceptible to menstrual dysfunction and injuries.

Many of the athletes in rhythmic gymnastics are children. In international competitions, 15-year-old girls are defined as seniors. These girls have a number of “important” others such as the coach, judges, administrators, and parents who are interested in helping these athletes approach their potential. The reported reasons for dieting support this assumption. Like other athletes, these gymnasts attempt to enhance performance by taking extraordinary measures to reduce body fat or remain thin. It is reasonable to believe that the pressure to reduce weight and/or maintain a prepubertal body is an important reason for the high frequency of EDs and dieting behavior in this group.

This study identified several factors associated with the development and maintenance of EDs in athletes. Since none of these gymnasts had symptoms of EDs before they began sport-specific training, the attraction-to-sport hypothesis cannot be the explanation for any of the subjects. Dieting at an early age has been associated with the onset of EDs in athletes (23). A significant number of athletes who began dieting to improve performance reported they did so because they believed their coach wanted them to. This is different from previous studies, where athletes reported that their coach actually told them to lose weight (23,25). This could be explained by the focus on the coach’s role in the development of EDs. Athletes are reporting that coaches are telling other athletes, assistant trainers, or judges to recommend that athletes lose weight; thus, the coaches probably feel less responsible for the consequences.

To perform for key figures (coach, judges, parents), young athletes may feel driven to lose as much weight as possible by whatever means possible and may dread the alternative (to remain heavier than the ideal). In the present study, the discrepancy between actual and self-defined ideal weight was significantly greater in the gymnasts than in controls. The higher the degree of discrepancy between actual and self-defined ideal weight, the more a person is at risk (4). The training, dieting, and weight history of the gymnasts who met the ED criteria indicated that they all had been involved with their sport for years before they revealed symptoms of EDs. Excessive exercise has been considered a feature and risk factor for the development of AN (8,9,25). For these gymnasts, however, high training volume is required in this technically demanding sport and should not be considered a means for burning calories, which often is true for nonathletes with EDs.

Increased training may lead to energy deprivation, which in turn may create a biological or psychological climate in which EDs may arise (13). Whether this has influenced the development of EDs in these gymnasts is difficult to answer, but it has been reported as a risk factor for the development of EDs in endurance athletes (25). Athletes have reported that they developed EDs at the time of injury or illness which left them unable to train at high levels. Furthermore, injury, illness, or the loss
of a coach might be conceptualized as traumatic events that trigger the onset of EDs (2). In this study, 2 of the gymnasts developed EDs at the time of injury.

**Summary**

The results of this study support the notion that elite athletes in this sport are at increased risk for clinical and subclinical EDs. This study has identified potential risk factors/conditions associated with the development of EDs. Longitudinal studies are necessary to determine whether these factors are necessary or sufficient for EDs to occur, or whether these and other factors such as age, gender, personality variables, or physical processes interact to create the disorders.

Both subclinical and clinical EDs should be taken seriously; the personal cost to the gymnasts is high because of the severe and even deadly consequences of EDs. Ultimately, the cost to the sport will be high if participation is considered dangerous. Research on the development, treatment, and prevention of EDs must be considered a priority. Athletes, coaches, and parents need to be educated about weight control, sound nutrition, and "natural" growth and development. The focus on leanness must be deemphasized and the unwritten rules in this sport changed. I am afraid that EDs will always be a problem within these sports where the competitors are young (still growing) and leanness is considered important for top performance, unless limits are placed on age and percent fat for participants in these sports.

**References**


