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PHASES OF THE OVARIAN-MENSTRUAL CYCLE AND CHARACTERISTICS OF TRAINING AND COMPETITIVE ACTIVITY IN FEMALE COMBAT SPORT ATHLETES: A REVIEW OF SCIENTIFIC EVIDENCE

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Abstract. This article presents a comprehensive review of scientific data on the effects of the ovarian-menstrual cycle (OMC) phases on the physiological status, adaptation to training loads, and competitive performance of female athletes, with a focus on combat sports (judo, women's wrestling, jiu-jitsu, boxing). The mechanisms of hormonal fluctuations and their influence on aerobic and anaerobic capacity, strength characteristics, recovery, and perceived performance are examined. Results from clinical studies and systematic reviews highlighting both controversial and consistent effects of the OMC on athletic performance are analyzed. Practical implications for coaches and athletes are discussed, along with perspectives for further research in the physiology of female athletes in combat sports.

Keywords: menstrual cycle, female physiology, athletic performance, hormonal phases, training planning, combat sports.

Introduction. The rapid increase in female participation in Olympic and international sports over recent decades has fundamentally changed the requirements for the scientific support of athlete preparation. By the mid-2020s, the Olympic program had achieved near-complete gender parity: at the Paris 2024 Summer Olympic Games, women and men were represented in comparable numbers, and most sports ensured equal competitive opportunities for both sexes, including disciplines traditionally associated with strength and contact, such as various combat sports. Under these conditions, the consideration of sex-specific biological factors, particularly the ovarian-menstrual cycle (OMC), has become increasingly important, as it represents a key regulator of physiological status, performance, and adaptive responses to training and competitive loads.

For combat sports such as judo, women's wrestling, jiu-jitsu, and boxing which are characterized by high intensity, a pronounced strength component, combined aerobic-anaerobic demands, and strict competition regulations ignoring the phase-dependent changes of the OMC may lead to reduced training effectiveness, increased fatigue, higher injury risk, and potential implications for reproductive health. In this context, analyzing contemporary scientific data on the phase-specific dynamics of the OMC in female combat athletes is of both theoretical and practical significance, as it can provide a foundation for the systematic planning of preparation at the stages of youth and junior sport as well as in elite athlete development [1].

Training programs for male and female athletes should account for sex-specific differences, primarily due to the unique menstrual function in women, the cyclical nature of which significantly influences physiological responses [2]. Fluctuations in estrogen and progesterone concentrations can affect strength, speed-strength, and coordination capabilities, as well as recovery processes. In combat sports, and judo in particular, performance largely depends on the athlete's ability to demonstrate high levels of physical, functional, and psychophysiological readiness under conditions of intense and short-term loads.

Analysis of current literature indicates that the effects of OMC phases on female athletes' physical performance are variable and largely individual. Nevertheless, several studies report trends of decreased subjective performance and reduced load tolerance during the early follicular and late luteal phases, which are associated with hormonally driven changes in functional state and neuromuscular regulation. For combat sports characterized by high-intensity, strength and speed-strength demands, as well as substantial psycho-emotional load, these fluctuations may exert a more pronounced effect on the effectiveness of training and competitive performance. Accordingly, a differentiated approach to planning training processes that accounts for OMC phases is considered a potentially valuable tool for optimizing female athlete preparation.

However, the limited amount of data, methodological heterogeneity of studies, and underrepresentation of female combat athletes in research samples underscore the need for further targeted investigations in this area [3, 4].

In contemporary sports science, particular attention is given to factors determining athletes' performance levels and the effectiveness of their competitive activities. Despite growing interest in individualizing the preparation of female athletes, the literature review indicates that studies addressing the influence of the OMC specifically in the context of combat sports remain relatively scarce compared to disciplines such as athletics, gymnastics, or winter sports. This gap underscores the relevance and necessity of the present analytical review.

The aim of this article is to synthesize and analytically interpret contemporary scientific and methodological data regarding the influence of female physiological characteristics and the phases of the ovarian-menstrual cycle on the structure, orientation, and content of training and competitive activities in women practicing combat sports.

Research Objectives:

1. To analyze and synthesize contemporary scientific publications concerning the physiological and functional characteristics of the female body in the context of athletic preparation, with a particular focus on combat sports.

2. To identify patterns in the influence of ovarian-menstrual cycle phases on physical performance and adaptation to training loads in women practicing combat sports, with regard to planning and adjusting training and competitive activities.

3. To formulate key requirements for the content of the training process for female combat athletes, taking into account the physiological phases of the ovarian-menstrual cycle based on the synthesis of available literature.

Materials and methods. This study was conducted as an analytical review aimed at systematizing and critically analyzing scientific data on the effects of the ovarian-menstrual cycle (OMC) on the physiological status and athletic performance of women practicing judo.

A systematic search of scientific publications was performed in both international and national databases, including PubMed, Scopus, Web of Science, RSCI, as well as electronic archives of specialized journals in sports science. The analysis focused primarily on publications from 1998 to 2025, which allowed the inclusion of both foundational studies and contemporary works reflecting current approaches to the topic.

The main keywords included: menstrual cycle, menstrual cycle phases, female athletes, eumenorrhea, exercise performance, strength, endurance, recovery, hormonal fluctuations, combat sports, judo, along with their Russian-language equivalents. Studies addressing specific aspects of female physiology and its influence on the training process were also considered. The review included:

- Systematic reviews and meta-analyses (McNulty et al., 2020; Carmichael et al., 2021; Schlie et al., 2025; review of 78 studies as of 2025)
- Research measuring hormonal profiles (Meignié et al., 2021)
- Studies addressing both subjective and objective performance indicators (McNulty et al., 2020; Carmichael et al., 2021)
- Empirical and clinical studies evaluating physical performance in different cycle phases, including anaerobic and aerobic tests, reaction time, strength, and endurance.

Only original studies and reviews reporting OMC phase data confirmed either by hormonal markers or reliable calendar-based methods were included. Excluded were studies lacking clear phase classification or sporting performance data. Exclusion criteria also encompassed research without information on menstrual cycle phases, studies with heterogeneous samples without the possibility of isolating combat sports-specific data, particularly judo, as well as publications that did not analyze performance indicators.

Results. Phase-dependent variability in female athletic performance within the ovarian-menstrual cycle represents an important factor to consider when planning training loads and preparing for competitive activity. The individual nature of functional changes in athletes necessitates a personalized approach to managing the training process. In this context, the professional competence of the coach becomes crucial, requiring foundational knowledge in biomedical sciences to structure training and competitive activities more effectively and optimize their outcomes.

Several contemporary studies emphasize the need for a differentiated approach to preparing female athletes during the pre-competition phase. For instance, Holtzman and Ackerman highlight that physiological characteristics of the female body, including hormonal regulation, body composition, and metabolic profile, directly influence athletic performance and adaptation to high-intensity training and competitive loads. The authors note that neglecting these factors may reduce performance efficiency and increase the risk of adverse functional states, whereas accounting for them enhances the reliability of competitive performance and minimizes performance losses under intense competitive conditions [5].

Hormonal fluctuations throughout the cycle—primarily estrogen and progesterone—affect metabolism, cardiovascular dynamics, neuromuscular regulation, and psychological state. Estrogen promotes improvements in aerobic capacity and vascular function, while elevated progesterone during the luteal phase is associated with increased body temperature and fatigue.

Table 1 provides a concise overview of hormonal changes and their expected physiological effects.

Table 1 - Hormonal changes and physiological effects of ovarian-menstrual cycle phases (compiled by the authors based on sources [6–10]).

Cycle Phase	Dominant Hormones	Physiological Effects
Menstrual	↓ Estrogen, ↓ Progesterone	Possible decrease in perceived performance
Follicular	↑ Estrogen	Enhanced aerobic endurance and metabolism
Ovulation	Estrogen peak	Increased reaction speed, potential improvements in strength and power
Luteal	↑ Progesterone	Fatigue, elevated body temperature, metabolic changes

Existing empirical evidence indicates that in practical sports training, female athletes engaged in combat sports often do not have the opportunity to adjust training loads according to the phases of their physiological cycle. This limitation arises because competition schedules are typically fixed in advance, and the structure of annual training plans is often rigid, restricting the ability to tailor training content to the individual biorhythms of athletes. Nevertheless, a growing body of research documents both subjective and objective changes in performance, well-being, and physical parameters depending on the menstrual cycle phase in female athletes [11, 12].

For instance, a longitudinal study involving female boxers revealed significant variability in both objective and subjective parameters including fatigue levels, stress, sleep quality, and coordination across the follicular, ovulatory, and luteal phases of the cycle, highlighting the necessity of accounting for these changes when planning training and recovery [13].

Moreover, large survey-based studies involving elite taekwondo and judo athletes (48 and 76 participants, respectively), as well as 81 volleyball players and 36 basketball players, showed that a substantial proportion of women reported better perceived well-being during the first 14 days of their cycle compared to the latter 14 days ($p < 0.01$). When comparing non-menstrual and menstrual periods, athletes indicated that their performance did not significantly differ ($p < 0.01$).

Broader narrative reviews emphasize that the metabolic and hormonal fluctuations characteristic of the menstrual cycle can influence aerobic, anaerobic, strength, and psycho-emotional components of physical performance, although these effects often manifest individually and can vary among athletes [14, 15].

In the scientific literature, there are isolated studies addressing changes in judo athletes' performance across menstrual cycle phases. However, the volume and depth of empirical data obtained from female combat sport athletes remain limited and do not allow for a comprehensive characterization of the menstrual cycle's effects on sports performance [16–18].

In a large-scale study by Niering et al., which included 433 healthy women representing various sports, it was found that the early follicular phase is generally unfavorable for all three classes of maximal strength examined during the menstrual cycle. The late follicular phase represents an optimal window for peak isometric strength, whereas the late luteal phase, likely due to low estrogen levels, appears to be the least favorable. Conversely, isokinetic maximal strength decreases in the late follicular phase, while the ovulatory phase is considered the most favorable, probably due to increased luteinizing hormone levels, which also enhance testosterone availability. The late follicular phase appears optimal for achieving maximal dynamic strength, potentially as a result of elevated estrogen, whereas the mid-luteal phase is considered least suitable for optimal muscular function due to reduced estrogen (decreased neuromuscular facilitation) and increased progesterone (reduced neuromuscular/synaptic transmission). To reduce heterogeneity in results for female athletes, further research should involve larger samples and account for sports experience, type of sport, and training level [19].

Studies investigating aerobic performance measures, such as VO_2max and time to exhaustion, have generally reported no significant differences across menstrual cycle phases. However, individual participants occasionally reported subjective decreases in well-being during the early follicular and mid-luteal phases. These findings suggest a relative stability of aerobic endurance in female athletes throughout the menstrual cycle [20].

Research conducted by University College London and published in *Sports Medicine – Open* (2025) demonstrated that women's cognitive performance varies according to the phase of the ovarian–menstrual cycle. Specifically, the ovulatory phase was associated with improved cognitive test outcomes, including a statistically significant reduction in sensorimotor reaction time compared to the luteal phase. The authors noted that habitual physical activity is an independent factor significantly influencing cognitive function, yet the menstrual cycle phase also contributes meaningfully to the observed variations [21].

Specific investigations in judo athletes remain limited. The most notable study by Itaka et al. [22] assessed menstrual symptoms in 169 judokas across different weight categories. The authors documented variations in subjective well-being during the postmenstrual period depending on the athletes' weight class; however, objective measures of strength and power performance across cycle phases were scarcely analyzed. Other studies examining the physical and technical-tactical preparedness of female judokas did not account for menstrual cycle phase, focusing instead on comparisons of strength and aerobic capacities across levels of athlete qualification [23–25].

Based on an analysis of contemporary scientific literature, generalized considerations for planning the training process of women engaged in combat sports according to the phases of the ovarian–menstrual cycle have been identified and are presented in Table 2.

Table 2 – Generalized considerations for planning the training process of women in combat sports (judo, women's wrestling, boxing, taekwondo) according to the phases of the ovarian–menstrual cycle (compiled by the authors based on sources [26–29])

Menstrual Cycle Phase	Characteristic Changes in Functional State	Typical Responses to Training Loads	Predominant Limitations and Risks	Methodological Training Focus
Menstrual	Variable reduction in performance, possible pain, increased fatigue	Reduced tolerance to high-intensity loads, slower recovery	Increased risk of overtraining, decreased attention and concentration	Reduce training volume and intensity; emphasize technical-coordination exercises and recovery
Follicular	Gradual stabilization of functional indicators, increase in energy potential	Enhanced adaptation to strength and speed-strength loads	Minimal limitations with adequate recovery	Increase training intensity; focus on strength development and sport-specific skills
Ovulatory	Optimal balance of physiological and psycho-emotional indicators	Maximal expression of speed-strength and coordination potential	Possible underestimation of fatigue during high loads	Conduct key training sessions; simulate competitive scenarios
Luteal	Gradual increase in fatigue, possible mood fluctuations	Decreased resilience to repeated high-intensity loads	Risk of accumulated fatigue and reduced motivation	Adjust training loads; increase recovery strategies; maintain technical proficiency

The analytical synthesis of scientific publications revealed pronounced differences in the functional state of women engaged in combat sports depending on the phases of the ovarian-menstrual cycle (Table 2). Each phase of the cycle is characterized by a specific combination of physiological, psycho-emotional, and motor-functional manifestations, which influence the organism's response to training loads

During the menstrual phase, most athletes exhibit variability in functional indicators, manifested as reduced tolerance to high-intensity loads and slower recovery processes. In the follicular phase, there is a trend toward stabilization of physiological status and enhanced adaptive capacity, accompanied by improved responses to strength and speed-strength stimuli. The ovulatory phase is characterized by the most favorable combination of physical and psycho-emotional parameters, supporting high efficiency in performing complex coordination and speed-strength tasks. In the luteal phase, a gradual increase in fatigue and decreased resilience to repeated high-intensity loads are observed, while technical stability is relatively maintained

These identified patterns allow for the systematic organization of methodological training priorities, including the adjustment of training volume, intensity, and focus according to the phase-specific physiological state of athletes in combat sports.

Based on a critical review and synthesis of current scientific literature, the authors identified the main phase-related patterns describing how the ovarian-menstrual cycle may influence physical performance, adaptation to training loads, and training organization in women involved in martial arts (Figure 1). The proposed framework summarizes recurring trends reported across studies and considers the biological cycle as an important factor in the individualization of training.

The reviewed evidence suggests that the menstrual phase is often associated with greater variability in well-being and a possible decline in perceived readiness to perform. In practice, this may justify a temporary reduction in training intensity, a stronger focus on technical tasks, and increased use of recovery strategies.

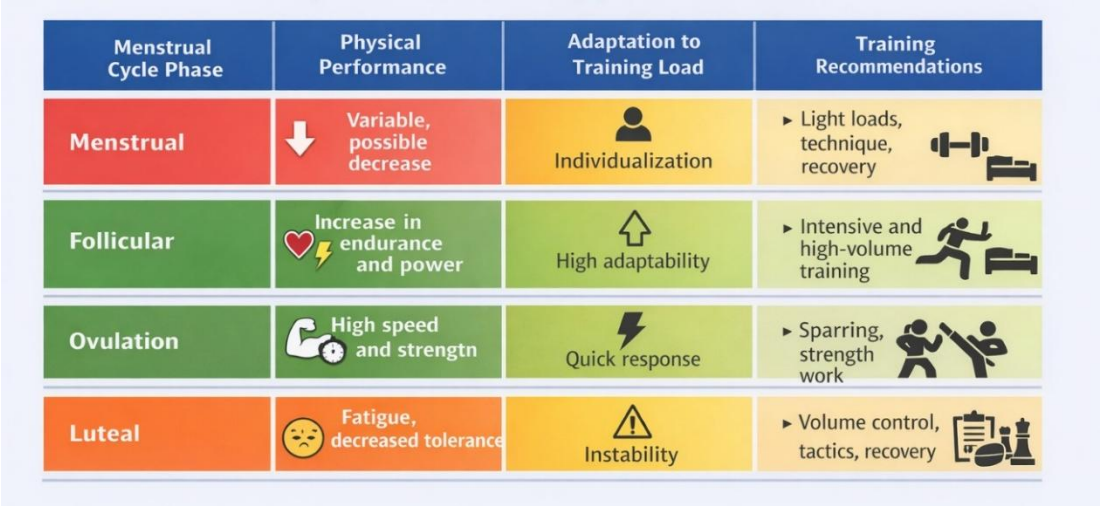

Figure 1 – Phase-Related Patterns of Ovarian-Menstrual Cycle Influence on Physical Performance, Training Adaptation, and Training Recommendations in Women Engaged in Martial Arts

During the follicular phase, more favorable conditions are commonly observed for endurance development, power output, and tolerance to larger training volumes. The ovulatory period may coincide with improved speed-strength qualities, faster reactions, and readiness for high-intensity work. In contrast, the luteal phase may be accompanied by higher fatigue, lower tolerance to demanding loads, and a greater need for flexible regulation of training volume, with additional emphasis on tactical preparation and recovery.

Overall, the synthesized data indicate a tendency toward improved strength performance during the late follicular and ovulatory phases of the cycle, relative stability of aerobic capacity, and potential variability in cognitive and reactive functions, which may have significant implications for both training and competitive performance in combat disciplines.

Discussion. Comparison of the results indicates that the role of the ovarian-menstrual cycle (OMC) in women's athletic performance is complex and multifaceted. Despite the lack of a unified scientific consensus regarding the significant impact of cycle phases on objective performance indicators, there is consistent recognition of the importance of hormonal fluctuations for the subjective perception of effort, recovery, and psychological state in female athletes.

Most contemporary meta-analyses and reviews emphasize that the influence of OMC phases on aerobic and anaerobic performance is moderate or minimal, yet the variability of effects among individual athletes remains a significant source of uncertainty. An important aspect is the distinction between objective physiological measurements and self-reported perceptions of performance. Recent studies indicate that women often report decreased performance in certain phases, even when objective measurements do not corroborate this, highlighting the relevance of psychophysiological factors in athletic preparation.

For athletes in combat sports, where strength, endurance, and coordination are all critical, such nuances can have practical significance, particularly during periods of peak training load and competition preparation.

The data analyzed suggest that the influence of OMC on women's athletic performance across various sports remains a topic of discussion. The contradictory findings in the literature largely stem from differences in study design, methods for assessing performance, and characteristics of participant samples. Nevertheless, several studies note that the phases of the ovarian-menstrual cycle affect both physiological state and subjective performance, although this influence is not always reflected in objective performance measures and is often dependent on individual characteristics of the athlete [30–32].

When planning the attainment of peak performance in young female athletes in combat sports, it is essential to conduct comprehensive monitoring of various components of functional state and to make timely adjustments to the training process based on the athlete's capacity.

For objective monitoring of functional status in female combat athletes, it is recommended to maintain a self-monitoring log that records: perceived well-being, fatigue, mood, motivation to train, presence of headache, lower back or abdominal pain, body mass, evaluation of training load, perceived tolerance to load, onset of menstruation (on time or with deviations), performance, and basal body temperature. Based on the data collected in the log, coaches, medical staff, or the athletes themselves can assess the impact of OMC phases on physiological and functional state, determine the adequacy of current training loads, and justify the need for adjustments overall or within specific cycle phases. This, in turn, provides a logical basis for targeted planning of training in mesocycles and macrocycles, as well as for evaluating the long-term developmental potential of each athlete.

Training sessions conducted during the pre-competition phase of centralized preparation are characterized by a substantial increase in training volume and, above all, intensity, reflecting the necessity of bringing athletes to an optimal level of competitive readiness. During this period, strict daily routines, rationally organized nutrition, comprehensive recovery interventions, and the availability of a sufficient number of sparring partners allowing the simulation of various competitive scenarios become particularly important. The effectiveness of preparation at this stage is largely ensured through continuous pedagogical and medical monitoring, as well as the reduction of extraneous domestic factors that could compromise training quality.

The present synthesis supports the view that the influence of the ovarian-menstrual cycle on athletic performance should not be treated as a fixed or identical response for all athletes. Rather, it appears to be an individual biological factor, expressed differently depending on the athlete and the training context. At the same time, the literature reveals several recurring tendencies that can be useful for coaches, sport scientists, and practitioners working with female combat sport athletes.

The framework developed in this study is not intended to impose rigid training prescriptions based only on calendar phases of the cycle. Instead, it offers an evidence-informed structure that may assist in adjusting training loads, selecting training means, and reducing excessive physiological strain. This approach is especially relevant in martial arts, where athletes must combine strength, endurance, reaction speed, coordination, technical precision, and psychological stability within the same training process.

It is also important to recognize that phase-related responses may be modified by age, competitive level, energy availability, psychological stress, individual cycle characteristics, and the use of hormonal contraception. Therefore, the proposed model should be viewed as a practical guide for personalized training management rather than a universal rule. Further empirical studies in specific martial arts disciplines are needed to refine and validate these assumptions.

During training camps, particular attention should be given to the analysis of pedagogical and medical monitoring data aimed at timely identifying discrepancies between the magnitude of training loads and the current functional state of female judokas. Neglecting this aspect may lead to cumulative fatigue and reduced efficiency of pre-competition preparation.

In judo, it is essential to consider the sport-specific characteristics, which include high-intensity efforts, a pronounced anaerobic component, substantial physical contact, and a strong emphasis on throwing techniques. Under these conditions, fluctuations in functional state associated with phases of the ovarian-menstrual cycle (OMC) may exert a more pronounced impact on competitive performance compared to less contact-intensive sports [23, pp. 147–166]. However, the limited number of studies conducted specifically on female judokas, alongside a predominance of descriptive research focusing on athletes' subjective perceptions, precludes the formulation of definitive practical recommendations for integrating OMC phases into training design. An additional limitation is the absence of standardized, judo-specific tests to assess performance across different cycle phases.

Thus, despite the availability of some publications, the influence of OMC on the athletic performance of women in combat sports remains insufficiently explored, underscoring the relevance and necessity of further targeted research.

Conclusion. The conducted analytical review enabled the systematization of contemporary scientific knowledge on the physiological and functional characteristics of the female body in the context of sports training. The findings highlight the complex interplay between hormonal fluctuations, adaptation to training stimuli, and performance outcomes, emphasizing the variability of these interactions across different phases of the ovarian–menstrual cycle and the need for a comprehensive assessment of athletes' functional status. The analysis demonstrates that cycle phases exert multifaceted effects on physical performance and adaptation to training loads in women engaged in combat sports, particularly due to fluctuations in estrogen and progesterone levels, which influence responses to high-intensity and speed–strength exercises. At the same time, the degree of influence varies across functional parameters, underscoring the importance of individualized monitoring and training control. Based on the synthesis of theoretical and empirical evidence, practical recommendations have been formulated for optimizing training processes, including the adjustment of training volume and intensity in accordance with functional status, strategic distribution of loads during physiologically favorable phases, enhancement of recovery strategies during periods of increased fatigue, and the integration of objective and subjective monitoring methods. Such a systematic approach contributes to improved adaptation, resilience to training stress, and more effective management of female athletes' preparation. Future research should focus on comprehensive longitudinal studies across menstrual cycle phases in both training and competitive settings, incorporating sport-specific performance tests while accounting for athletes' skill levels and weight categories in combat sports.

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ФАЗЫ ОВАРИАЛЬНО-МЕНСТРУАЛЬНОГО ЦИКЛА И ОСОБЕННОСТИ ТРЕНИРОВОЧНО-СОРЕВНОВАТЕЛЬНОЙ ДЕЯТЕЛЬНОСТИ ЖЕНЩИН В ВИДАХ ЕДИНОБОРСТВ: ОБЗОР НАУЧНЫХ ДАННЫХ

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Аннотация. В статье представлен комплексный обзор научных данных о влиянии фаз овариально-менструального цикла (ОМЦ) на физиологическое состояние, адаптацию к тренировочным нагрузкам и соревновательную деятельность женщин-спортсменок, с акцентом на виды единоборств (дзюдо, женская борьба, джиу-джитсу, бокс). Рассмотрены механизмы гормональных колебаний, их влияние на аэробные и анаэробные показатели, силовые качества, восстановление и воспринимаемую работоспособность. Проанализированы результаты клинических исследований и систематических обзоров, выявляющих как спорные, так и устойчивые эффекты ОМЦ на спортивную работоспособность. Обсуждаются практические выводы для тренеров и спортсменок, а также перспективы дальнейших исследований в области физиологии женского спорта в единоборствах.

Ключевые слова: менструальный цикл, женская физиология, спортивная работоспособность, гормональные фазы, планирование тренировок, единоборства.

ЖЕКПЕ-ЖЕК СПОРТ ТҮРЛЕРІМЕН АЙНАЛЫСАТЫН ӘЙЕЛ СПОРТШЫЛАРДЫҢ ЖАТТЫҒУ-ЖАРЫС ҚЫЗМЕТІНІҢ ЕРЕКШЕЛІКТЕРІ ЖӘНЕ ОВАРИАЛДЫ-МЕНСТРУАЛДЫҚ ЦИКЛ ФАЗАЛАРЫ: ҒЫЛЫМИ ДЕРЕКТЕРГЕ ШОЛУ

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Аңдатпа. Мақалада овариальды-менструалды циклдің (ОМЦ) фазаларының әйел спортшыларының физиологиялық жағдайына, жаттығуларға бейімделуіне және жарыстық қызметіне әсері жөніндегі ғылыми деректердің кешенді шолуы ұсынылған, соның ішінде жекпе-жек спорт түрлері (дзюдо, әйелдер күресі, джиу-джитсу, бокс) назарға алынған. Гормондық өзгерістердің механизмдері, олардың аэробты және анаэробты көрсеткіштерге, күштік қасиеттерге, қалпына келуге және субъективті жұмыс қабілетіне әсері қарастырылған. Клиникалық зерттеулер мен жүйелі шолулардың нәтижелері талданып, ОМЦ-ның спорттық қабілетке әсерінің дау тудыратын және тұрақты эффектілері анықталған. Тренерлер мен спортшыларға арналған практикалық ұсыныстар талқыланып, әйелдер спортшыларының физиологиясы саласындағы әрі қарайғы зерттеулер перспективалары көрсетілген.

Түйінді сөздер: менструалдық цикл, әйелдер физиологиясы, спорттық жұмыс қабілеті, гормондық фазалар, жаттығу үдерісін жоспарлау, жекпе-жек спорт түрлері.

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