
Nutritional Knowledge and Calorie Intake Among University Athlete with Risk of Female Athlete Triad

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ABSTRACT

Female Athlete Triad (FAT) has always been a concern to competitive female athletes as it affects female athletes in terms of their sport performance and importantly, their overall health. In Malaysia, there is a limited of studies regarding FAT. This cross-sectional study was aim to assess the risk of developing FAT in female university athletes and its relationship with their sport nutritional knowledge and calorie intake. In total of 44 female athletes from public universities in Malaysia completed self-reported questionnaires and diet recall. Almost half of the female athletes (40.9%) were at risk of developing FAT. There was no difference in sport nutritional knowledge between female athletes who are at risk and not at risk of FAT. However, it was observed that those who were at risk consumed significantly lower daily calorie intake than those who were not at risk ($p < 0.05$). Participants who were at risk also sustained significantly higher time-loss injury during the last year ($p < 0.001$). In summary, the results showed that most of the female university athlete were at risk of developing FAT and appropriate intervention is needed in order to reduce the risk of FAT as it will lead to sports injury and impact their sports performance.

Keywords: Female Athlete Triad (FAT); nutritional knowledge; calorie intake

INTRODUCTION

FAT is a combination of low energy availability with or without eating disorder, low bone density and menstrual dysfunction that occur among female athletes that involved in sport that concern about leanness of the body (Nattiv et al., 2007). Previous studies reported FAT prevalence of 1.5% and 6.7% in leanness sports group among collegiate and elite athletes (Ranson, Patterson & Colvin, 2018). Meanwhile, the prevalence of FAT in Malaysia was 5.3% in leanness sports group (Quah et al., 2009). Although the prevalence of FAT in Malaysia is considered low, however, the prevalence of two components of FAT is high with the combination of menstrual irregularities and eating disorder being the highest (24.1%), eating disorder and poor bone quality (9.4%) and poor bone quality and menstrual irregularities (1.9%).

In addition, previous studies also showed that the prevalence of low energy availability alone were between 7.9% to 100% in female athletes from various sports. For example, almost half of the participants were at risk of low energy availability in studies among Australian football female players and recreational female athletes (Condo et al., 2019 and Slater et al., 2016). Similar prevalence was reported among swimmers and a result their swimming performance is decreased significantly (Shaal et al., 2016 and Vanheest et al., 2014). Besides, the other two FAT components were highly related to

improper nutrient intake (Ciadella et al., 2014) and also inter-related to each other (Nose-Ogura et al., 2018). Therefore, if the female athletes had one of the components, it is highly possible for them to get the other two components.

The challenge to recognize FAT among female athletes always difficult due to the normalization of irregular and/or stopping of menstrual cycle among female athletes and secretive nature of eating disorder. FAT can result in decreasing performance and further injury and serious illness to female athletes. Thus, it is important for FAT to be detected as early as possible in order to reduce the consequences that may impose on female athletes in term of sport performance and overall health. This study assessed the nutritional knowledge and calorie intake among female university athletes in Malaysia. This study also highlights the relationship of injury in female university athletes with their risk of developing FAT.

METHODOLOGY

Subjects and Study Design

This study design is cross-sectional, involving female university athletes ($n = 44$) from various sports such as running, swimming, taekwondo, karate-do and silat. Athletes were recruited through social media and email. The five sports were chosen because female athletes participating in endurance, aesthetic and weight class sport have increased risk of developing FAT. The female athletes must be currently or will be representing at least state level in their sports and trained ≥ 5 times/week as frequent training is related to energy availability. Competitive female athletes are at risk of developing FAT compared to recreational female athletes.

Data Collection

Low Energy Availability in Females Questionnaire (LEAF-Q) (Melin et al., 2014) was used to assess FAT risk. The questionnaire consists of 25 items and consist of three parts; (i) injuries, (ii) gastrointestinal function, and (iii) menstrual function and use of contraceptives. Each answer to every question has a score that will be summed up. The answers have score of 0-4. The female athletes are considered to be at risk of FAT if the total score is ≥ 8 .

Abrided Nutritional Sport Knowledge Questionnaire (ANSKQ) (Trackman et al., 2018) was used to assess nutritional knowledge of participants. ANSKQ has 37-item questionnaire which consists of 17 questions of general nutrition knowledge and 20 questions of sport nutrition knowledge.

Participants' calorie intake was assessed using 24-hour dietary recall. Participants required to recall their food intake in details such as meal time, food sources, type of food or drink, ingredients in food or drink, and household measurement used.

Statistical Analysis

All statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS 26.0). Results were reported as mean \pm standard deviation (SD) for normally distributed variables. Chi-square test was used to compare time-loss injury status between female athletes who are at risk of developing FAT and those who are not. Independent *t*-test was used to compare sport nutritional knowledge and calorie intake between female athletes at risk of FAT and not at risk. Statistical significance was set to a level of $p \leq 0.05$.

RESULT

Table 1 showed the female athletes' demographic and anthropometric data. Five sports were included in the study, with 27.3% ($n=12$) of taekwondo and track female athletes, 18.2% ($n=8$) karate-do female athletes and 13.6% ($n=6$) pencak silat and swimming female athletes.

Table 1. Demographic and anthropometric data of the female athletes

	Mean ± SD
Age (years)	22.6 ± 2.1
Weight (kg)	55.6 ± 7.0
Height (cm)	161.9 ± 4.9
BMI (kg/m ²)	21.2 ± 2.7
Training (hr/wk)	8.0 ± 4.3
Type of sports	
Running	12 (27.3)
Taekwondo	12 (27.3)
Karate-do	8 (18.2)
Swimming	6 (13.6)
Pencak Silat	6 (13.6)

* n (%)

Table 2 shows the participants' LEAF score according to their sports. Almost half of the female athletes were at risk (40.9%). Pencak silat, taekwondo and swimming have the highest number of female athletes at risk of FAT (50.0%) compared to other sports. Meanwhile, karate-do has the lowest number of female athletes at risk of developing FAT (25.0%). The questionnaire included a question regarding the athletes' previous injury during the last year that prevented them from their sport participation, which is shown in Table 3. Among 18 female athletes who were at risk of FAT, 83.4% of them answered 'Yes' to the question. Meanwhile, only 26.9% from 26 female athletes who were not at risk of FAT chose 'Yes' as the answer. There was a significant difference in time-loss injury between the two groups with $p < 0.001$.

Table 2. LEAF-Q score of the female athletes according to the sports

	Mean ± SD (%)	
	At Risk ≥8	Not At Risk <8
Silat (n=6)	10.3 ± 0.6 (50.0)	3.7 ± 2.3 (50.0)
Taekwondo (n=12)	10.2 ± 2.6 (50.0)	5.3 ± 0.5 (50.0)
Karate-d0 (n=8)	11.5 ± 3.5 (25.0)	4.5 ± 2.8 (75.0)
Running (n=12)	11.5 ± 2.6 (33.3)	4.8 ± 1.2 (66.7)
Swimming (n=6)	8.5 ± 0.8 (50.0)	5.3 ± 0.6 (50.0)
All (N=44)	10.3 ± 2.3 (40.9)	4.8 ± 1.7 (59.1)

Table 3. Percentage of female athletes with time-loss injury during the last year according to risk of developing FAT

Time-loss Injury	At Risk (n=18)	Not At Risk (n=26)
Yes	83.4	26.9***
No	16.7	73.1***

***Significantly difference between groups at $p < 0.001$

The score and accuracy of nutritional knowledge was presented in Table 4. The mean score was 18.5 with mean percentage accuracy of 51.4%. Taekwondo female athletes have lower sport nutritional knowledge (46.8%) while swimming athletes have the highest knowledge (67.6%). However, there was no significant difference in sport nutritional knowledge between those at risk and not at risk. Participants' calorie and macronutrient intake that was assessed using 24-hour diet recall were presented in Table 5. The calorie and macronutrient intake of the participants were compared with recommendation nutrient intake (RNI) suggested for Malaysian population (MOH, 2017). There was no difference in percentage contribution of macronutrient towards total daily energy intake between participants who were at risk and those who were not at risk. Carbohydrate and protein intake of the

two groups of female athletes falls in recommended range. Both groups slightly exceed the recommended range for fat intake.

Meanwhile, all female athletes have insufficient daily calorie intake (1367kcal/d) compared to daily calorie intake for female active population in Malaysia (2080kcal/d) as presented in Table 6. Participants at risk of developing FAT have an average of 1262kcal/d intake, which is lower compared to those who were not at risk (1440kcal/d). However, no significant difference in daily calorie intake between the two groups ($p=0.10$). Carbohydrate and protein intake of the female athletes regardless of their risk of developing FAT are lower than recommended intake which are 6 to 10g/kcal/d and 1.8 to 2.7g/kcal/d, respectively. There is a small difference in fat intake between the two groups with female athletes at risk of FAT have lower intake (45.4g/d) compared to those who were not at risk (51.5g/d).

Table 4. ANSK-Q score of the female athletes according to sport

	Mean \pm SD (%)	
	Score	% Accuracy
Silat (n=6)	18.2 \pm 3.6	50.5 \pm 10.0
Taekwondo (n=12)	16.8 \pm 2.5	46.8 \pm 7.0
Karate-d0 (n=8)	19.3 \pm 4.3	53.5 \pm 12.0
Running (n=12)	16.9 \pm 4.3	47.0 \pm 8.9
Swimming (n=6)	24.3 \pm 7.9	67.6 \pm 21.9
All (N=44)	18.5 \pm 4.7	51.4 \pm 13.1

Table 5. Respondents' percentage contribution of macronutrient towards total daily energy intake (TEI) compared with current recommendation

Nutrient (% of TEI)		At Risk	Not At Risk	All
Carbohydrate	Actual	50.0 \pm 11.3	51.0 \pm 8.0	50.6 \pm 9.4
	Recommended	50-65		
Protein	Actual	18.9 \pm 6.7	16.9 \pm 4.6	17.7 \pm 5.6
	Recommended	10-20		
Fat	Actual	31.1 \pm 8.1	32.1 \pm 6.4	31.7 \pm 7.1
	Recommended	25-30		

Table 6. Macronutrient intake of respondents (mean \pm SD) and current recommendations

Nutrient (% of TEI)		At Risk	Not At Risk	All
Carbohydrate	Actual	1262 \pm 364.7	1440 \pm 335.7	1367 \pm 354.9
	Recommended	2080		
Protein	Actual	3.0 1.3	3.3 1.0	3.2 1.1
	Recommended	6.0-10.0		
Fat	Actual	1.1 .5	1.1 .4	1.1 .5
	Recommended	1.8-2.7		

DISCUSSION

Current study showed that almost half (40.9%) of female university athlete were at risk of developing FAT. This finding is higher than previous study among female Australian rules football players which was only 30% female athletes at risk of FAT (Condo et al., 2019). This is might be due to the current study only focuses on leanness sports that is known to have higher risk of FAT than the other sports (Gibbs et al., 2013; Quah et al., 2009). Leanness sports are any sports that emphasize low body weight, body image or aesthetic & sports with weight category.

The current study reported almost similar score of sport nutritional knowledge (51.4%) with previous study (54.4%) (Condo et al., 2019). The current study found that female athletes have average sport nutritional knowledge. Even though in this present study showed no significant difference of nutritional knowledge between those at risk of FAT and those not, still it is recommended to encourage them to increase their sport nutritional knowledge as higher sport nutritional knowledge may improve sport performance (Nikolaidis et al., 2014).

Meanwhile, all female athletes regardless of whether they were at risk of FAT or not, were found to consume insufficient daily calorie intake with mean daily calorie intake of 1367 kcal per day. The Ministry of Health Malaysia through Recommended Nutrient Intake for Malaysia (2017) suggested that an active female required to consume approximately 2080 kcal per day. In addition, female athletes who were at risk of FAT have lower daily calorie intake compared to those who were not at risk, however it is not significantly difference. It might be due to small sample size. Nevertheless, insufficient calorie intake may increase the risk of developing FAT as insufficient calorie intake closely related to low energy availability (Wasserfuth et al., 2020).

There is a significant difference in time-loss injury suffered by the female athletes who were at risk and not at risk of FAT. This is due to low energy availability induced increased risks of injury (Mountjoy et al., 2018) and FAT is associated with musculoskeletal injury (Rauh, Barrack & Nichols, 2014). High intensity training is found to be correlated with musculoskeletal injury (Sawai et al., 2018). Musculoskeletal injuries were also associated with menstrual dysfunction and low BMD (Rauh, Barrack & Nichols, 2014). However, current study did not analyze the relationship between female athletes' menstrual status and bone mass density with time-loss injury.

CONCLUSION

This is the first study in author's knowledge that exploring on female university athletes' sports nutritional knowledge and calorie intake in regards of FAT in Malaysia. FAT is not well-researched in Malaysia, therefore, the actual prevalence and risk of female athletes at risk of the condition are not known. Current study found a high prevalence of female university athletes in Malaysia who were at risk of developing FAT. Calorie intake was not found significantly related to the risk of developing FAT. However, more research on this area might found more information on this regard. The current study found that female university athletes competing in leanness sports are exposed to risk of developing FAT and it is associated with time-loss injury. Female athletes have average sports nutritional knowledge and insufficient calorie intake despite the risk of developing FAT. Therefore, it is recommended to give more awareness towards FAT to female university athletes in order to reduce the risks of suffering musculoskeletal injuries. Education on sports nutritional knowledge and importance of getting enough energy intake to facilitate energy expenditure may be beneficial to female athletes' sport performance with minimal injury sustained. As the current study did not assess mass density, it is suggested for future studies to include this parameter as it will give more thorough information about status of FAT incidence among female university athletes in Malaysia.

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