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Evaluation of female athlete triad and gynecological complaints in young Turkish female athletes

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Summary

Purpose: Female athlete triad (FAT) is a serious healthcare concern in the young female population. The aim of this study was to determine the prevalence and clinical characteristics of FAT and its relationship with gynecologic complaints of young Turkish female athletes. *Materials and Methods:* This was a cross-sectional survey and included 87 female athletes involved in a variety of sports as a case group and 85 sedentary female university students from Ege and Celal Bayar Universities. All subjects completed a questionnaire consisting of 32 separate questions assessing eating behavior, menstrual status, gynecologic and systemic complaints, psychological problems, and sexual history. SPSS 21.0 was used for statistical analysis. *Results:* This survey involved 172 females in between to 30 years of age. The age of menarche was found to be significantly lower in the sedentary group ($p = 0.00$). Late menstruation and oligo-amenorrhea were notable complaints among the athletes, and body mass index (BMI) was found to be statistically lower in the athletic group ($p = 0.00$). Cold hands and hair loss were seen more often in the sedentary group compared to the athletic group ($p < 0.05$). According to a logistic regression analysis, independent variables (BMI, menstrual status, and bone fractures) were found to be statistically insignificant ($p > 0.05$). *Conclusions:* Excessive sports activity can be hazardous in young female population. Lower BMI might be related to menstrual irregularity. Young female population should be informed about this relationship, especially athletes who are particularly at risk. Certain precautions should be taken into consideration in this population in order to get benefits of sports activity.

Key words: Anorexia nervosa; Amenorrhea; Bone health; Disordered eating; Energy deficiency; Female athlete triad; Menstrual irregularity.

Introduction

Female athlete triad (FAT) was identified as the association of the three distinct conditions of an eating disorder, amenorrhea, and osteoporosis by the American College of Sports Medicine in 1997 [1, 2]. The triad is now described as a medical condition often observed in physically active girls and women and involves any one of the following three components: low energy availability (EA) with or without disordered eating, menstrual dysfunction, and low bone mineral density (BMD) [3]. Clinical manifestations including eating disorders, functional hypothalamic amenorrhea, and osteoporosis could be seen in untreated subjects.

Obviously, habitual exercise is beneficial to the health and well-being of girls and women. Proper EA is very important for maintaining the physiological processes of the body [4]. EA refers to the amount of dietary energy remaining after exercise for all other physiological processes and is calculated as follows: dietary energy intake minus exercise energy expenditure [5]. Energy intake that is chronically inadequate to compensate for energy expenditure results in insufficient stored energy to maintain physiological processes; this condition is known as low EA. Low EA may be the result of losing more energy than is gained through food intake or of restricting energy intake [1]. Girls and women participating in sports that emphasize a low body weight are more likely than other active females to restrict their EA [6].

When EA is too low, physiological mechanisms reduce the amount of energy used for cellular maintenance, thermoregulation, and reproduction [7]. The type of amenorrhea caused by low EA is classified as functional hypothalamic amenorrhea. Ovarian function is suppressed by an abnormally slow frequency of luteinizing hormone pulses in the blood. In animal experiments, reducing energy intake by more than 33% causes infertility and delays puberty [8, 9].

Amenorrhea results in an estrogen-poor environment, which has a negative effect on bone formation. Compromised bone health increases the risk of fractures during the entire lifespan, highlighting the long-term health consequences of FAT. Stress fractures are often a clinical manifestation of low bone mass [10].

The potentially irreversible consequences of these clinical conditions emphasize the critical need for the prevention, early diagnosis, and treatment of FAT.

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Table 1. — *Menstrual status and complaints of the athletes and sedentary groups.*

		Athlete (%)	Sedentary (%)	*p*-value
Menstrual status	Premenarche	26.4	0	0.00*
	Normal	58.6	90.6	
	Oligo-menorrhea	4.6	3.5	
	Menorrhagia or menstruation > 7 days	1.1	4.7	
	First menstruation > 15 years	5.7	0	
	First menstruation >15 years + oligo-menorrhea	3.4	1.2	
Dysmenorrhea		44.8	57.6	0.09
Analgesic use for dysmenorrhea		28.7	42.4	0.06
PMS		36.8	54.1	0.02*
Inconvenience of menstruation	No	43.7	24.7	0.99
	Sometimes	31	0	
	Yes	25.3	75.3	

PMS: premenstrual syndrome, *$p < 0.05$ value shows statistically significance.

Materials and Methods

This was a cross-sectional survey and included 87 female athletes involved in a variety of sports as a case group and 85 sedentary female university students from Ege and Celal Bayar Universities as a control group. All subjects completed a questionnaire consisting of 32 separate questions assessing eating behavior, menstrual status, gynecologic and systemic complaints, psychological problems, and sexual history. Written informed consent was obtained from each subject (and from the parents of those < 18 years of age), and all procedures for recruitment and the conduct of the study were approved by the Institutional Review Board.

Inclusion criteria included being ten to 30 years of age and participation on a varsity sports team at a very high level of physical activity (physical exercise at least three to four days a week for about 1.5 to three hours a day). Exclusion criteria included pregnancy, known metabolic or systemic disease, and/or medication usage. Females ten to 30 years of age who did not participate regularly in sports activities (less than two times a week for about 20 minutes a day) were included in the study as the sedentary group.

SPSS 15.0 was used for the statistical analysis. A descriptive analysis was conducted, the difference of variables between groups was analyzed, and a Mann Whitney test was used to examine the nominal and abnormally distributed variables. Potential factors that related to engaging in sports activity were analyzed using a logistic regression model. Results were assessed as follows: a p-value < 0.05 was considered statistically significant and a p-value > 0.05 was considered statistically insignificant at a 95% confidence interval.

Results

This survey included 172 females (87 athletic and 85 sedentary females) ten to 30 years of age. The median age was 20 years for the athletes and 18 years for the sedentary group ($p = 0.00$). The median age for starting sports was nine years; 54% of the athletes were involved in gymnastics, 18.4% were involved in folk dancing, 6.9% were involved in volleyball, and the remaining athletes were involved in handball, rugby, tennis, and other types of dance. The median age for menarche was 14 years for the athletes and 13 years for the sedentary group. The age of menarche was found to be significantly lower in the sedentary group ($p = 0.00$). Menstrual status and complaints related to menstruation are detailed in Table 1. Sports activity seems to be a protective factor against premenstrual syndrome (PMS) ($p = 0.02$).

Table 2. – *Comparison of the pulse rate, BMI values, and the complaints related with bone health between athletes and sedentary cases.*

	Athlete	Sedentary	*p*-value
Pulse rate	84.26 ± 12.77	80.93 ± 6.2	0.00*
BMI	19.69 ± 2.49	21.41 ± 2.94	0.00*
Bone fracture history	19.5	12.9	0.24
BMD measure	4.6	8.2	0.33
Musculoskeletal injury in last six months	24.1	3.5	0.00*

BMI: Body- mass index, BMD: bone mineral density.
*p<0,05 value shows statistically significance.

The pulse rate varied between 62 and 118 and was found to be statistically higher in the athletic group, and BMI was found to be statistically lower in the athletic group (Table 2). The Spearman's correlation analysis revealed a weak but significantly negative relationship between the age of menarche and BMI (36.8%) (correlation is significant at the 0.01 level [two-tailed]). There was no difference between the two groups in terms of previous bone fractures or BMD measurement, but musculoskeletal injury in the last six months was seen in the athletic group more often than in the sedentary group ($p = 0.00$) (Table 2).

Bradycardia, orthostatic hypotension, and cold/discolored hands and feet may be signs of eating disorders. Both groups were asked to answer some questions about complaints related to low EA, dry skin, cold hands and feet, hair loss, late wound healing, hypotension, breast concerns, incontinence, and fatigue. Interestingly, the present authors found hand and foot coldness and hair loss occurred more frequently in the sedentary group compared to the athletic group ($p < 0.05$) (Table 3).

Table 3. — *Comparison of the complaints related with low energy availability between athletes and sedentary cases.*

Complaints		Athlete (%)	Sedentary (%)	*p*-value
Dry skin	Yes	34.5	34.1	0.96
	No	65.5	65.9	
Cold hands and feet	Yes	52.9	68.2	0.04*
	No	47.1	31.8	
Hair loss	Yes	46	75.3	0.00*
	No	54	24.7	
Late wound healing	Yes	13.8	17.6	0.49
	No	86.2	82.4	
Hypotension	Yes	28.7	21.2	0.25
	No	71.3	78.8	
Complaints with breast	Yes	14.9	12.9	0.71
	No	85.1	87.1	
Incontinence	Yes	3.4	2.4	0.67
	No	96.6	97.6	
Fatigue	Never	5.7	0	0.23
	Sometimes	50.6	69.4	
	Frequently	36.8	25.9	
	Always	6.9	4.7	

*p<0.05 indicates statistical significance in complaints between two groups.

There was no significant difference in terms of depression history between the groups (5.7% *vs.* 7.1%, respectively; $p = 0.73$). Similarly, there was no statistical significance regarding mood status between the athletic and sedentary groups; 72.4% of the athletic group and 81.2% of the sedentary group described their daily mood as "good" ($p = 0.11$). Diagnosed eating disorders were not observed in either group.

The subjects were asked about their sexual activity and chosen method of contraception, and the answers are summarized in Table 4. Interestingly, 11 of 12 sexually active athletes stated they did not use any contraception.

Using a binary logistic regression model, sports activity was used as the dependent variable and BMI, menstrual status, and bone fractures were used as the independent variables. Using this model, the authors found a 25.6% correlation between the dependent and independent variables. This model accurately predicted the outcomes of 41.3% of the athletic group and 96.5% of the sedentary group. Based on the logistic regression analysis, the independent variables (BMI, menstrual status, and bone fractures) were found to be statistically insignificant ($p > 0.05$). This indicated that BMI, menstrual status, and bone fractures did not affect being physically active.

Discussion

This is the first study about FAT and its relationship with gynecologic complaints conducted on young female athletes in the Mediterranean region that also involved control subjects.

Table 4. — *Sexually activity and contraception rates of the athletes and sedentary cases.*

		Athlete	Sedentary
Sexually active	No	48	50
	Yes	12	2
	Did not want to say	27	33
Contraception	No	11	1
	Yes	1	1
	Did not want to say	27	33

The prevalence of FAT was 1–2% in different studies when three components of FAT were taken into consideration [11, 12]. In the present study, there was no athlete who had all three of the triad components because eating disorders and symptoms with related with low EA did not exist in our study population.

The American Society of Reproductive Medicine Practice Committee defined the age of primary amenorrhea as 15 because menarche occurs at an earlier age [13]. The prevalence of menstrual dysfunction in athletes differs in the literature (6–79%) [14]. The prevalence of amenorrhea varies widely according to sport, age, amount of training, and body weight [15]. Sports activity caused late onset menarche and oligo-amenorrhea in the present athletic group compared to the sedentary group, similar to the findings of Hoch *et al.* and Nichols *et al.* [11, 12]., The prevalence of oligo-amenorrhea was found to be 14.8% in the present study, which was lower than in previous studies (54% and 23.5%, respectively) [11, 12].

Only two of the present subjects had a history of both bone fractures and menstrual disorders (amenorrhea and oligo-menorrhea). Although none of the subjects had diagnosed eating disorders, the BMI of the two subjects mentioned above was 19.81 and 19.05. Hoch *et al.* showed that low BMI is a risk factor for low BMD [11]. Approximately 90% of the peak bone mass acquired before age 20 and bone mineralization is estrogen-dependent. Thus, menstrual irregularities, including oligo- and amenorrhea, are associated with reduced BMD [16, 17]. Feldmann *et al.* showed there is low awareness regarding this relationship among American high school athletes and their coaches [18].

According to the American College of Sports Medicine recommendations, BMD should be assessed after a stress or low-impact fracture and after a total of six months of amenorrhea, oligo-amenorrhea, disordered eating, or an eating disorder [19]. Only two of 14 subjects with oligo-amenorrhea had BMD measured and only three BMD measurements were taken in 21 cases of bone fractures in the present study group. This situation highlighted the lack of information about FAT in Turkey.

Knowledge of FAT is important before commencing nutritional counseling for individuals at risk of FAT or some of its components. The first aim of treatment is to increase

EA and calcium, vitamin D, and vitamin K supplementation [19].

In conclusion, excessive sports activity can be hazardous in young female population. Lower BMI might be related to menstrual irregularity. Young female population should be informed about this relationship, especially athletes who are particularly at risk. Certain precautions should be taken into consideration in this population in order to get benefits of sports activity.

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