Analysis of Risks of Low Energy Availability and Eating Disorders in Female Elite Dancers at X Dance School in Jakarta, Indonesia

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ABSTRACT

Due to their aesthetic demand and high training load, ballet dancers are often at risk of low energy availability (LEA), with or without eating disorders (ED). A prolonged state of LEA may alter physiological function and lead to other major health concerns. This study aims to analyze the risk of LEA and eating disorders in female elite dancers at X dance school in Jakarta. This descriptive cross-sectional design study was followed by 11 dancers. Risk of LEA was assessed using the low energy availability in females questionnaire (LEAF-Q), eating behaviors using the eating attitude test (EAT-26) questionnaire, and body composition using the bioelectrical impedance analysis (BIA) instrument. A total of 18.2% of dancers were at risk of LEA (LEAF-Q score ≥8) and no dancers were at risk of eating disorders. The most common characteristics of LEA are gastrointestinal dysfunction (90.9%), followed by menstrual disturbance (45.5%), and musculoskeletal injury (9.1%). Compared to the first study in Indonesia, this study showed lower proportion of dancers at risk of LEA and ED at X dance school in Jakarta. Despite a lower proportion, most dancers experienced other characteristics of LEA, thus prevention and health management are required to reduce further health issues.

Keywords: Female elite dancers, gastrointestinal dysfunction, low energy availability, menstrual disturbance, musculoskeletal injury.

ABSTRAK

Mengingat tuntutan estetik dan beban latihan yang tinggi, penari balet lebih rentan mengalami ketersediaan energi yang rendah (REN), dengan atau tanpa gangguan makan. Kondisi REN yang berkepanjangan dapat mengubah fungsi fisiologis tubuh dan menimbulkan masalah kesehatan lain. Penelitian ini bertujuan untuk menganalisis risiko REN dan gangguan makan pada penari elit wanita di sekolah tari X di Jakarta. Penelitian deskriptif desain potong lintang tersebut diikuti oleh 11 penari. Risiko REN dinilai menggunakan kuesioner ketersediaan energi yang rendah (KEREN), perilaku makan dinilai menggunakan *kuesioner eating attitude test* (EAT-26), dan komposisi tubuh dinilai menggunakan alat *bioelectrical impedance analysis* (BIA). Didapatkan 18,2% penari berisiko REN (skor KEREN ≥8) dan tidak ada penari yang berisiko gangguan makan. Karakteristik REN yang paling sering adalah disfungsi pencernaan (90,9%), diikuti gangguan menstruasi (45,5%), dan cedera muskuloskeletal (9,1%). Dibandingkan dengan penelitian pertama di Indonesia, penelitian ini menemukan proporsi penari yang berisiko REN dan gangguan makan lebih rendah di sekolah tari X di Jakarta. Meski proporsinya lebih rendah, sebagian besar penari mengalami ciri-ciri REN lainnya, sehingga dibutuhkan upaya pencegahan dan penanganan kesehatan untuk mengurangi masalah kesehatan lebih lanjut. **Nani Cahyani Sudarsono, Ria Lestari, Yose Natasa. Analisis Risiko Ketersediaan Energi yang Rendah dan Gangguan Makan pada Penari Elit Wanita di Sekolah Tari X Jakarta, Indonesia**.

Kata Kunci: Penari elit wanita, disfungsi pencernaan, ketersediaan energi yang rendah, gangguan menstruasi, cedera muskuloskeletal.

INTRODUCTION

Dance is classified as a high-intensity activity with high energy demands; dancers need adequate energy intake to replenish their energy.[1,2] Ballet, on the other hand, places emphasis on a lean and slim body, which is thought to enhance performance and raise aesthetic value. As a result, ballet dancers are frequently left in a state of high-level body dissatisfaction and a high drive to be slim. Ballet dancers may then resort to extreme measures to reach the desired weight, such as extreme dieting that may lead to eating disorder (ED) and low energy availability (LEA).[2,3]

LEA can be described as a state of energy imbalance; the body does not have the ability to maintain optimal health due to a lack of energy, which can be caused by a low energy intake, a high energy expenditure, or both. A prolonged state of LEA may alter physiological body functions, including metabolic and immune function, bone health, and menstrual cycle which can lead to major health concerns in female athletes.[4] LEA, menstrual dysfunction, and low bone mineral density

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(BMD) formed a complex called female athlete triad (FAT); a term coined in 1992 to represent a health problem frequently seen in female athletes.[5]

Multiple studies have proven that LEA is fairly common among ballet dancers. Staal, *et al*, discovered that approximately 35% of female ballet dancers in Denmark have LEA.[6] Civil, *et al*, found a greater rate, 65% of ballet dancers in Scotland suffered from LEA.[7] Keay, *et al*, study found that around 57% of female dancers have LEA, 85% are ballet dancers.[8] While there has been a lot of research on LEA in ballet dancers, only one has been conducted in Indonesia.[9] This study aims to analyze the risk of LEA and ED among female elite dancers at X dance school in Jakarta.

METHODS
This is a descriptive study with a cross-sectional design. Data were collected using the bioelectrical impedance analysis (BIA) instrument, the low energy availability in female questionnaire (LEAF-Q), the eating attitude test (EAT-26) questionnaire, and direct interviews.

The study was conducted from March to April 2023, in the Faculty of Medicine, University of Indonesia, and was approved by the Ethics Committee of the Faculty of Medicine, University of Indonesia – Cipto Mangunkusumo Hospital (KEPK FKUI-RSCM).

Participants
This study used a total population sampling method. The participants were all dancers from X dance school in Jakarta. All dancers aged 12 or older, and have been actively training for at least 12 months prior to the start of this study. Dancers with a history of chronic disease, pregnancy, menopause, or who are unwilling to participate were excluded. Initially, 12 dancers participated in the interview and body composition data collection, but one dancer did not complete the questionnaires. In total, 11 dancers were included in this study.

Background Information and Body Composition
The interview session lasted for around 15 minutes for each dancer. Dancers were asked about their background information, including age, length of dance exposure, and weekly dance frequency. They were also asked about their health conditions and provided with general information on dancers' related health issues.

Body composition measurement was carried out with Tanita MC-780MA P Tanita BIA instrument and was done with minimal clothing to ensure accuracy. BIA is a method for assessing body composition by measuring the electrical impedance of a very low electric current applied through the body. Measured data included height, weight, BMI, muscle mass, fat mass, and fat mass percentage. Asia-Pacific BMI classification was used in this study.

Risk of LEA
Dancers were asked to complete LEAF-Q, a validated tool frequently used as a screening method to assess the risk of LEA in female athletes.[10] It also serves as an easier option compared to directly measuring Energy Availability (EA).[10] This questionnaire has been validated for use among the Indonesian population.[9] LEAF-Q contains 20 questions regarding gastrointestinal dysfunction, musculoskeletal injury, contraceptive pill usage, and menstrual disturbance.[9] Each question was scored with the LEAF-Q Scoring Key. A total score of ≥8 indicates a risk of LEA.

Eating Habits
Dancers were also asked to complete the EAT-26 questionnaire, which is designed to detect abnormal eating habits.[11] This questionnaire has been validated and can be used in Indonesia.[12] EAT-26 identifies the risk of ED by assessing attitudes, feelings, and behaviors towards eating. It contains 26 self-reported questions on common eating habits and five additional questions on risky eating habits. The score for each question ranges from 0-3, a total score of >25 indicates a risk of ED. EAT-26 can assist in the screening and diagnosis of ED such as anorexia nervosa, bulimia nervosa, and binge eating disorders.[11]

Knowledge of Dancers' Related Health
Dancers were also asked to answer a few extra questions with a yes or no regarding

Table 1. Participant characteristics.

Variable	Dancers with a Risk of LEA (n=2)	Dancers Without Risk of LEA (n=9)
Age (years)	29.5 ± 10.6	25 ± 5
Experience in dance (years)	23 ± 9.9	19.7 ± 3.6
Dance frequency per week	7.5 ± 3.5	5.9 ± 2.1
Body Composition		
Body height (cm)	160.5 ± 3.5	161.7 ± 6.1
Body weight (kg)	60.5 ± 15.5	55.9 ± 8.9
BMI (kg/m^2)	23.4 ± 5	21.3 ± 2.9
Muscle mass (kg)	37 ± 4.2	37.8 ± 3.6
Body fat (kg)	21.2 ± 10.8	15.7 ± 5.6
Body fat (%)	33.8 ± 9.3	27.5 ± 5.2
EAT-26 score	4.5 ± 0.7	5.1 ± 4.6

Table 2. LEA characteristics.

Symptoms	n	%
Musculoskeletal injury	1	9.1
Gastrointestinal dysfunction	10	90.9
Menstrual disturbance	5	45.5

Table 3. Gastrointestinal symptoms.

Symptoms	n	%
Dyspepsia	1	9.1
Diarrhea	1	9.1
Constipation	2	18.2
Bloating	8	72.7
Discomfort	1	9.1

the impact of menstrual disturbance. The questions included "Do you think it's normal for a dancer not to menstruate?", "Aside from the inability to get pregnant, do you believe there are any negative consequences for women who do not menstruate?". They were asked to specify any negative consequences they were aware of. Dancers were also asked if they were familiar with or had heard of terminology such as LEA, FAT, relative energy deficiency in sports (RED-S), disordered eating (DE), and orthorexia.

Statistical Analysis

Data are presented as mean and standard deviation (SD) unless otherwise specified. Data analysis was conducted using the Microsoft Excel 2021 computer program.

RESULTS

Participant Characteristics

BMI measurement revealed that one (9.1%) dancer was underweight and three (27.3%) dancers were overweight. Using the LEAF-Q, we found that two (18.2%) dancers were at risk of LEA. Participant characteristics including background information and body composition can be seen in **Table 1**.

LEA Characteristics

Musculoskeletal injury, gastrointestinal dysfunction, and menstrual disturbance are characteristics of LEA. Musculoskeletal injury is defined as injury of muscles, bones, tendons, joints, ligaments, and other soft tissues.[13] Gastrointestinal dysfunction is characterized by symptoms such as abdominal discomfort, dyspepsia, diarrhea, constipation, and bloating.[10] Menstruation disturbance was defined as a disruption in bleeding patterns, such as menorrhagia, oligomenorrhea, polymenorrhea, or amenorrhea.[14]

LEA characteristics can be seen in **Table 2**. One (9.1%) dancer suffered from an injury in the lower extremity (hip flexor) within the last year. Ten (90.9%) out of 11 dancers suffered from gastrointestinal dysfunction, and three (27.3%) dancers experienced multiple symptoms. The most common gastrointestinal symptom was bloating **(Table 3)**. Menstrual disturbance was reported by five (45.5%) dancers.

Eating Habits

None of the dancers were at risk of ED; the mean EAT-26 score for dancers at risk of LEA = 4.5 (0.7) and 5.1 (4.6) for dancers without risk of LEA.

Knowledge of Dancers' Related Health

Out of 11 dancers, 4 (36.4%) dancers agreed that it is not normal for dancers to not menstruate. When asked to specify the negative effects, one dancer provided two answers, while other dancers provided one. Two (18.2%) dancers answered "affecting general health", one (9.1%) dancer answered "osteoporosis", one (9.1%) dancer answered "low energy", and one (9.1%) dancer answered "acne" **(Table 4).**

Seven (63.6%) dancers were familiar with one or more of the terminologies asked. Six (54.5%) dancers had heard of DE, three (27.3%) dancers had heard of LEA, one (9.1%) dancer had heard of orthorexia, and one (9.1%) dancer had heard of FAT. However, none of them were familiar with the term RED-S (Table 5).

DISCUSSION

Participants Characteristics

Ballet dancers are required to have a slender figure since it is thought to facilitate artistic movements and expression. This demand often puts dancers' health in a vulnerable state. The most common health issues among ballet dancers include disordered eating, menstruation disturbance, and poor bone health.[15,16]

Consistent with the study by Lestari,[9] this study found an early specialization combined with a high duration and frequency of training each week. These factors may increase the energy requirements that are already large enough for growth and development in young dancers, contributing to an early risk factor for FAT.[17]

Ballet dancers generally have a normal or low BMI, which can be linked to high energy expenditure, demands to maintain a slender body, or a lack of food intake to meet the energy needs of dance. Dancers, on average, have a lower prevalence of higher BMI than the general population. This study found that 18.2% of dancers had a higher BMI. While persistent energy deficiency was correlated with a lower BMI, a high BMI still poses an issue, as a higher BMI was correlated with a higher risk of injury in contemporary dancers and adolescent athletes.[18,19]

This current study found that 18.2% of dancers were at risk of LEA, lower than Lestari's finding that 36.3% of dancers were at risk of LEA.[9] Keay, et al, also found a higher prevalence, with 57% of dancers at risk of LEA.[8] This study was similar to a study by Prus, et al, who discovered that 28% of dancers had LEA.[20] A low proportion in this study may be due to the variances in sample size and the method of determining LEA.

LEA Characteristics

This study found that 9.1% of dancers suffered from a lower extremity injury within the last year. Compared to other dance methods, ballet has a higher rate of lower extremity injuries.[21] This may be correlated with a maintained hyperextended knee position. Dancers are also expected to perform perfectly, which

Table 4. Dancers' answer on the negative effects of not menstruating.

Negative Effect	n	%
Don't know	7	63.6
Affecting general health	2	18.2
Osteoporosis	1	9.1
Low energy	1	9.1
Acne	1	9.1

Table 5. Dancers' knowledge of terminologies associated with LEA and eating habits.

Terminologies	n	%
LEA	3	27.3
RED-S	0	0
Female athlete triad	1	9.1
Disordered eating	6	54.5
Orthorexia	1	9.1
Don't know/never heard	4	36.4

can only be accomplished through rigorous training. Prolonged training with repetitive motions combined with an inadequate recovery period may leave dancers vulnerable to injury.[21]

Menstrual disturbance is an objective and sensitive indicator of LEA and can be associated with an increased risk of health issues such as breast cancer, ovarian cancer, diabetes, cardiovascular disease, and fractures.[22] Almost 50% of dancers in this study had menstrual disturbance. However, only 18.2% of the dancers reported having it, while the remaining 27.3% considered their menstrual disturbance 'normal'. Many dancers did not understand or were aware of the normal menstrual cycle and its significance to their health.

According to Adam, *et al*, this lack of knowledge on menstruation is not only experienced by dancers but also by athletes, coaches, and even healthcare professionals. This could be due to a lack of clinical studies on the menstrual cycle in certain populations, especially athletes.[23] Discussion on menstruation is also considered taboo in the general population and the athlete population.[24]

Gastrointestinal dysfunction has been shown to be a reliable indicator of LEA.[25] In this study, gastrointestinal dysfunction was found in more than 90% of dancers, of whom 18.2% were at risk of LEA. The link between LEA and gastrointestinal dysfunction can be explained by mucosal atrophy caused by persistent energy deficiency, which then reduces function and alters the morphology of the digestive tract. The availability of sufficient energy ensures that dancers have available energy for basic physiological functions, including the digestive system.[10,25]

Eating Habits

This study did not find the risk of ED among dancers, while Lestari found that 9% of dancers were at risk of ED.[9] While ED underlies most cases of LEA, other conditions such as rapid weight loss or extreme exercise can cause LEA without an accompanying ED.[26] According to Wyon, *et al,* dancers' level of knowledge about food increases with age.[27] This is in line with this study, where the majority of the dancers are young adults, which may influence the outcomes of the EAT-26 questionnaire.

Knowledge of Dancers' Related Health

Based on these findings, it can be concluded that insufficient health knowledge can contribute to their health issues. These findings were in line with the findings of Keay, *et al*, who found that only 37% of dancers knew about LEA, 27% of dancers knew about FAT, and 30% of dancers knew about RED-S.[8]

It can also be concluded that dancers had a lack of awareness of the long-term health consequences of menstrual disturbance. While 36.4% of dancers agreed that it is not normal for dancers to not menstruate, only 9.1% were able to correctly identify osteoporosis as one of the negative consequences. According to Mathisen, *et al*, a continuous educational program, combined with multiple repetitions, and a shorter interval between sessions are needed for dancers to maintain their knowledge about health issues.[28]

CONCLUSION

The proportion of dancers at risk of LEA and ED at X dance school in Jakarta was lower compared to the earlier study in Indonesia in 2021. Despite a lower proportion, the majority of dancers experienced other characteristics of LEA, such as gastrointestinal dysfunction, menstrual disturbance, and/ or musculoskeletal injury, prompting a more thorough investigation. Additionally, a lack of awareness also warranted a continuous educational program to ensure dancers' knowledge improvement and retention.

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