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THE PREVALENCE OF THE FEMALE ATHLETE TRIAD COMPONENTS AND RISK FACTORS IN ATHLETES AND DANCERS

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Abstract

Purpose: The female athlete triad is a condition of low energy availability, menstrual dysfunction, and low bone mineral density familiar to dancers and weight-class athletes. This study investigated the prevalence of the female athlete triad components and risk factors. The elements and risk factors were discussed in light of the sources of nutritional information and factors that affected the daily dietary intake of female athletes and dancers.

Materials and Methods: Fifty-four (54) female athletes and dancers (18.96 ± 3.49 years old) answered a survey questionnaire about years of formal dance or sports training, sources of nutritional information, factors that affected their daily food choices, menstrual history, and injury history. Energy availability was estimated using the Low Energy Availability in Females Questionnaire (LEAF-Q; MELIN et al., 2014).

Results and Conclusion: Twenty-one participants (38.90 %) had a risk of low energy availability, while 28 participants (51.90 %) had menstrual dysfunction. Twenty participants (37%) had a history of musculoskeletal injuries. The mean body mass index was 20.46 ± 4.08, and the mean percent body fat was 18.19 ± 5.73%. The primary sources of nutritional information were coaches, peers, and magazines. Personal preference, convenience, and parents were the main factors that affected daily food choices. The prevalence of the Female Athlete Triad components and risk factors was relatively high. The presence of the components and risk - factors should alarm coaches, trainers, and parents for further tests and proper intervention measures.

Keywords: *female athlete, menstrual dysfunction, low energy availability, female athlete triad*

THEORETICAL BACKGROUND

The Female Athlete Triad is a condition of chronic low energy availability (LEA) leading to menstrual dysfunction and low bone mineral density (BMD) (NATTIV et al., 2007; MOUNTJOY et al., 2014). This condition has detrimental effects on sports and dance performance and, more importantly, lifelong health. It is a condition where physically active women of leanness and aesthetic sports are found to be most vulnerable (BEALS-HILL, 2006; BARRACK et al., 2014). The rigors of striving to be lean may lead to habits of restricted food intake and, eventually, insufficient nourishment (BEALS-HILL, 2006).

The mechanism of the female athlete triad begins with the reduction in food intake, which may be insufficient to support the nutritional demands of training and normal

physiological processes (MOUNTJOY et al., 2014). Low energy availability is the inadequate amount of energy left to support normal physiological functions after the total energy used during the day is subtracted from the amount of daily energy intake (AMORUSO et al., 2024). As a state of LEA ensues, it affects the neuroendocrinesystem's hypothalamic–pituitary–ovarian axis (CORUJEIRA et al., 2012). This has been shown to suppress the follicular and luteal phases of the menstrual cycle and subsequently decrease estrogen secretion (ZANKER, 2006). This is manifested through menstrual disturbances, especially amenorrhea. However, less severe disorders of ovarian function caused by low estrogen levels may not show through menstrual disturbances, making early detection vital (DE SOUZA et al., 2014; DE SOUZA et al., 2008). Prolonged decreases in estrogen concentration cause faster bone resorption and lower bone mineral density, as estrogen has a protective effect on bone structure (LOUCKS et al., 2011). This increases the susceptibility to stress fractures and prevalence (De SOUZA et al., 2008). Thus, severe undernutrition can lead to amenorrhea and osteoporosis (NATTIV et al., 2007; MOUNTJOY et al., 2014). Early detection and intervention are necessary to protect our athletes and dancers from the effects of the female athlete triad.

There are limited studies on the East Asian population about the Female Athlete Triad. A survey on Malaysian athletes by Quah et al. (2009) found that menstrual irregularity was 47.6 % in a group of female athletes. Eighty-nine percent were at risk for eating disorders, and 13.3% had poor bone quality. Meng (2020), in a study of Chinese female athletes from aesthetic sports, found 41.6% were at risk for low energy availability, and 53.8% had amenorrhea. Studies on the prevalence rate of the triad components and the factors affecting food choices and nutrition information sources of athletes and dancers are scarce. This study is highly relevant in developing educational and training programs for athletes and dancers.

The International Olympic Committee Consensus Statement on the Female Athlete Triad and the American College of Sports Medicine position stands have warned athletes, coaches, and parents. Female athletes were recommended to undergo annual screening with a female athlete triad-specific self-report questionnaire, accompanied by a more comprehensive evaluation if the athlete is at risk with any of the components.

This study examined the prevalence of the female athlete triad components and other risk factors in Filipino athletes and dancers. It looked into the factors considered in daily food choices and nutrition information sources as possible factors affecting the prevalence rate. The presence of the female athlete triad risk - factors such as the high incidence of musculoskeletal injuries, relatively low energy availability, participation in a weight class and aesthetic sport, menstrual disturbances, poor eating habits, low BMI, and low-fat percentage, individually or in combination, should alarm coaches, trainers, dance directors, and parents to conduct medical tests and proper intervention measures.

METHODS AND PROCEDURES

This study employed a quantitative-descriptive research design. It examined the prevalence of the female athlete triad components and related risk factors of ballet dancers and athletes within Metro Manila, Philippines. It used purposive sampling and focused on three ballet companies, the national gymnastics team, the national dance sports association, and female collegiate sports teams (swimming, track and field, judo, taekwondo).

This study began with the acquisition of written approval from the presidents of the ballet companies, the sports directors, and the secretary general of each national team. This research followed ethical guidelines where all participants's informed consent was secured. The researcher ensured that participation was voluntary and that the purpose, procedures, benefits, risks, confidentiality, and anonymity were clear. Moreover, the participants were assured that participation in the study did not affect their status as athletes and dancers of their respective teams and dance companies.

INSTRUMENTS

Two questionnaires were used for data collection. The first questionnaire gathered information on the age at which they started formal dance or sports training, the total number of years of training, the source of nutritional information/ guidance, factors that affect their daily food choices, menstrual histories such as age at menarche, the number of menstrual cycles in the last 12 months and the previous six months, regularity of the menstrual cycle (variations between 3 days, 4 – 10 days or variation more significant than ten days), oral medications or hormonal replacement to regulate menstrual cycle; and questions related to injury history and family history on osteoporosis, if they have been diagnosed with low bone density, scoliosis, type and the number of injuries they have sustained, injuries and time lost in training/ performing, unreported injuries, and reasons for not reporting injuries.

The second questionnaire estimated energy availability. This was the Low Energy Availability in Females Questionnaire (LEAF-Q) (MELIN et al., 2014). The questions relate to injuries and reproductive and gastrointestinal function. These questions pertain to indicators of bodily functions affected by inadequate energy intake. It was designed to find symptoms in female athletes that lead to risk for low energy availability. It is a 25-item questionnaire with a reported 78% acceptability and 90% specificity, with an overall validity of 73% in accurately categorizing energy availability and reproductive and bone conditions (MELIN et al., 2014).

Body Mass Index (BMI) was computed by dividing the person's weight (kilograms) by his height (meters) squared. The height of the participants was measured using a wall-mounted stadiometer. Weight was measured by a digital weighing scale (Tanita, Hd-314).

Percent body fat was approximated with a hand-held bioelectrical impedance analyzer (Omron HBF-306C, Bannockburn, IL).

DATA ANALYSIS

Descriptive statistics with means, frequencies, and percentages were used to identify the prevalence of the specific components and risk factors, describe the physical and training characteristics, and analyze the sources of nutrition information and factors affecting daily food choices. The LEAF-Q data obtained was analyzed using the LEAF-Q Scoring Key (DEPARTMENT OF NUTRITION, EXERCISE, AND SPORT, UNIVERSITY OF COPENHAGEN, 2013, October). When the total score is ≥ 8, the athlete or dancer is considered a risk for LEA and, consequently, the female athlete triad.

RESULTS

PARTICIPANT CHARACTERISTICS

There were 54 participants (Table 1.), with a mean age of 18.96 (±3.49) years old. There were 15 ballet dancers, four dance sports members, eight from contemporary dance, nine artistic gymnasts, eight judo athletes, and ten taekwondo athletes.

The physical and training characteristics are seen in Table 1. The participants had a mean BMI of 20.46 (±4.08) and a mean percent body fat of 18.19 (±5.73). Dancers have been training relatively more prolonged than the athletes, 10.30 (±4.29) years vs 5.25 (±3.53) years. The mean age at menarche was 12.56 (±1.61) years. There were 4 participants with menarche age > 15 years old. All participants' current age, except one, were beyond two years of menarche.

Table 1. Physical and training characteristics of the subjects, Mean (± SD)

Characteristic	Dancers(N=27)	Athletes (N= 27)	All (N=54)
Age, years	21.44 (±2.92)	16.48 (± 1.87)	18.96 (±3.49)
Menarche Age, years	12.52 (±1.76)	12.59 (±1.47)	12.56 (±1.61)
Age started training, years	10.89 (±4.58)	10.92 (±3.43)	10.91 (±4.01)
Years of training, years	10.30 (±4.29)	5.25 (±3.53)	7.9 (±4.6)
Body mass index, Kg/m^2	19.01 (±1.16)	21.90 (±5.31)	20.46 (±4.08)
Percent Body Fat, %	17.60 (±4.77)	18.79 (±6.58)	18.19 ±5.73)

PREVALENCE RATE OF THE TRIAD RISK FACTORS AND COMPONENTS

From the results of the LEAF-Q, it was estimated that there were 21 participants (38.90

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%) who had symptoms of the risk for low energy availability (LEAF-Q scores were > 8). There were 28 participants (51.90 %) with menstrual dysfunction. Delayed menarche or primary amenorrhea is defined as menarche occurring after the age of 15 years (MOUNTJOY et al., 2014). Missing menstrual periods for three or more consecutive months is secondary amenorrhea, while oligomenorrhea is a menstrual cycle lasting more than 35 days (MOUNTJOY et al., 2014). In the present study, 4 participants (7.4 %) had primary amenorrhea, 11 participants (20.4%) had secondary amenorrhea, and 13 participants (24.1%) had oligomenorrhea. Furthermore, there were 20 participants (37%) who had a history of injuries. The most common parts of injury included the foot and leg (shin), back, and knees. Seventy-five percent (75%) of those who had injuries reported that the injuries caused them to stop training. Moreover, two (3.7%). Participants had a critical BMI of < 17.5 Kg/m^2. There were nine dancers and 13 athletes with body fat levels less than 17.0 percent; this is 40.70 % of the total participants (Table 2).

Table 2. Prevalence of the components and risk factors of the Female Athlete Triad expressed in the number of athletes or dancers (and percentage %).

	Dancers (N=27)	Athletes (N= 27)	All (N=54)
Low EA/ At risk for the Triad (LEAF-Q)	12 (44.4%)	9 (33.3%)	21 (38.9%)
Menstrual Dysfunction	11 (40.74%)	17 (62.97%)	28 (51.90%)
Primary Amenorrhea	3 (11.1%)	1 (3.7%)	4 (7.40%)
Secondary Amenorrhea	3 (11.1%)	8 (29.6%)	11 (20.40%)
Oligomenorrhea	5 (18.5%)	8 (29.6%)	13 (24.10%)
Musculoskeletal Injuries	12 (44.44%)	8 (29.6%)	20 (37%)
Critical Body Mass Index	2 (7.41%)	0	2 (3.7%)
Critical Percent Body Fat	9 (33.33%)	13 (48.15%)	22 (40.70%)

PRIMARY SOURCES OF NUTRITIONAL INFORMATION OR ADVICE AND THE FACTORS THAT MAY AFFECT THE TYPE AND AMOUNT OF FOOD THEY EAT

The top three sources of nutritional advice and information were coaches, peers or teammates, and magazines. The top three factors that affected their daily food choices were personal preference and craving, convenience of food items (easy access or easily prepared), and parents. Several athletes and dancers lived in the university dormitories, national team dorms, or boarding houses. Participants needed a complete meal for breakfast and would sometimes skip breakfast or grab whatever was available on the way to class. They enjoyed occasions when a teammate or a company member's mother would bring food for the team. Unfortunately, food service for recovery meals specific to these young athletes and dancers was unavailable.

DISCUSSION

The participants in the current study generally have a healthy mean BMI of 20.46 (±4.08), which is far from the borderline of 17.5 kg/m^2. A BMI less than 17.5 kg/m^2 indicates being underweight. It has been studied to be connected to bone stress injury as it demonstrates insufficient nutrition, which could increase susceptibility to injury (BARRACK et al., 2014; TWITCHETT et al., 2008; OSMAN et al., 2017). Coherently, in a study by Quah et al. (2009), 67 Malaysian athletes (13 – 30 years old) had similar BMI levels, 16.9 (± 1.6) for aesthetic sports or dance and 20.9 (± 2.0) for weight class sports. For female athletes aged 13 - 35, low BMI was a risk factor for low BMD (GIBBS et al., 2013). Moreover, in the current study, two dancers had a critical BMI of < 17.5 Kg/m^2. According to the literature, as many as 44.3% of dancers have been reported to have a critical BMI of < 17.5 Kg/m^2. This BMI level is used as a diagnostic criterion for anorexia nervosa (HERBRICH et al., 2011). In a previous study, dancers with a BMI <19 were found to spend more days off from training due to injury compared to dancers with a BMI >19 (BENSON, 1989 in TWITCHETT et al., 2008).

A critical amount of body fat of 17.0 % is needed to prevent amenorrhea, and at least 22% of body fat is required to avoid subsequent menstrual dysfunction (FRISCH, 1987). The study participants had a mean percentage body fat of 18.19 (±5.73). This was classified as within the healthy range for the general female population. The American College of Sports Medicine recommends a percentage of body fat between 9 to 12 percent in females for essential body function and 15 to 25 percent for general health (AMERICAN COLLEGE OF SPORTS MEDICINE, 2014). Stokic et al. (2005) found a moderate correlation between body fat percentage and menstrual cycle duration in 30 dancers (r= -.415). Physiologically, it was suggested that the secretion of leptin, a hormone secreted by adipose tissue, has a permissive effect on the normal functioning of the hypothalamus-pituitary- gonadal axis (STOKIC et al., 2005; WEIMANN, 2002). This is responsible for normal menstrual physiology. Dietary restriction leading to low energy stores may decrease leptin levels and affect regular menstrual cycles.

There were 21 participants (38.90 %) with symptoms of low energy availability (LEAF-Q scores were > 8) or found to be at risk for the female athlete triad. Similarly, in a study by Hoch (2009), 36% of the athletes had low energy availability. At the same time, 79.5 % of female athletes in Jesus et al. (2021) were found to be at risk for LEA using the LEAF-Q. There is a wide range of prevalence of low energy availability, from 2.2 % to 79.5% among female athletes beyond 18 years of age (ALMOUSA-BANDIN VAN LOON, 2024). This wide variation may be due to the different methods used to estimate energy availability.

This study showed that 51.90% had menstrual dysfunction. Menstrual dysfunction prevalence of 7.4 % primary amenorrhea, 20.4% secondary amenorrhea, and 24.1% oligomenorrhea was found. This is comparable to Quah et al. (2009), where the

prevalence of menstrual dysfunction was 47.6%, primary amenorrhea at 9.5 %, secondary amenorrhea at 14.3%; and oligomenorrhea at 23.8%. The range of reproductive abnormalities was found to be from 6 to 79% of active women, and the prevalence varies with the kind of sport and degree of competition (MARQUEZ-MOLINERO, 2013).

This study's 37 percent injury rate was relatively high compared to similar studies. In Barrack et al. (2014), only 11% of participants sustained an injury to bone. Inadequate calorie intake for a prolonged period can disrupt normal hormone levels such as lower leptin and estradiol (ZANKER, 2006; BARRACK et al., 2014). The changes in hormone levels can intensify bone resorption, eventually decreasing bone development and repair (BARRACK et al., 2014). Low energy availability may also affect muscle, tendon, and ligament integrity, paving the way for a higher injury risk (BARRACK et al., 2014). In the current study, some of the injuries mentioned, including mild sprains, were undiagnosed. The athletes and dancers tended to brush off or take pain and discomfort lightly as long as they could perform. The menstrual dysfunction rate (51.9 %) was considerably higher than the injury rate (37 %). Half of the menstrual dysfunction reported were oligomenorrhea (24.10%). The duration of reproductive dysfunction may not have been long enough to drastically reduce bone mineral density and manifest as musculoskeletal injuries (DAVIES et al.,1990).

Coaches were the primary source of nutritional advice and information for the athletes and dancers in this study. Argôlo et al. (2018) found parents as the primary source of nutritional information for adolescents, while the Internet was the primary source for adults. In the current study, parents came in 6th, and the Internet came in ^{seventh}. Insufficient dietary intake in athletes was evidenced in various studies and was deduced to be connected to poor nutritional knowledge and substandard nutritional information sources (SPRONK, 2015). Though coaches may be experts in the technical knowledge of the sport and coaching, their expertise in proper nutrition for young women athletes may be inconsistent across sports. Peers, teammates, and print media were also popular sources of nutritional information. This may reflect young athletes' time with their peers since most live away from home and depend on each other.

Food preparation skills, personal preferences, and cultural backgrounds may dictate athlete's meal plans and diets (HEANEY et al., 2008). Since most participants live independently of their parents, their food choices depended mainly on their preferences and convenience. Even if the food in dormitories or at home were available, these may have provided little nourishment specific to their sport (HEANEY et al., 2008). Further, parents play a significant role in developing the eating habits of adolescents (DESBROW et al., 2014). With the busy schedules of adult athletes and dancers in this study, the convenience of the food source was a common factor in deciding daily meals. The lack of time to prepare meals hinders practicing healthy dietary habits (KEARNEY-MCELHONE, 1999).

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In conclusion, the risk for low energy availability was estimated to be 38.9 %, menstrual dysfunction was 52%, and injury rate was 37%. The estimated prevalence of the female athlete triad components and risk factors with athletes and dancers in this study was similar to those from Malaysia and other countries. The prevalence was found to be quite alarming, especially the 52% rate of menstrual dysfunction. Athletes relied extensively on their coaches' advice for nutritional information. The athletes and dancers may have needed the proper nutrition specific to the demands of their sport when it was left to themselves to prepare them.

The presence of the female athlete triad risk - factors such as the high incidence of musculoskeletal injuries, risk for low energy availability, participation in a weight class and aesthetic sport, menstrual disturbances, poor eating habits, low BMI, and low-fat percentage, individually or in combination, should alarm coaches, trainers, dance directors, and parents for further tests and proper intervention measures.

Most of the information in this study was self-reported, and its validity depended on the honesty of the participants. The participants were tested during the busiest time of the year, during high training and competition levels, which may have restricted nutritional practices. For future studies, a food and activity diary or 24-hour recall method may be used to complement the results of the LEAF-Q for a more accurate estimate of the risk for low energy availability.

To the researcher's knowledge, the female athlete triad has just been investigated in Filipino female athletes. It should be noted that the results of the study sample of Filipino female athletes may limit the generalizability of the results and conclusions to other contexts.

Finally, educators, coaches, parents, and trainers should consider the complexity of the Female Athlete Triad condition. With the physiological evidence, one should consider socio-cultural and psychological aspects of the whole being of the athlete and dancer. These athletes and dancers should be equipped with the knowledge and emotional and psychological support to make well-informed choices and decisions that will significantly affect their quality of life now and in the future.

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