©Journal of Sports Science and Medicine (2005) **4,** 550-555
http://www.jssm.org

Research article

PREVALENCE OF THE FEMALE ATHLETE TRIAD IN EDIRNE, TURKEY

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Received: 31 August 2005 / Accepted: 14 October 2005 / Published (online): 01 December 2005

ABSTRACT

The aim of this study was to determine the prevalence of the female athlete triad, which is a clinical condition defined as the simultaneous occurrence of disordered eating, amenorrhea, and osteopenia and/or osteoporosis in female athletes. A total number of 224 female athletes from Edirne city participated in our study. Eating attitudes test (EAT 40) and a self-administered questionnaire were used to assess disordered eating behavior and menstrual status respectively. The participants having both disordered eating and amenorrhea were performed dual energy x-ray absorptiometry to evaluate bone mineral density. Thirty seven subjects (16.8%) had disordered eating behavior and 22 subjects (9.8%) were reported to have amenorrhea. Six athletes (2.7%) met two criteria (disordered eating and amenorrhea) of the triad. Of these, only three athletes met all components of the triad. We have found that the prevalence rate of female athlete triad was 1.36% among young Turkish female athletes. Female athletes have under considerable risk for the disordered eating and amenorrhea components of the triad.

KEY WORDS: Amenorrhea, disordered eating, osteoporosis, osteopenia, anorexia nervosa.

INTRODUCTION

Over the past century, there has been an exponential increase in the number of female athletes both for competitive and/or recreational facilities. Besides many beneficial effects of exercise, female athletes are susceptible to disordered eating behavior, amenorrhea, and osteoporosis. The constellation of these three clinical conditions was defined as the female athlete triad by the American College of Sports Medicine (Nattiv et al., 1994; Otis et al., 1997; Yeager et al., 1993). Not only elite athletes but also physically active girls and women have been accepted to be at risk of developing one or more components of the triad (Otis et al., 1997; West, 1998; Golden, 2002).

Amenorrhea was reported to range from 1% to 44% in the female athletes (De Souza, 2003). The reported prevalence of disordered eating in some collegiate and elite athletes was found equal to or higher than the general population (Otis et al., 1997). The occurrence of disordered eating behavior was reported in 15 to 62 percent of female athletes (Beals and Manore, 2002; Dummer et al., 1987, Rosen et al., 1986, Sundgot-Borgen, 1994). Although several studies reported that prevalence of one or two components, only one study documented the prevalence of the triad as a whole among female soldiers and did not find any subjects who met the whole criteria of the triad (Lauder et al., 1999). In this study, our aim was to investigate prevalence of the female athlete triad in young Turkish female athletes from different branches.

METHODS

The current prevalence study consists of a cross-sectional analysis. The study was approved by the local ethics committee of Trakya University and carried out between February and June, 2004. Details of the study were explained to each subject, and informed consent was obtained from the participants, and the parents of those who were younger than 18 year old.

Subjects

Two hundred and twenty-four female athletes participated to the study in the city of Edirne, Turkey. The ages of all subjects ranged from 16 to 25 years. Participants were recruited from regional sport clubs, high schools, and university sports teams of different branches. Branch distribution was as follows: basketball (n = 79, 35.3%), handball (n = 17, 7.6%), running (n = 26, 11.6%), swimming (n = 25, 11.2%), rhythmic gymnastics (n = 2, 0.9%), wrestling (n = 6, 2.7%), tennis (n = 4, 1.8%), volleyball (n = 40, 17.9%), taekwondo (n = 16, 7.1%), and dancing (n = 9.4%). Athletes using oral contraceptives were excluded from our study, because oral contraceptive use is known to regulate the menstrual cycle. All subjects were nulliparous.

Questionnaire

A self-administered questionnaire was used to assess age, weight, height, beginning age to sports, training regimen, menstrual status, and history of fractures. Subjects were asked detailed questions about their current menstrual status, frequency and regularity of menstrual cycles. Eumenorrhea was defined as menstrual cycles occurring every 28-30 day and lasted in this regular cycle for at least 12 months. Menstrual irregularity was used to describe irregular cycle lengths (cycles not occurring every 28-34 days) (Beals and Manore, 2002). The presence of primary amenorrhea was regarded as the absence of menstruation by the age of 16 (ASRM Practice Committee, 2004; Otis et al., 1997). Secondary amenorrhea was regarded as absence of menstrual bleeding following at least three or more consecutive menstrual cycles after menarche (ASRM Practice Committee, 2004; Otis et al., 1997). Body mass index (BMI) was calculated as weight in kilograms per height in square meter.

Eating Attitudes Test (EAT-40)

Disordered eating behaviors were assessed by the EAT-40 which is a widely used, standardized, and self-reported questionnaire designed to assess pathological eating behaviors, attitudes, and thoughts (Garner and Garfinkel, 1979). A Turkish translation, reliability and validity of this test were performed in a group of sample consisting Turkish subjects (Erol et al., 1989). Response options ranging from "1 = always" to "6 = never", with higher scores indicative of clinical levels of disordered eating. The scores, which were equal to and higher than 30, were regarded as having disordered eating behaviour (Erol et al., 1989). The participants having both amenorrhea and disordered eating behaviour were invited to psychiatric interview. All psychiatric interviews were performed by the same psychiatrist (EV) using DSM-IV research criteria (APA, 1994).

Bone densitometry

Dual energy x-ray absorptiometry (DEXA) was performed to evaluate bone mineral density. As the primary aim of our study was to investigate the prevalence of all criteria of the Triad, we performed DEXA only on the athletes, who met the two criteria of the triad. Areal bone density was measured using DEXA (Norland XR36, Norland Medical Systems Inc., Fort Atkinson, USA). DEXA scans were taken of the lumbar spine (anteroposterior and lateral, L2-L4) and femoral neck. In our laboratory, the coefficient of variation values for BMD were estimated to be 1.0% (lumbar L2-4 spine), 1.2% (femoral neck).

Blood analysis

The subjects having all criteria of the female athlete triad underwent blood analyses. Blood samples were collected from a peripheral vein in a resting state to determine the endocrine profiles including TSH, FSH, LH, progesterone, prolactin, estradiol, DHEA-S and cortisol measurements (Chemiluminescent Immunoassay System BioDPC, Euro/DPC Ltd United Kingdom).

Statistical analysis

Values were given as the mean ± SD. Chi-square method was performed to evaluate relationships between nominal variables and Student's t test was used for continuous variables. A p-value of below 0.05 was considered to be significant.

RESULTS

Menstrual irregularities and amenorrhea

Amenorrhea was present in 22 (9.8%) of all athletes. Of the 22 athletes, two (0.9%) reported primary amenorrhea. Both of the atheletes who were reported primary amenorrhea were 16 years old, engaging in rhythmic gymnastics and EAT-40 scores of these subjects are not higher than the cutt of the EAT-40 score. They met only amenorrhea component of the

Table 1. Comparison of general characteristics in athletes with or without menstrual irregularity.

	Eumenorrhea (n=181)	Menstrual irregularity (n=43)
Age (yr)	19.5 (2.6)	19.1 (2.5)
Height (m)	1.68 (0.07)	1.67 (6.6)
Weight (kg)	57.5 (7.1)	54.8 (7.6) *
BMI (kg·m^{-2})	20.3 (2.1)	19.6 (1.9) *
Participation age to sports (yr)	11.5 (3.1)	10.8 (3.5)
Duration of training (yr)	6.8 (3.3)	6.5 (3.9)
Amount of training (h/week)	6.5 (4.9)	6.7 (6.4)
EAT-40 score	18.9 (9.9)	22.8 (12.4)

BMI= body mass index, EAT-40 = eating attitudes test-40. * $p < 0.05$.

triad. The remaining 20 reported secondary amenorrhea. Menstrual irregularity was reported by 43 (19.2%) of the athletes. Eighty percent of all participating athletes (n = 181) reported regular menstrual cycles during the past year. Athletes with irregular menstrual cycle had lesser body weight and BMI with respect to eumenorrheic group (Table 1). There were no differences in EAT-40 test scores, age, height, participation age to sports, duration of training and amount of training between the athletes having eumenorrhea and menstrual irregularity (Table 1).

Disordered eating

Four athletes completed EAT-40 questionnaire improperly and were excluded from the study. Eventually, 220 subjects were available for further investigation. High EAT-40 scores were reported by 37 athletes (16.8%). Within the high EAT-40 group, 6 subjects (16.2%) reported amenorrhea, whereas in the normal EAT-40 group, 14 subjects (7.7%) reported amenorrhea (Chi-square $p<0.05$). Six athletes (2.7%) met disordered eating and amenorrhea criteria of the triad (Figure 1).

Psychiatric evaluation was made for the six athletes, whose EAT-40 scores were high, and who had amenorrhea. Two of these athletes were diagnosed with having eating disorders. One of these athletes met the diagnosis of anorexia nervosa. She was found to be in remission during psychiatric interview. The other one was diagnosed to have eating disorders not otherwise specified (EDNOS). The remaining four athletes did not have the diagnostic criteria for anorexia nervosa, bulimia nervosa or EDNOS.

Athletes with high EAT-40 scores had higher body weight (59.8 ± 7.6) than those with normal EAT-40 scores (56.5 ± 7.0 $p < 0.02$).

Bone mineral density

Six athletes, who had two criteria (disordered eating and amenorrhea) of the triad, underwent DEXA scans to assess bone mineral density. Consequently we identified the subjects with BMD diagnostic criteria defined by Word Health Organization (Kanis, 2000). Osteoporosis is defined as bone mass more than 2.5 SD below the mean normal peak bone mass. Osteopenia is defined as bone mass that

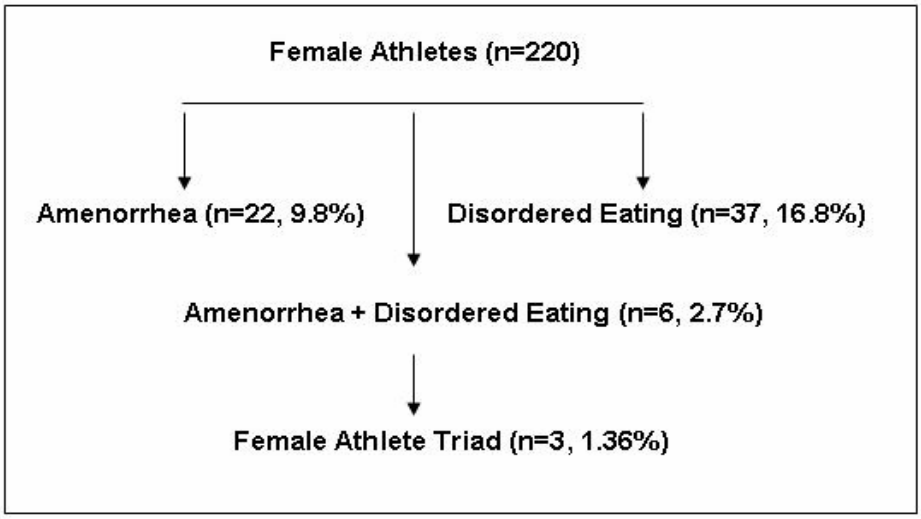

Figure 1. Number and percentage of the athletes who have one or more criteria of the triad.

Table 2. General characteristics and bone mineral density of the three subjects who meet whole criteria of the triad.

Subjects	**1**	**2**	**3**
Symptoms	DE+A+OPO	DE+A+OPE	DE+A+OPE
Branches	Basketball	Running	Running
Age (yr)	20	25	18
Height (m)	1.65	1.62	1.64
BMI ($kg \cdot m^{-2}$)	18	20	24
Participation age to sports (yr)	16	12	15
Duration of training (yr)	4	9	3
Amount of training (h/week)	6	4	4
Eating disorder	EDNOS	AN	-
BMD, lumbar spine ($gr \cdot cm^{-2}$)	0.85	0.90	1.09
T score	-2.66	-2.27	-1.37
Z score	-2.49	-2.10	-1.29
BMD, femoral neck($gr \cdot cm^{-2}$)	0.97	0.83	0.94
T score	0.62	-0.53	-0.04
Z score	0.67	-0.49	0.03

DE = disordered eating, A = amenorrhea, OPO: osteoporosis; OPE: osteopenia, BMI: body mass index, EDNOS: eating disorders not otherwise specified diagnosis, AN: anorexia nervosa, BMD: bone mineral density.

ranges between 1.0 and 2.5 SD. BMD level of the 3 subjects were within osteoporotic (n = 1) or osteopenic (n = 2) limits (Table 2).

Blood analyses

Blood analyses were performed in the six athletes, who had whole criteria of the triad. Only one of these athletes' FSH/LH ratio changed in favor of LH (FSH, 6.99 $mlU \cdot ml^{-1}$, LH 12.9 $mlU \cdot ml^{-1}$) and she had complaint about hirsutism. This finding suggested polycystic ovary syndrome. In order to find a reason for amenorrhea, a detailed gynecologic investigation was made, and this inquiry verified the diagnosis of polycystic ovary syndrome. The laboratory results of the remaining five athletes did not make us consider any explanations (hypotroidi, hyperprolactinemia or Cushing syndrome, etc) to clarify the reasons for amenorrhea.

DISCUSSION

We found the prevalence rate of the triad as 1.36% in our study population. Although, it was suggested that the symptoms of the triad decrease physical performance, and increase the potential risk for considerable morbidity and mortality, little is known about the prevalence of all symptoms of female athlete triad (Otis et al., 1997). Only one prevalence study was investigated the whole criteria of the triad, and it was not found any women, who met whole symptoms of female athlete triad in the female soldiers (Lauder et al., 1999). We determined all symptoms of the triad in three athletes in our study. One of these athletes had both diagnosis of polycystic ovarian syndrome and anorexia nervosa. She reported that her symptoms had begun after intensive exercising period when she was 16 years old. Since amenorrhea of this athlete could not only be ascribed to the polycystic ovarian syndrome but also to the anorexia nervosa, we regarded her as an athlete who met the symptoms of the female athlete triad in this study.

Kuğu et al. (2002) investigated prevalence of eating disorder among 980 Turkish university students using EAT-40 and they reported that 7.4% of the subjects were above the cut off point. We found disordered eating behavior in 16.8% of the study group. Furthermore, athletes with high EAT-40 scores had higher body weight than the athletes with normal EAT-40 scores in our study. Cobb et al. (2003) showed similar results, and they suggested that heavier women were more inclined to eating disorders, because they were more dissatisfied with their natural body type.

Menstrual irregularity is a common condition among female athletes. For instance, as many as two-thirds of runners who have menstrual periods have short luteal phases or are anovulatory (De Souza et al., 1998). However, most of the studies on female athlete triad accepted solely amenorrhea rather than oligomenorrhea or other irregularities as one of the criteria of the triad (Anderson, 1999; Donaldson, 2003; Golden, 2002; Nattiv et al., 1994; Otis et al., 1997; Putukian, 1998). Furthermore, DSM-IV research criteria of eating disorders include only amenorrhea (APA, 1994). In the light of above literature, we preferred amenorrhea as a definition criterion.

We measured bone mineral density of six athletes, who had disordered eating and amenorrhea and found osteoporosis in one athlete and osteopenia in two athletes in our study. Thus, we detected osteoporosis or osteopenia in the half of the athletes, who met the two criteria of the triad. Osteoporosis was described as one of the three criteria of the triad in many publications (Golden, 2002; Otis et al., 1997). However, Khan et al. (2005) suggested that osteopenia could be defined among the criteria of female athlete triad syndrome because osteporosis was rare and osteopenia in a young athlete may provide a worse prognosis for bone health of this athlete. In addition, significant osteopenia that is, T-score of –2.0, in a twenty year old may lead to a worse prognosis for long term bone health than osteoporosis in a 65 year old with a T-score of –2.6 (Khan et al., 2005). Therefore, we regarded osteopenia as one of the criteria of the triad in our study.

There are several limitations that deserve comment. In our study, the EAT-40 was used as an initial screening tool, and individual psychiatric interviews were performed with athletes, who met the two criteria of triad to rule out false-positive results. Unfortunately, the true false-negative rate could not be determined through our study, because all women were not interviewed. It was known from previous studies that EAT-40 might give 2-3% false-negative result (Rodrigez-Cano, 2005). On the other hand, our study did not show any prevalence for all subjects in terms of osteoporosis and/or osteopenia of the triad. However, this study showed the frequency of osteoporosis or osteopenia of the subjects who have the two components of the triad.

CONCLUSIONS

In conclusion, the prevalence rate of the triad was 1.36% in our study. In addition, prevalences of disordered eating and amenorrhea were 16.8% and 9.8% respectively in our study population. We believe that further investigation of the prevalence of all components of the triad in larger groups is needed, with which our results can be compared.

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KEY POINTS

- The prevalence rate of the occurrence of whole criteria of the female athlete triad was 1.36 % in young Turkish athletes in Edirne.
- Female athletes who met whole criteria of female athlete triad are more prone to the eating disorders.
- The occurrence of disordered eating behavior was higher in female athletes according to general population.
- Amenorrhea prevalence was significantly higher in female athletes who had disordered eating.

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