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THE RELATIONSHIP BETWEEN TRAINING INTENSITY, ENERGY AVAILABILITY, AND SLEEP QUALITY WITH THE MENSTRUAL CYCLE OF FEMALE TAEKWONDO ATHLETES

Korelasi Intensitas Latihan, Energy Availability, dan Kualitas Tidur dengan Siklus Menstruasi Atlet Taekwondo Wanita

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ABSTRACT

Menstrual cycle irregularities are commonly reported by female athletes engaged in physically demanding sports. Menstrual irregularities not only impact athletic performance but also pose potential risks for future health issues such as osteoporosis, infertility, diabetes mellitus, and cardiovascular disease. Factors influencing menstrual cycles include exercise intensity, energy availability, and sleep quality. This study aims to determine the correlation between training intensity, energy availability, and sleep quality with the menstrual cycle regularity among female Taekwondo athletes in the Pelatihan Cabang Taekwondo Indonesia Kabupaten Bandung Barat (PELATCAB TI KBB). This research uses a quantitative approach with a cross-sectional design. The sample consisted of 33 participants selected using total sampling technique. Data were collected through the RPE scale questionnaire, PSQI questionnaire, 2×24 hour food recall, and anthropometric measurements using Bioelectric Impedance Analysis The data obtained were analyzed using the Chi-Square test. The results of the study showed a significant relationship between exercise intensity (p-value = 0.014) and energy availability (p-value = 0.000) with the menstrual cycle. In addition, the study found no significant relationship between sleep quality (p-value = 0.222) and the menstrual cycle of female taekwondo athletes. The conclusion of this study is that training intensity and energy availability have a significant relationship with the menstrual cycle, while sleep quality does not show a significant relationship with the menstrual cycle.

Keyword: *energy availability; female athletes; menstrual cycle; sleep quality; training intensity*

ABSTRAK

Gangguan keteraturan siklus menstruasi kerap dialami oleh atlet wanita yang aktif dalam olahraga fisik. Ketidakteraturan menstruasi tidak hanya berdampak pada performa atletik, tetapi juga berpotensi menimbulkan berbagai masalah di masa mendatang, seperti osteoporosis, infertilitas, risiko diabetes melitus, dan penyakit kardiovaskular. Beberapa faktor yang dapat memengaruhi siklus menstruasi antara lain intensitas latihan, energy availability dan kualitas tidur. Tujuan dari studi ini adalah untuk mengidentifikasi korelasi intensitas latihan, energy availability, dan kualitas tidur dengan siklus menstruasi pada atlet wanita muda yang tergabung dalam Pelatihan Cabang Taekwondo Indonesia Kabupaten Bandung Barat. Studi ini menggunakan metode kuantitatif dengan pendekatan cross sectional, dan melibatkan 33 partisipan yang dipilih melalui teknik total sampling. Data yang diperoleh kemudian dianalisis menggunakan uji Chi-Square. Hasil penelitian menunjukkan terdapat korelasi yang signifikan antara intensitas latihan (p-value = 0.014) dan energy availability (p-value = 0.000) dengan siklus menstruasi. Selain itu, tidak ditemukan korelasi yang signifikan antara kualitas tidur (p-value = 0.222) dengan siklus menstruasi atlet taekwondo wanita

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Kata Kunci; atlet wanita; energy availability; intensitas latihan; kualitas tidur; siklus menstruasi

INTRODUCTION

The menstrual cycle is an important indicator of women's reproductive health, which is influenced by various physiological and environmental factors. Irregular menstrual cycles not only affect physical performance but also pose a risk of long-term health problems such as osteoporosis, infertility, diabetes mellitus, and cardiovascular disease (Mittiku *et al.*, 2022) . In 2020, the WHO reported that approximately 45% of women worldwide experience menstrual irregularities, and in Indonesia, the prevalence reaches 13.7% among women aged 10–59 years.

Female athletes have a higher risk of experiencing menstrual disorders due to high training intensity, low energy intake, and physical and psychological stress (Witkoś *et al.*, 2024) . The prevalence of this disorder varies depending on the sport, with the highest reports reaching 61% (Gimunová *et al.*, 2022) . This condition is closely related to the *Female Athlete Triad* (FAT) syndrome, which consists of menstrual disorders, poor bone health, and low *energy availability* (LEA) with or without eating disorders (Witkoś and Petrycka, 2022) . Sustained LEA can lead to metabolic, immune system, and hormonal dysfunction, which impacts the menstrual cycle (Wasserfurth *et al.*, 2020) .

Additionally, sleep quality significantly influences hormonal health. Poor sleep quality can reduce melatonin production and disrupt reproductive hormone balance, thereby affecting menstrual regularity (Illanes *et al.*, 2023) . Young athletes are prone to sleep disturbances due to high training loads and competitive pressures (Hrozanova *et al.*, 2020) .

Previous studies have shown limitations in simultaneously examining the relationship between training intensity, *energy availability*, and sleep quality on the menstrual cycle, particularly among adolescent taekwondo athletes in Indonesia. Preliminary results from a study of 33 female taekwondo athletes in West Bandung Regency showed that 31.3% experienced menstrual disorders, 25.8% had poor sleep quality, and 67.7% exhibited irregular eating patterns . This indicates a high potential risk

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of FAT among young athletes.

Based on this, the study aims to identify the relationship between training intensity, *energy availability*, and sleep quality on menstrual cycle regularity in young female taekwondo athletes. The contributions of this research are expected to enrich the literature in the field of sports nutrition and serve as a basis for planning more effective training and health interventions for female athletes.

METHOD

Design, location, and time

This study is an observational study with a *cross-sectional* design to determine the relationship between training intensity, *energy availability*, and sleep quality with the menstrual cycle. The study was conducted from October 2024 to June 2025. Data collection was carried out at the West Bandung Regency Indonesian Taekwondo Branch Training Centre.

Number and method of subject/instrument and material collection

The population in this study consisted of female athletes who were members of PELATCAB TI KBB. The inclusion criteria for subjects in this study were having experienced menstruation, having no reproductive system problems, and being willing to be respondents. Meanwhile, the exclusion criteria for subjects were samples who had not yet menstruated and were unwilling to be respondents. There were 33 female taekwondo athletes in the study. Sampling was conducted using *total* sampling. This study obtained ethical approval from the Health Research Ethics Committee, Faculty of Health Sciences, Muhammadiyah University Surakarta, with number 932/KEPK-FIK/II/2025.

Type and method of data collection/research steps

This study examined the variables of training intensity, *energy availability*, and sleep quality as independent variables, and the menstrual cycle as a dependent variable. The study was conducted by taking measurements, conducting direct interviews, and filling out questionnaires. Training intensity data was obtained through direct interviews using the *Rating of Perceived Exertion* (RPE) instrument, which is an international standard instrument of the s and

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has been translated. Exercise intensity based on the RPE scale was categorised as rest (0), very light (1), light (2), moderate (3), somewhat heavy (4), heavy (5-6), very heavy (7-9), and maximum (10) (Borg, 1982).

Energy availability data was obtained through direct interviews using a *24-hour recall* instrument and direct measurements using *a Bioelectrical Impedance Analyser* (BIA). *Energy availability* was calculated using the formula EA = (*energy intake – exercise energy expenditure)/fat-free mass*. *Energy availability* was categorised into four groups: *high EA* (>45 kcal/kg FFM), optimal EA (≥45 kcal/kg FFM), subclinical EA (30–45 kcal/kg FFM), and clinical EA (Melin, 2019).

Sleep quality data was obtained through direct interviews using the *Pittsburgh Sleep Quality Index*, which is an international standard instrument that has been translated. Sleep quality was categorised into two groups: good (score ≤5) and poor (score >5) (Buysse *et al*., 1989). Menstrual cycle data were obtained through direct interviews using a menstrual cycle questionnaire that had undergone validity and reliability testing. The menstrual cycle is categorised into four types: polymenorrhoea (<21 days), eumenorrhoea (21-35 days), oligomenorrhoea (21-35 days), and amenorrhoea (>90 days) (Amalia *et al*., 2024).

Data analysis

The data obtained were subjected to descriptive analysis and analysed using the *Chi-Square* test, assuming a correlation between the data if the p-value was <0.05, to analyse the correlation between exercise intensity, *energy availability*, and sleep quality with the menstrual cycle. Data processing was performed using SPSS version 26.

RESULTS AND DISCUSSION

Respondent Characteristics

Respondent characteristics based on age are shown in Table 1. The data indicate that the respondents in this study ranged in age from 13 to 20 years. Most respondents were 16 years old (27.3%), which falls within the mid-adolescent category (WHO, 2018), while the smallest number of respondents were 20 years old (3%).

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Table 1. Characteristics of Respondents Based on Age

Age	Frequency (n)	Percentage (%)
13 years old	2	6.1
14 years old	4	12.1
15 years old	4	12.1
16 years old	9	27.3
17 years old	7	21.2
18 years old	3	9.1
19 years old	3	9.1
20 years old	1	3

The characteristics of respondents based on age at menarche can be seen in Table 2. The data shows that the age *at menarche* of respondents varied between 10 and 15 years. Most respondents experienced *menarche* at the age of 13 years (30.3%), while the age *of menarche* with the fewest subjects was 10 years (3%). This age range is still within the normal age of menarche, which is 12-14 years (Rosso *et al*., 2020).

Table 2. Characteristics of Respondents Based on Age at Menarche

Age of Menarche	Frequency (n)	Percentage (%)
10 years old	1	3
11 years old	4	12.1
12 years old	13	39.4
13 years old	10	30.3
14 years old	2	6.1
15 years old	3	9.1

Nutritional status was determined by considering the age category of the respondents. Respondents in the adolescent category were assessed using BMI/U, while respondents in the adult category were assessed based on BMI. The characteristics of respondents based on nutritional status can be seen in Table 3. The data shows that among respondents in the adult category, all subjects had normal nutritional status (12.1%). Among respondents in the adolescent category, most had good nutrition (72.7%) and a small number were overweight (15.2%). The nutritional status of athletes assessed based on BMI was generally within the normal range, although there were still some who showed indications of underweight or overweight (Barjaktarovic-Labovic *et al*., 2023).

Table 3. Characteristics Based on Nutritional Status

Nutritional Status	Frequency (n)	Percentage (%)
Nutritional status (BMI)		
Underweight	0	0
Normal	4	12.1
Overweight	0	0
Nutritional status (BMI/U)		
Malnourished	0	0
Good nutrition	24	72.7
Overweight	5	15.2
Obesity	0	0

Research variable data

Table 4 shows that no respondents rated exercise intensity as rest, very light, light, or maximum. Most subjects rated exercise as moderately heavy (30.3%) and moderate (27.3%). This reflects the

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characteristic exercise patterns typical of taekwondo athletes at the competitive level. In addition, most respondents had *energy availability* in the *clinical EA* category (54.4%), indicating a very low level of *energy availability* caused by an imbalance between food intake and energy expenditure. The quality of sleep among respondents was mostly good (54.5%). The menstrual cycles of respondents showed that most experienced normal menstrual cycles (39.4%), but the number of respondents experiencing oligomenorrhea was still quite high (30.3%). This reflects that adolescent athletes are at risk of experiencing menstrual cycle disorders.

Table 4. Research Variable Data

Variable	Frequency (n)	Percentage (%)
Training intensity		
Rest	0	0
Very light	0	0
Light	0	0
Moderate	9	27.3
Somewhat Heavy	10	30.3
Heavy	6	18.2
Very Heavy	8	24.2
Maximum	0	0
Rest	0	0
Very Light	0	0
Energy Availability		
High EA	12	36.4
Optimal EA	1	3
Subclinical EA	2	6.1
Clinical EA	18	54.5
Sleep quality		
Good	18	54.5
Poor	15	45.5
Menstrual Cycle		
Polymenorrhoea	6	18.2
Eumenorrhoea	13	39.4
Oligomenorrhoea	10	30.3
Amenorrhoea	4	12.1

Table 5 shows that the variables of exercise intensity and *energy availability* are related to the menstrual cycle with a p-value < 0.05. Meanwhile, the variable of sleep quality is not related to the menstrual cycle with a p-value ≥ 0.05. These findings indicate that exercise intensity and *energy availability* have a more significant contribution to menstrual cycle variation than sleep quality, which did not show a significant relationship in this analysis .

Table 5. Results of the Analysis of the Relationship between Research Variables

Variable	Menstrual Cycle P value
Exercise Intensity	0.01
Energy availability	0.000
Sleep quality	0.222

Relationship between training intensity and menstrual cycle

Taekwondo athletes are required to have high strength, speed and endurance, so their training programmes tend to be conducted at medium to high intensity levels to support their performance in meeting the demands of competition (Bartel *et al.*, 2022) . The correlation test results show a significant

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relationship between exercise intensity and the menstrual cycle ($p < 0.05$). This finding is reinforced by similar research revealing a significant relationship between high training intensity and menstrual disorders (Gayatri and Safitri, 2022) .

High-intensity exercise in adolescent athletes offers physiological benefits but also poses potential risks. High-intensity exercise has been shown to significantly improve cardiovascular fitness and anaerobic capacity in athletes (Fang, Kim & Choi, 2021) . However, high-intensity exercise can also increase the risk of injury, particularly to the shoulders, knees, and back (Barranco-Ruiz *et al.*, 2020) .

Furthermore, continuous involvement in high-intensity exercise has the potential to cause menstrual irregularities, particularly oligomenorrhoea, and can lead to disturbances in gonadotropin production, resulting in luteal phase deficiency and anovulation (Hirschberg, 2020) . This is due to exercise-related hypothalamic dysfunction that suppresses the secretion *of gonadotropin-releasing hormone* (GnRH), thereby reducing the production of *luteinising hormone* (LH) and *follicle-stimulating hormone* (FSH), which are essential for ovulation (Basri *et al*., 2018). This disorder is associated with increased stress hormones, leptin levels, and fatigue due to low energy availability, which affects the body's reproductive function (Ramadan *et al.*, 2025)

The relationship between *energy availability* and the menstrual cycle

Energy availability (EA) is an important indicator in assessing energy balance in athletes. Correlation test results show a significant correlation between *energy availability* and the menstrual cycle ($p < 0.05$). These findings reinforce evidence from previous studies showing a significant association between *energy availability* and menstrual irregularities (Bingzheng *et al.*, 2024)).

Inadequate *energy availability* can disrupt thyroid, reproductive, and growth hormone function, as well as decrease muscle synthesis and bone health, which can ultimately lead to menstrual disorders, reduced muscle mass, brittle bones, and decreased physical ability (Areta *et al.*, 2021) . LEA can be influenced by various factors, such as high energy expenditure, inadequate energy intake, training demands, nutritional barriers, concerns about body image, and

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eating disorders (Jagim *et al.*, 2022) .

LEA in female athletes is closely associated with a syndrome known as *the Female Athlete Triad* (Wasserfurth *et al.*, 2020) . LEA disrupts endocrine regulation mechanisms, characterised by abnormal GnRH secretion, which affects LH and FSH hormone levels. If this imbalance persists, it can lead to menstrual disorders and reduced bone mineral density due to decreased oestrogen levels (Witkoś & Petrycka, 2022) .

The relationship between sleep quality and the menstrual cycle

Sleep is very important in supporting regular hormone release, muscle growth, and muscle fibre repair (Fusi *et al.*, 2025) . Impaired sleep quality can inhibit melatonin production and stimulate activation of the *hypothalamic-pituitary-adrenal* (HPA) axis, which increases cortisol secretion. Elevated cortisol suppresses GnRH secretion from the hypothalamus, thereby reducing LH and FSH from the pituitary gland, which play a role in ovulation and the menstrual cycle (Lateef & Akintubosun, 2020).

Correlation test results indicate that sleep quality does not have a significant association with the menstrual cycle ($p \geq 0.05$). These results align with similar studies that also found no significant relationship between sleep quality and the menstrual cycle (Anzela *et al.* , 2024) (Salsabilla *et al.*, 2023) . This indicates that sleep quality alone is not the primary factor causing significant menstrual cycle disorders.

Athletes' sleep quality is influenced by general factors as well as factors related to the type of sport, such as irregular schedules, training volume, travel, head injuries, and supplement use (Brauer, 2022) . Good sleep quality in athletes can improve cognitive function, overall health, and reduce the risk of injury (Hamlin *et al.*, 2021) . Poor sleep quality can affect athletes' physiology, resulting in reduced immune function, increased risk of injury, and fatigue (Sim *et al.*, 2023) .

This study has several limitations, namely that the scope of the study only involved taekwondo athletes, thus limiting the generalisation of findings to other sports that are also at risk of *Female Athlete Triad* (FAT). This study also only assessed sleep quality without considering sleep duration, which actually plays an important role in recovery and hormonal regulation related to the menstrual cycle. Additionally, the use of

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a *cross-sectional* design in this study can only describe the relationship between variables but cannot establish that one variable causes changes in another variable.

CONCLUSION

The results of the study show that there is a significant correlation between training intensity and *energy availability* with the menstrual cycle. The correlation test also shows that there is no significant correlation between sleep quality and the menstrual cycle. These findings confirm that energy balance and training load are the main factors that affect the reproductive function of female athletes. These results also support the need for training guidelines and nutritional management that ensure adequate energy intake and monitoring of exercise intensity to maintain the menstrual health of female athletes.

BIBLIOGRAPHY

Amalia, I.N., Budhiana, J. and Sanjaya, W. (2023) 'Hubungan stres dengan gangguan siklus menstruasi pada remaja putri', *Jurnal Wacana Kesehatan*, 8(2), pp. 75–82. doi: 10.52822/jwk.v8i2.526.

Anzela *et al.* (2024) 'Antara Kualitas Tidur dan Aktivitas Fisik dengan Siklus Menstruasi pada Remaja Putri di SMAN 5', *Bandar Lampung Medula* |, 14, pp. 469–475.

Areta, J.L., Taylor, H.L. and Koehler, K. (2021) 'Low energy availability: history, definition and evidence of its endocrine, metabolic and physiological effects in prospective studies in females and males', *European Journal of Applied Physiology*, 121(1), pp. 1–21. Available at: https://doi.org/10.1007/s00421-020-04516-0.

Basri, S.W.G. *et al.* (2018) 'Pengaruh Intensitas Olah Raga terhadap Kadar Hormon GNRH (Gonadotropin Releasing Hormon) pada Siklus Haid Altet di Pusat Pembinaan Latihan Pelajar Makassar', *UMI Medical Journal*, *3*(2), pp.46-58.

Barjaktarovic-Labovic, S., Pantovic, S., Joksimovic, I. and Banjri, I. (2023) 'Nutritional knowledge and status of Montenegrin athletes: Focus on general and sports nutrition', Hrana i Ishrana, 64(2), pp. 12–19. doi: 10.5937/hraish2302012b.

Barranco-Ruiz, Y. *et al.* (2020) 'Prevalence of Injuries in Exercise Programs Based on Crossfit®, Cross Training and High-Intensity Functional Training Methodologies: A Systematic Review', *Journal of Human Kinetics*, 73(1), pp. 251–265. Available at: https://doi.org/10.2478/hukin-2020-0006.

Bartel, C. *et al.* (2022) 'Energy demands in high-intensity intermittent taekwondo

DOI 10.20884/1.jgipas.2025.9.2.17304

specific exercises', *PeerJ*, 10, pp. 1–14. Available at: https://doi.org/10.7717/peerj.13654.

Bingzheng, Z. *et al.* (2024) 'Study on the correlation between energy availability and subclinical menstrual disorders', *Frontiers in Nutrition*, 11(November), pp. 6–10. Available at: https://doi.org/10.3389/fnut.2024.1479254.

Brauer, A.A. (2022) 'Prevalence and Causes of SleepProblems in Athletes', *Current Sleep Medicine Reports*, 8, pp. 180–186. Available at: https://doi.org/doi.org/10.1007/s40675-022-00241-6.

Borg, G.A.V. (1982) 'Psychophysical bases of perceived exertion', *Medicine and Science in Sports and Exercise*, 14(5), pp. 377–381.

Buysse, D.J., Reynolds, C.F., Monk, T.H., Berman, S.R. and Kupfer, D.J. (1989) 'The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research', *Psychiatry Research*, 28(2), pp. 193–213. doi: 10.1016/0165-1781(89)90047-4.

Fang, B., Kim, Y. and Choi, M. (2021) 'Effect of cycle-based high-intensity interval training and moderate to moderate-intensity continuous training in adolescent soccer players', *Healthcare (Switzerland)*, 9(12). Available at: https://doi.org/10.3390/healthcare9121628.

Fusi, J. *et al.* (2025) 'Improving Sleep Quality to Enhance Athletic Activity—The Role of Nutrition and Supplementation: A Mini-Short Review', *Nutrients* , 17(11). Available at: https://doi.org/10.3390/nu17111779.

Gayatri, S.W. and Safitri, A. (2022) 'Pengaruh Intensitas Olah Raga Terhadap Siklus Haid Atlet', *Wal'afiat Hospital Journal*, 03(01), pp. 13–19.

Gimunová, M. *et al.* (2022) 'The Prevalence of Menstrual Cycle Disorders in Female Athletes from Different Sports Disciplines: A Rapid Review', *International Journal of Environmental Research and Public Health*, 19(21). Available at: https://doi.org/10.3390/ijerph192114243.

Hamlin, M.J. *et al.* (2021) 'The Effect of Sleep Quality and Quantity on Athlete's Health and Perceived Training Quality', *Frontiers in Sports and Active Living*, 3(September), pp. 1–10. Available at: https://doi.org/10.3389/fspor.2021.705650.

Hirschberg, A.L. (2020) 'Female hyperandrogenism and elite sport', *Endocrine Connections*, 9(4), pp. R81–R92. Available at: https://doi.org/10.1530/EC-19-0537.

Hrozanova, M. *et al.* (2020) 'Reciprocal associations between sleep, mental strain, and training load in junior endurance athletes and the role of poor subjective sleep quality', *Frontiers in Psychology*, 11(October), pp. 1–14. Available at: https://doi.org/10.3389/fpsyg.2020.545581.

Illanes, A.L. *et al.* (2023) 'A New Paradigm in the Relationship between Gut

DOI 10.20884/1.jgipas.2025.9.2.17304

Microbiota and Breast Cancer: β-glucuronidase Enzyme Identified as Potential Therapeutic Target', *Pathogens*, 12(9), pp. 1–22. Available at: https://doi.org/10.3390/cancers13133141.

Jagim, A.R. *et al.* (2022) 'Contributing Factors to Low Energy Availability in Female Athletes : A Narrative Review of Energy Availability , Training', *Nutrients*, 14(986).

Lateef, O. M., & Akintubosun, M. O. (2020) 'Sleep and Reproductive Health. Journal of Circadian Rhythms', 18(1), 1–11. doi: https://doi.org/10.5334/jcr.190

Melin, A.K., Heikura, I.A., Tenforde, A. and Mountjoy, M. (2019) 'Energy availability in athletics: Health, performance, and physique', International Journal of Sport Nutrition and Exercise Metabolism, 29(2), pp. 152–164. doi: 10.1123/ijsnem.2018-0201.

Mittiku, Y.M. *et al.* (2022) 'Menstrual irregularity and its associated factors among college students in Ethiopia, 2021', *Frontiers in Global Women's Health*, 3. Available at: https://doi.org/10.3389/fgwh.2022.917643.

Ramadan, W., Xirouchaki, C.E. and El-Gilany, A.H. (2025) 'The Comparative Effects of High-Intensity Interval Training and Traditional Resistance Training on Hormonal Responses in Young Women: A 10-Week Intervention Study', *Sports*, 13(3), pp. 1–11. Available at: https://doi.org/10.3390/sports13030067.

Rosso, G., Aragno, E., Mehanović, E., Di Salvo, G. and Maina, G. (2020) 'Age at menarche in women with bipolar disorder: Correlation with clinical features and peripartum episodes', Frontiers in Psychiatry, 11, pp. 1–7. doi: 10.3389/fpsyt.2020.00851.

Salsabilla, B., Anwar, K. and Maskar, D.H. (2023) 'Status Gizi, Kadar Hemoglobin, Kualitas Tidur dan Siklus Menstruasi pada Siswi di SMAN 8 Tangerang', *Jurnal Ilmu Gizi dan Dietetik*, 2(1), pp. 16–23. Available at: https://doi.org/10.25182/jigd.2023.2.1.16-23.

Sim, J.E. *et al.* (2023) 'Sleep patterns before and after competition: A real-world examination of elite athletes', *Journal of Sports Sciences*, 41(22), pp. 2014–2026. Available at: https://doi.org/10.1080/02640414.2024.2308960.

Wasserfurth, P. *et al.* (2020) 'Reasons for and Consequences of Low Energy Availability in Female and Male Athletes: Social Environment, Adaptations, and Prevention', *Sports Medicine - Open*, 6(1). Available at: https://doi.org/10.1186/s40798-020-00275-6.

WHO (2018) *Handout for Module A Introduction*. Geneva: World Health Organization.

Witkoś, J. *et al.* (2024) 'Menstrual cycle disorders as an early symptom of energy deficiency among female physique athletes assessed using the Low Energy Availability in Females

DOI 10.20884/1.jgipas.2025.9.2.17304

Questionnaire (LEAF-Q)', *PLoS ONE*, 19(6 June), pp. 1–17. Available at: https://doi.org/10.1371/journal.pone.0303703.

Witkoś, J. and Petrycka, M.H. (2022) 'Female athlete triad and relative energy deficiency in sport – endocrine changes and treatment in women', *Polish Annals of Medicine*, 29(2), pp. 281–287. Available at: https://doi.org/10.29089/paom/148215.

DOI 10.20884/1.jgipas.2025.9.2.17304