Original Article

The female athlete triad among elite Malaysian athletes: prevalence and associated factors

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Women participating in a wide range of competitive sports are at higher risk of developing eating disorders, menstrual irregularities and osteoporosis, which are generally referred to as the 'female athlete triad'. The objective of this study was to determine the prevalence of female athlete triad and factors associated with this condition among athletes participating in different sports. A total of 67 elite female athletes aged between 13-30 years participated in the study and were subdivided into the 'leanness' and 'non-leanness' groups. Eating disorders were assessed using a body image figure rating and the Eating Disorder Inventory (EDI) with body dissatisfaction (BD), drive for thinness (DT), bulimia (B) and perfectionism (P) subscales. Menstrual irregularity was assessed with a self-reported menstrual history questionnaire. Bone quality was measured using a quantitative ultrasound device at one-third distal radius. Prevalence of the female athlete triad was low (1.9%), but the prevalence for individual triad component was high, especially in the leanness group. The prevalence of subjects who were at risk of menstrual irregularity, poor bone quality and eating disorders were 47.6%, 13.3% and 89.2%, respectively, in the leanness group; and 14.3%, 8.3% and 89.2%, respectively, in the non-leanness group. Since the components of the triad are interrelated, identification of athletes at risk of having any one component of the triad, especially those participating in sports that emphasise a lean physique, is an important aid for further diagnosis.

Key Words: female athlete triad, eating disorders, menstrual irregularity, bone quality, osteoporosis

INTRODUCTION

The 1994 Brighton Declaration aimed to develop a sporting culture that enables and values the full involvement of women in all aspects of sports. Since then, the participation of women in sports has increased.[1] Even though the participation of women in sports is being widely encouraged, there have been concerns that women involved in a wide range of physical activities may be at risk to develop eating disorders, menstrual irregularities and osteoporosis.[2] Termed as 'the female athlete triad', each of these conditions alone can result in serious health consequences. However, the latter two are also closely interrelated with eating disorders, which lead to low energy availability and is the key contributing factor to the triad.[3]

Two large, well-controlled studies reported the prevalence of eating disorders among female athletes range from 20% to 22% as compared with 5.8% to 9.0% in the normal population.[4,5] Nevertheless, eating disorders usually go unnoticed unless the athletes themselves acknowledge their problem and seek medical help.[6] Sometimes, athletes with menstrual irregularities also have eating disorders.[7] Eating disorders are linked to menstrual irregularities because caloric restriction or energy imbalance contributes to metabolic disturbances, such as irregular secretion of luteinising hormone,[8,9] oestrogen deficiency and other hormonal changes, which are involved in regulation of the menstrual cycle.[10]

Oestrogen deficiency has been implicated as a primary cause of osteopenia in amenorrheic athletes.[11] Thus, athletes with menstrual irregularities during their late teens or early adulthood may fail to reach peak bone mass,[12] exposing them to the risk of osteoporosis and osteopenia later in life. However, osteoporosis is not always caused by menstrual irregularity. Energy restriction may also lead to a lower bone mineral density.[13]

Among athletes, those participating in sports that emphasise leanness have been associated with a higher risk for the triad. [14-16] Most previous studies had been carried out in Caucasian populations[6,10,15] however Asians, including Malaysians, with a different genetic heritage are known to have differences in body composition, climate, diet and perhaps exercise training programme as well. Since the three conditions associated with female athlete

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Manuscript received 11 November 2008. Initial review completed 27 May 2009. Revision accepted 1 June 2009.

triad are linked to each other, the identification of athletes who are at risk is of significant importance, especially in Malaysia, where research on the female athlete triad is scarce.

The main aims of this study are to determine the prevalence and those at risk of female athlete triad among elite athletes in Malaysia and to investigate the differences among athletes participating in the 'leanness' sports and the 'non-leanness' sports.

MATERIALS AND METHODS

Subjects

This cross-sectional study comprised 67 elite female athletes training at the National Sports Institute of Malaysia in the years 2005/2006. An elite athlete was defined as one who has qualified for the national team at the junior or senior level or one who has been representing Malaysia in local and international tournaments. To be eligible, women must be involved in intensive training as they prepare to represent Malaysia at international tournaments. Athletes from the karate, taekwondo, *pencak silat*, gymnastics, shooting, archery, fencing, hockey or squash teams participated in this study. Details of the study and testing procedures were explained to the subjects and their coaches, and written, informed consent was obtained. The study protocol was approved by the National Sports Council.

The types of sports were categorized as shown in Figure 1. The leanness sports was defined as sports that emphasize a lean physique or a certain body weight.[14] In this study, gymnastic, karate, taekwondo and *pencak silat* were grouped as the leanness sports. A further division into four separate sports categories, namely aesthetics, weight class, technical and ball game, allows for a better understanding of the female athlete triad, based on the nature of each sport.[14] Each subject had to complete a socio-demographic information sheet, as well as assessments for eating disorders, bone quality, calcium intake and menstrual status.

Assessment of eating disorders

The Eating Disorder Inventory 2 (EDI-2) was used in this study to identify individuals who have 'sub-clinical' eating problems or those who may be at risk of developing eating disorders. The EDI-2 consists of 11 subscales with a total of 91 items.[17] However, only four of the subscales commonly used in other studies could be related to the athletes who were analysed in this study.[16] These subscales were: body dissatisfaction (EDI-BD), drive for thinness (EDI-DT), bulimia (EDI-B) and perfectionism (EDI-P). The scores for each subscale were then compared to the normalised scores for eating disorders.[17] The subjects were categorised as at-risk if their scores were more than the cut-off for the eating disorders norm. The cut-off points used were 12.1 for EDI-DT, 8.5 for EDI-B, 14.2 for EDI-BD and 6.8 for EDI-P, respectively.[17] Eating disorder risk was also measured using a modified 11-scale body dissatisfaction instrument.[18] Mean dissatisfaction was calculated by the discrepancy scores of the two body images that were marked by each subject.

Assessment of bone quality

Bone quality was measured using a portable ultrasound densitometer (Sunlight Omnisense ® bone sonometer 8000S, Sunlight Medical, Ltd, USA) at one-third distal radius. The measured parameter was axially transmitted speed of sound (SOS), expressed in meter per second (m/s). In addition, Z-score was used to categorise subjects into two groups, as recommended by ISCD (2004): with those having low bone quality for chronological age classified as Z-score $\leq$ -2.0 SD and the normal group as Z-score > -2.0 SD.[19] Another category, at-risk of poor bone quality for chronological age was classified at -2.0 SD < Z-score < -1.0 SD and was also included in this study because athletes are expected to have a 5% to 15% higher BMD than non-athletes.[20]

Assessment of calcium intake

A validated food frequency questionnaire (FFQ) that comprised of 60 food items for the assessment of calcium

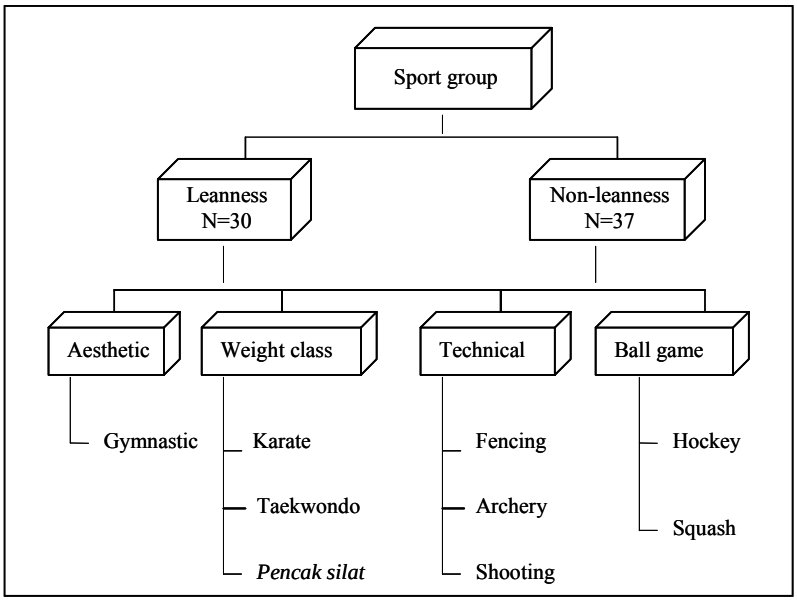

Figure 1. Classification of various sports into sport groups with reference to Sundgot-Borgen and Larsen[13]

dietary intake was used in this study.[21] The data obtained was processed using Microsoft Excel (Microsoft Corporation) worksheet designed to calculate calcium intake base on portion size (small, medium, large) and frequency selected. Calcium intake was compared to the Recommended Nutrient Intakes for Malaysia.[22]

Assessment of menstrual status

A 16-item self-administered questionnaire was used to assess the athlete's menstrual status during the past year. Subjects were asked for their age of first menarche, the number of menstruations in the past year, the average number of days between menstrual cycles, the length of one menstrual period, usage of oral contraceptives and changes in menstruation following intensive training. Subjects were then divided into four categories based on their menstruation history over the past year, including primary amenorrhea, secondary amenorrhea, oligomenorrhea and eumenorrhea. Primary amenorrhea was defined as the absence of menstruation at the age of 16 years with the presence of secondary sex characteristics or the absence of secondary sex characteristics at the age of 14 years. Secondary amenorrhea was described as the absence of menstruation for more than six months, outside of pregnancy or menopause.[23] Oligomenorrhea was classified as having between four and nine menstrual cycles per year. Eumenorrhea was identified as having between ten and thirteen menstrual cycles per year.[24,25] Primary amenorrhea, secondary amenorrhea and oligomenorrhea were all defined as menstrual irregularities.

Assessment of Body Composition

Body fat percentage and lean body mass were measured using the bioelectrical impedance technique (Bodystat 1500 MDD, Isle of Man, UK). Weight was measured using the Tanita HD 309 (Japan) to the nearest 0.01kg, and height was measured with the SECA bodymeter 208 (Germany) to the nearest 0.1cm. Body mass index was calculated using the classification recommended by WHO (1995) for adolescents and WHO (1998) for adults above 18-years-old.[26,27]

Tests Procedures

This study was conducted over three sessions for each participant. These sessions included: (a) measurement of body composition (approximately 10 min.), (b) completion of the questionnaire (approximately 40 min.), and (c) measurement of bone quality with administration of the FFQ for calcium (approximately 30 min.).

Statistical analysis

Data were analysed using Statistical Package for the Social Sciences version 11.0 (SPSS, Inc., Chicago, IL). Descriptive analyses showed prevalence of eating disorder indices, menstrual status and bone status. All variables were checked for normality using Kolmogorov-Smirnov. The differences between sport categories were examined with parametric (independent t-tests, analyses of variance) and nonparametric tests (Mann-Whitney, Fisher's exact test) based on their normality of distribution.

RESULTS

Characteristics of subjects

There was a significant difference ($p<0.05$) in age between subjects in the leanness and non-leanness sports groups (Table 1). Based on sports categories, athletes participating in aesthetic sports were younger ($p<0.05$) and started training at an earlier age than the athletes participating in weight class and technical sports. Among all of the sport groups, aesthetic sports showed a significantly ($p<0.05$) lower value for all the variables relating to physical characteristics.

Menstruation status

Eleven subjects were excluded from the analyses because the date of their first menarche was less than a year at the time of measurement or they had more than 13

Table 1. Physical and training-related characteristics of the subjects according to sport category, mean ± SD *(range)*

	Sport Category			
	Aesthetic (n=16)	Weight class (n=14)	Technical (n=18)	Ball game (n=19)
Age (year)	15.3 ± 1.9[a] (13.0-19.0)	21.6 ± 3.2[b] (17.0-28.0)	19.6 ± 3.0[b] (16.0-28.0)	20.8 ± 3.1[b] (16.0-28.0)
Height (cm)	152.4 ± 9.3[a] (135.6-164.7)	162.5 ± 6.5[b] (154.2-178.5)	162.3 ± 4.7[b] (154.3-170.4)	158.9 ± 4.6[b] (150.2-169.9)
Weight (kg)	39.3 ± 5.3[a] (28.7-47.0)	55.4 ± 7.4[b] (42.5-69.0)	59.0 ± 6.9[b] (48.0-74.6)	53.8 ± 3.9[b] (45.5-61.5)
BMI (kg/m^2)	16.9 ± 1.6[a] (15.0-20.3)	20.9 ± 2.0[b] (16.6-23.8)	22.4 ± 2.3[b] (19.7-27.6)	21.3 ± 1.5[b] (18.9-24.2)
Body fat (%)	18.9 ± 5.2[a] (10.9-28.9)	22.1 ± 3.2[ab] (15.7-26.9)	25.7 ± 4.3[b] (15.1-32.2)	21.5 ± 3.9[a] (13.4-27.0)
Lean body mass (kg)	31.8 ± 3.8[a] (24.4-39.1)	43.1 ± 5.6[b] (33.2-53.9)	43.7 ± 3.9[b] (36.4-51.1)	42.2 ± 3.0[b] (35.6-48.5)
Training (hr/wk)	31 ± 5.3 (25.0-48.0)	31.7 ± 4.8 (20.0-40.0)	28.2 ± 7.4 (15.0-44.0)	29.2 ± 6.5 (20.0-45.0)
Age start received training	9.1 ± 1.8[a] (5.0-12.0)	14.4 ± 3.2[b] (9.0-19.0)	14.8 ± 1.6[b] (12.0-18.0)	10.9 ± 2.2[a] (5.0-15.0)

Values with different alphabet tags showed significant differences between sport categories, $p<0.05$, according to ANOVA followed by Scheffe post-hoc test

Table 2. Prevalence of the components of the female athlete triad according to sport groups, [expressed as number (%)]

Components of the triad	Sport groups	
	Leanness sports	Non-leanness sports
At risk of eating disorders†	25 (89.2)	33 (89.2)
Based on 1 subscale	15 (53.6)	24 (64.9)
Based on 2 subscales	6 (21.4)	8 (21.6)
Based on 3 subscales	4 (14.3)	1 (2.7)
At risk of poor bone quality (-2SD <Z-score< -1SD)‡	4 (13.3)	3 (8.3)
Irregular menstruation§	10 (47.6)*	5 (14.3)
Primary amenorrhea	2 (9.5)	0
Secondary amenorrhea	3 (14.3)	0
Oligomenorrhea	5 (23.8)	5 (14.3)
At risk of eating disorders and irregular menstruation	10 (52.6)	3 (8.6)
At risk of eating disorders and poor bone quality	4 (14.3)	2 (5.6)
At risk of irregular menstruation and poor bone quality	1 (5.3)	0
At risk of eating disorders, irregular menstruation and poor bone quality	1 (5.3)	0

†subjects at risk in any of the four EDI-2 subscales were categorised as at risk of disordered eating. Analyses excluded two subjects who did not complete the EDI-2 questionnaire; ‡ analyses excluded one subject from a non-leanness sports who had a fracture at the radius; § subjects who were categorised as having primary amenorrhea, secondary amenorrhea and oligomenorrhea based on their past year's menstruation history were defined as having irregular menstruation. Analyses excluded 11 subjects who had not reached menarche and puberty, who had menarche for less than one year and who had menstrual cycles more than 13 times per year; *p<0.05, differences between sport groups, Fisher's Exact test.

Table 3. Mean scores for various parameters associated with components of the female athlete triad (mean ± SD)

	Sport group		Overall
	Leanness	Non-leanness	
EDI-2 subscales			
EDI-B	3.50±4.25	1.76±1.99	2.51±3.26
EDI-DT	8.07±6.00*	4.89±5.07	6.26±5.67
EDI-BD	10.46±7.32	8.35±5.69	9.26±6.47
EDI-P	8.39±3.69	9.57±2.66	9.06±3.17
Mean dissatisfaction (unit)	0.82±1.46	0.63±1.28	0.71±1.36
Speed of Sound (m/s)	4068±217**	4275±241	4175±254
Calcium intake (mg/day)	597±278*	781±341	699±325
% RNI calcium†	66.6±31.8***	91.5±43.5	80.4±40.4

†Percentage of Malaysia Recommended Nutrient Intake for calcium; *p<0.05, differences between sport groups, Mann-Whitney U test; **p<0.01, differences between sport groups, Independent t-test; ***p<0.01, differences between sport groups, Mann-Whitney U test.

menstruation cycles per year. Subjects from the leanness sports (47.6%) experienced significantly (p<0.05) more irregular menstrual cycle compared to subjects from the non-leanness sports (14.3%). Among the 26.8% subjects who reported having irregular menstruation, 3.6% subjects fit the criteria for primary amenorrhea, 5.3% for secondary amenorrhea and 17.9% for oligomenorrhea (Table 2).

Bone status

Based on the analyses of 66 subjects (one excluded due to bone fracture), none of the subjects had a Z-score of 2.0 SD below the reference value. However, 13.3% and 8.3% of the subjects from the leanness sports and the non-leanness sports groups, respectively, were at-risk of poor bone quality (-2.0 SD < Z-score < -1.0SD) (Table 2). Both groups showed a significant difference in the measurement of the speed of sound (SOS), which was 4275 ± 241 ms^{-1} and 4068 ± 217 ms^{-1} for the non-leanness sports and leanness sports, respectively (p<0.01). The results suggested that on average subjects from the non-leanness sports have better bone quality than the subjects from the leanness sports group (Table 3).

Eating disorders

There was no significant difference between both groups for any of the EDI subscales, except EDI-DT (p<0.05). However, subjects in the leanness sports group showed a higher score for all EDI subscales, except for the EDI-P. The mean score of EDI subscales is shown in Figure 2. The prevalence of athletes who were at risk for eating disorders was the same in both groups (89.2%). However, if the risk for eating disorders was based on the body image scales, the women in the leanness group showed an overall increased mean dissatisfaction with their body image (0.82 unit) when compared to the non-leanness group (0.63 unit) (p>0.05) (Table 3).

The female athlete triad

A comprehensive analysis of the data for each subject revealed that only one subject (1.9%) from the aesthetic group was at risk of the female athlete triad. Even though the prevalence of female athlete triad was low, the prevalence of subjects who were at risk for any two conditions of the female athlete triad was high. Figure 3 shows that the highest prevalence occurred in the combination of

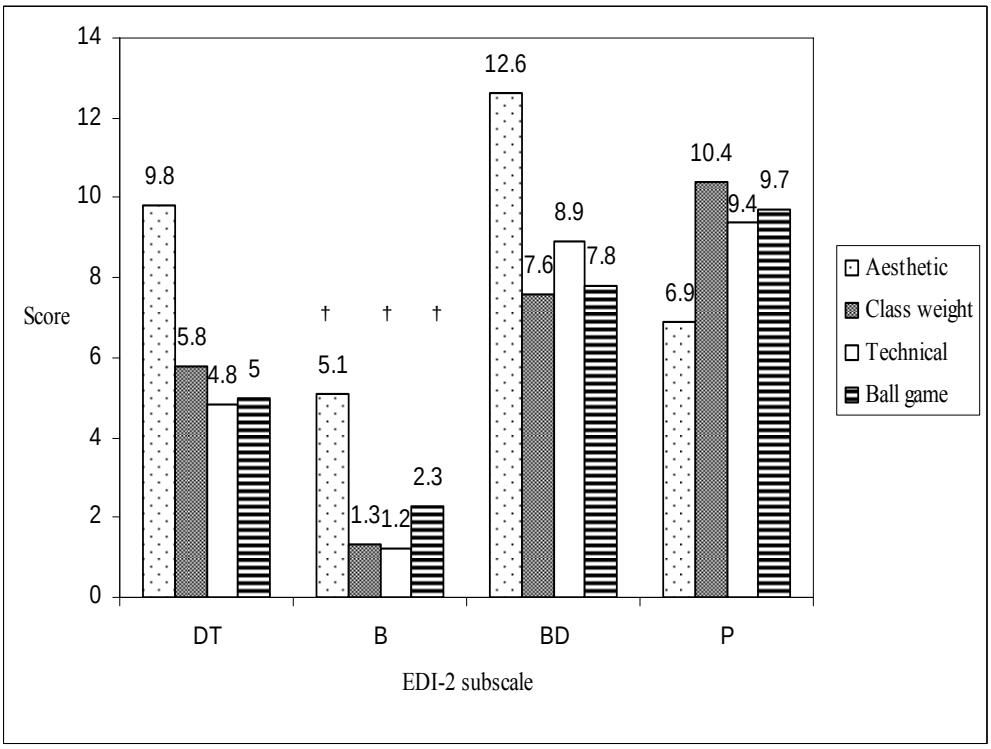

Figure 2. Mean score for EDI-2 subscales, according to sport category [†Significant difference for EDI-B between aesthetic with class weight and technical category, Kruskal Wallis test followed by Mann Whitney test].

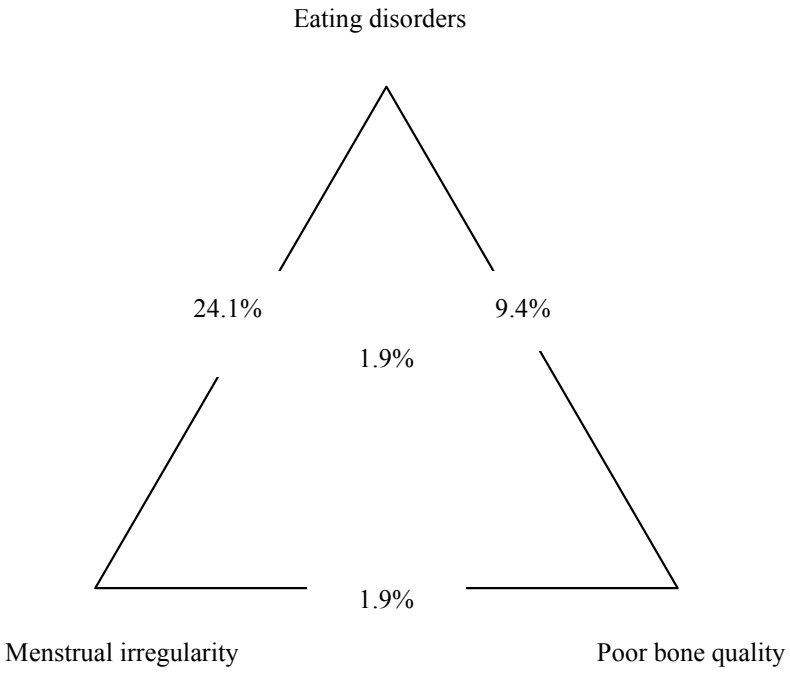

Figure 3. Prevalence of the components and the combination of the triad components

eating disorders and menstrual irregularities (24.1%), followed by the combination of eating disorders and low bone quality (9.4%). Comparison of the leanness sports and non-leanness sports groups, table 2 suggests that subjects who were at risk of developing eating disorders appeared to be more prone to develop menstrual irregularities than low bone quality. In addition, the likelihood of having both low bone quality and menstrual irregularities was lower than the likelihood of having low bone quality and an eating disorder.

DISCUSSION

Subjects who were at risk of suffering from the female athlete triad were more likely to be from the leanness sports, particularly gymnastics. Other studies have also reported similar trends in which athletes of leanness sports were at a higher risk,[14,15,28] while in Norway[16] the

prevalence reported was higher (4%) as compared to the 1.9% reported in the present study. Although the overall prevalence of the female athlete triad reported in this study was low, the conditions related to the triad were interrelated, and thus, subjects who were at risk in any of the three conditions should be screened for the other two components.

In this study, the percentage of subjects who were at risk for both menstrual irregularity and eating disorders was high (24.1%). Due to the cross-sectional study design, it is difficult to conclude if eating disorders were a contributing factor to irregular menstruation or vice versa. Similarly one can only imply that the number of subjects at risk of eating disorders and irregular menstruation was higher than those at risk of eating disorders with low bone quality or menstrual irregularity with low bone quality.

It had been suggested that high impact and weight bearing activities have a positive osteogenic effect on the bone,[29] which may diminish some negative effects due to menstrual irregularity and eating disorders. In our study, none of the subjects had a Z-score below 2.0SD, which denotes poor bone quality. However, it was found that the prevalence of subjects at risk of poor bone quality for chronological age was higher in the leanness sports. In this study, the non-leanness sports reported a higher fracture rate (35.1% compared to 26.7% in the leanness sports, $p<0.05$), and these athletes had a higher SOS ($p<0.05$) and a significantly higher calcium intake (91.5 ± 43.5% RNI) than those in the leanness sports (66.6 ± 31.8% RNI) ($p<0.05$). Further analyses revealed that even though the leanness sports showed a lower incidence of fractures, 28.6% of the subjects suffered a fracture at two or three sites, compared to only 7.7% of the subjects from the non-leanness sports. It should be noted however that a fracture is not solely due to calcium intake and bone quality but also depends on the type of activities performed by the athlete.

The higher prevalence of menstrual irregularities in the leanness sports may be due to a variety of factors besides the components of the triad. Other potential influences may include intensive training, which impinges on the endocrine factors that regulate the human menstrual cycle, and a lower percentage of body fat. In order to explore the effects of training on the reproductive system, subjects were asked if intensive training (during the pre-competition phase) had any effect on their menstrual cycle. Approximately 42% of the subjects indicated that training had an effect on their menstruation. Among those affected, 71.4% were subjects from aesthetic sports, which was consistent with the higher menstrual irregularities reported among athletes from the leanness sports. However, there is no significant difference ($p>0.05$) between subjects of the leanness and non-leanness sports who had indicated that training had had an effect on their menstrual cycle. The changes reported included heavy bleeding (21.6%), a longer duration between cycles (10.8%) and more days of menstruation (18.9%).

Besides intensive training, factors such as BMI and percent body fat can lead to irregular menstruation.[30] Therefore, it is possible that the higher prevalence of menstrual irregularities among athletes in the leanness sports could be due to a lower body fat percentage. Based on a theory by Frish,[31] 22% body fat is needed to start and to maintain or sustain menstruation. Based on this theory, only subjects in the category of oligomenorrhea, eumenorrhea and those with more than 13 menstrual cycles per year had more than 22% body fat. However, this theory has been challenged where other studies have reported a body fat percentage as low as 4% has also been associated with a normal menstruation.[32,33]

In contrast to other studies,[5,28] this study did not find any significant differences in the prevalence of eating disorders between the leanness sports and the non-leanness sports, which is most likely due to the unique subject categories. In this study, subjects with an elevated score for any one subscale was considered as being at risk for developing an eating disorder, while previous studies used different point limitations for EDI-BD and EDI-DT.[16] Another study used a cumulative score for EDI-BD, EDI-DT and EDI-B instead of looking at the scores for each subscales individually, and EDI-P was not included.[34] Eating disorders, however, were found to be more prevalent among those athletes with higher aims and expectations.[35] Thus, EDI-P was included in this study. Moreover, by summarising the scores for all subscales, any true effect may be masked since not all at risk subjects scored high in all subscales. This study, however, focuses more on identifying individuals who are at risk of developing eating disorders, and thus any subject with an elevated score for any subscale was considered at risk. Diagnosis of athletes who are at risk would require follow-up sessions with clinical psychologists or psychiatrists trained in eating disorder management.

The leanness sports showed a higher prevalence of subjects who have elevated scores in two or three subscales, given that the prevalence of being at risk for an eating disorder was equal between both sport groups. Among them, 63% were athletes involved in the higher level of international sports competition. Thus, it is possible that the likelihood of developing an eating disorder increases with the level of competition. Therefore, it is recommended that more attention may be placed on women participating in higher levels of competition, besides just those participating in the leanness sports.

Based on the 11-scale body dissatisfaction questionnaire, the subjects from the leanness sports, especially those in the aesthetic sports, showed a higher mean for dissatisfaction ($p>0.05$). Besides the characteristic of the sports which places a higher emphasis on a lean body, the highest mean dissatisfaction among subjects in aesthetic sports may be due to physical changes related to puberty.[36] Changes in body shape due to puberty affect not only physical appearance but also an athlete's performance.[37] Hence, by looking at both the EDI subscale scores and subjects' mean dissatisfaction, our results suggest that the subjects in the leanness sports were at higher risk of developing eating disorders.

This study is the first of its kind reported in Malaysia, aimed to screen elite athletes who were at risk of the female athlete triad. It is suggested that subsequent studies be focused on athletes participating in the leanness sports as well as those involved in a higher level of competition to examine the negative consequences related to the female athlete triad that may affect the performance of ath-

letes. Priority should be placed on the nutritional status of the athletes because eating disorders is the key contributing factor to the triad, and good nutrition is of utmost importance to an athlete's performance.[38]

CONCLUSION

The overall prevalence of a combination of two or three conditions of the female athlete triad is relatively low among Malaysian female elite athletes. However, the prevalence of eating disorders was high (89.2%). Since each condition of the triad is linked to the others, early identification of athletes who are at risk for any of the triad components is important. Prevention of osteoporosis as well as stress fractures and other considerable medical consequences is also critical, especially among women participating in sports that emphasise a lean physique and in weight-restricting sports such as gymnastics and competitive martial arts. Besides that, other factors such as calcium intake, family history of menstrual irregularities, fracture history and level of competition are possible factors that affect the prevalence of each component of the triad. These factors need to be taken into account when planning any intervention program. A further follow-up study should be undertaken in order to diagnose athletes who are at risk for the female athlete triad. It is the task of a sports nutritionist to ensure that athletes get enough nutrients to enable them to perform optimally. Furthermore, there is a strong need to protect athletes from any potential harm that would threaten their athletic career and their future life, especially with regards to the female athlete triad among women.

ACKNOWLEDGMENTS

This project was funded by Universiti Kebangsaan Malaysia. We wish to thank all the subjects and their coaches for their full cooperation and support during this study. We are also grateful to the Nutrition Unit of the National Sports Institute of Malaysia for their cooperation and assistance, especially Ms Mohalijah Mohd Ali. We would also like to thank the National Sports Council for their approval to conduct the study.

AUTHOR DISCLOSURES

All authors declared that there is no conflict of interest.

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Original Article

The female athlete triad among elite Malaysian athletes: prevalence and associated factors

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優秀的馬來西亞運動員的女性運動員三症候群：盛行率及其相關因子

女性經常參加競爭性運動，有較高的風險而致罹患飲食失調、月經不規律及骨質疏鬆，這普遍被稱為"女性運動員三症候群"。此研究目的為評估那些參與不同運動的運動員，其女性運動員三症候群的盛行率及相關因子。總共有 67 名年齡介于 13-30 歲的優秀女性運動員參與這個研究，並且被分為'精瘦組'與'非精瘦組'。飲食失調是使用一種體型形象等級評比及飲食障礙調查(EDI)包括：體型不滿意(BD)、對體瘦的渴求(DT)、暴食(B)及完美主義(P)評估。月經不規律是由自填式月經史問卷評估。骨質是使用量化超音波儀器測量 1/3 的遠端橈骨。女性運動員三症候群盛行率虽不高(1.9%)，但其單一症候盛行率却蛮高，尤其是在精瘦組。研究對象精瘦組有月經不規律、骨質差及飲食失調风险的盛行率分別為 47.6%、13.3%及 89.2%；在非精瘦組則分別 14.3%、8.3%及 89.2%。因為三症候群的各組症候是有相互關聯的，因此確認運動員有任何一種症候的风险，尤其是那些強調參與瘦體型運動的運動员，對進一步的診斷有重要幫助。

關鍵字：女性運動家三症候群、飲食失調、月經不規律、骨質、骨質疏鬆