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QUANTITATIVE ASSESSMENT AND NOMENCLATURE OF THE MENSTRUAL CYCLE PHASES IN ATHLETES: ANALYSIS OF CLASSIFICATIONS

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Abstract. The menstrual cycle can influence the well-being and physical performance of elite female athletes. Objective – to analyze existing approaches to the classification of menstrual cycle phases in female athletes in the scientific literature, with an emphasis on the quantitative definition and nomenclature of the phases used. The study was conducted in two stages. Methods of the first stage: the literature search was carried out in accordance with the PRISMA-S and PRESS checklists. The literature search was performed in the PubMed database. The time frame of the search was 5 years. No language barrier was set. Methods of the second stage: the ACCORD guideline was used to ensure compliance with reporting rules between experts. Participants were recruited through purposive sampling, during which a group of experts was selected based on the criteria of knowledge of the issue. The search identified 63 references. A total of 12 studies met the inclusion criteria. The studies indicated from 2 to 7 menstrual cycle phases with different names. The experts' opinions mainly differed in their commitment to consider the ovarian cycle (n=7, 50%), the uterine cycle of the menstrual cycle (n=5, 35%), and a mixed variant (n=2, 15%). The need for further research in the field of the menstrual cycle is due to the lack of unanimity among experts regarding the number of phases and their names. Until a consensus is reached in the scientific community, the results of all studies including female participants should be interpreted with caution.
Keywords: menstrual cycle, ovarian hormones, estrogens, progesterone, sports.

Introduction. Since Gamberale et al [1] showed in 1975 that pulmonary ventilation during submaximal exercise varies throughout the menstrual cycle, interest on an influence of female sex hormones on the performance of athletes picks up [2-5]. It is known that estrogen and progesterone fluctuations potentially influence the physical performance of women [2]. Maximal muscle strength appears to be higher in the follicular phase and in ovulation than in the luteal phase in both untrained [6] and trained women [7], while muscle fibre recovery and remodeling has been shown to occur faster in the mid-follicular phase than in the luteal phase following eccentric exercise [8]. Thus, there is a suggestion that estrogen fluctuations may influence the body's adaptive responses to physical activity [9]. For the same reason, the influence of the menstrual cycle on training response in female athletes has attracted particular attention [10, 11]. In their meta-analysis, Romero-Parra et al [12] have revealed that lower training activity or longer recovery periods may be observed in the early follicular phase, when sex hormone concentrations are lower and women may be more vulnerable to muscle injury, whereas strength training activity may be increased in the mid-luteal phase.

In the scientific literature, menstrual cycles are frequently divided into physiological phases from the simplest (two phases) to very detailed (seven phases) [13]. However, most previous studies tend to rely on a three-phase model with the assumption that there is a steady hormone level: menstruation (low sex hormones level, early follicular phase), pre-ovulation (high estrogen, late follicular phase) and luteal phase (high estrogen and progesterone) [14]. Despite its simplicity, the three-phase model does not take into account important hormonal shifts occurring during the cycle. It does not reflect the changes associated with the transition from high estrogen in the late follicular phase to ovulation, then to the luteal phase, characterized by high estrogen and progesterone, and finally return to menstruation. Hormonal changes during phase transition can be rapid and significant in magnitude, creating dramatic changes in a woman's hormonal environment and making homeostasis maintenance difficult [15]. It should be noted that the premenstrual phase, which is traditionally considered as a part of the luteal phase, is a critical period of dramatically reduced hormone levels and has hardly been studied in sports science research. However, it is in the premenstrual phase and during the subsequent

early follicular phase (menstruation) that unfavorable symptoms of the menstrual cycle are most common in athletes and increase the likelihood of the need for prolonged recovery from training [12], deterioration of the training process and performance [16]. Taking into consideration the analysis of the issue, data from modern literature and enquiries from sports biologists, physiologists and sports medicine physicians, we have formed the objective of the study.

Objective – to analyze existing approaches to the classification of menstrual cycle phases in female athletes in the scientific literature, with an emphasis on the quantitative definition and nomenclature of the phases used.

Methods and organization. The study took place in the Sports Medicine Department of the Russian University of Sport (Moscow). The ACCORD (ACcurate COnsensus Reporting Document) guideline [17] dedicated and applicable to all consensus methods used in biomedical studies was implemented to ensure compliance with the survey rules between the experts. The study included two stages.

Stage I. The researchers have conducted a systematic literature search in compliance with the ACCORD (items M6 and M7) guideline for the number and names of the menstrual cycle phases. The literature search was performed in accordance to the PRISMA-S [18] and PRESS (Peer Review of Electronic Search Strategies) [19] checklists. The following keywords were used in the PubMed database: (Menstrual Cycle Phase) AND (female athletes). The time frame of the search was 5 years. No language barrier was set and no study design restrictions were applied.

Stage II. Choosing the experts. Participants were recruited through purposive sampling, during which a group of experts was selected based on the criteria of knowledge, work experience, scientific interest and communication skills. The experts were recruited from the following areas: obstetrics and gynecology (n=4), sports physiology (n=4), coaching activity in sports (n=6, among which n=2 – biathlon; n=2 – rhythmic gymnastics; n=2 – weightlifting). The expert selection process started with sending an invitation via e-mail to the experts meeting the selection criteria by one of the authors (N.V. Lunina). The sent invitations had the following content: info about the research project, information consent forms and the literature review results on the number and naming of the menstrual cycle phases. The reviewers were invited to contact the author via email, phone or social media to discuss the sent project. In addition, the participants were invited to send info about the project to interested experts in the abovementioned fields of professional activity, who, in their opinion, are competent in the specified issue and meet the selection criteria. The interested experts then confirmed their participation via email. An approval from ethical committee was not required for the implementation of this study. All participants provided written informed consent prior to inclusion in the study. The ACCORD description provides info that there are no generally accepted standards for the number of experts recruited for the consensus. As a result, the committee target size (14 people) was determined by the desired representation and ensuring an acceptable response rate (7, assuming a 50% participation rate) in the event of non-participation or partial completion of the survey. The expert committee members who agreed to participate received an info package containing an introductory letter, a plain short summary, an informed consent statement as well as a questionnaire containing the literature review, the number and names of the menstrual cycle phases (table 1), against which the experts were asked to express their opinion in accordance with the presented data. If they disagreed with it, they were asked to present their option of the number and names of the menstrual cycle phases.

The interviewing process. The interviewing process included an online questionnaire that the experts completed over a 7-day period (January-February 2025). Participants were invited to rate their level of agreement with a number of statements assessing adherence to the number and names of the menstrual cycle phases.

Results and discussion. *Stage I results.* The search identified 63 references. Twelve studies met the inclusion criteria (table 1).

The studies indicated 2 [23, 27] to 7 phases with [13] different names. The smallest number of phases was identified by Homer et al. [23] – follicular phase and luteal phase, however Tagliapietra et al [27] used different names – early-follicular phase and mid-luteal phase. The greatest number was determined by Elliott-Sale et al [13]: early follicular phase, mid follicular phase, late follicular phase, ovulation, early luteal phase, mid luteal phase, late luteal phase.

Six studies have identified 3 phases. Romero-Parra et al [12], Thompson et al [20] and Guisado-Cuadrado et al [26] used the following names: early follicular phase, late follicular phase and midluteal phase. Tucker et al named them differently [24]: the follicular phase, the ovulatory phase and the luteal phase). Brown et al [25]: early-follicular phase, mid-late follicular phase and luteal phase. Galletti et al [28]: early follicular phase, ovulatory phase and mid-luteal phase. In the remaining 3 included studies, Bruinvels et al [14] identified 4 phases: late follicular phase, ovulation, luteal phase and menstruation, while D'Souza et al [21] named 6: early follicular phase, late follicular phase, ovulation, early luteal phase, midluteal phase, late luteal phase. Niering et al applied the same names [22].

Table 1

Literature review of the menstrual cycle phases in female athletes

Authors/year	Number of phases	Names of phases
Romero-Parra et al, 2021 [12]	3	Early follicular phase Late follicular phase Midluteal phase
Elliott-Sale et al, 2021[13]	7	Early follicular phase Mid follicular phase Late follicular phase Ovulation Early luteal phase Mid luteal phase Late luteal phase
Thompson et al, 2021 [20]	3	Early follicular phase Late follicular phase Midluteal phase
Bruinvels et al, 2022 [14]	4	Late follicular phase Ovulation Luteal phase Menstruation
D'Souza et al, 2023 [21]	6	Early follicular phase Late follicular phase Ovulation Early luteal phase Mid-luteal phase Late luteal phase
Niering et al, 2024 [22]	6	Early follicular phase Late follicular phase Ovulatory phase Early luteal phase Mid-luteal phase Late luteal phase
Homer et al, 2024 [23]	2	Follicular phase Luteal phase
Tucker et al, 2024 [24]	3	Follicular phase Ovulatory phase Luteal phase
Brown et al, 2024 [25]	3	Early-follicular phase Mid-late follicular phase Luteal phase
Guisado-Cuadrado et al, 2024 [26]	3	Early follicular phase Late follicular phase Midluteal phase
Tagliapietra et al, 2024 [27]	2	Early-follicular phase Mid-luteal phase
Galletti et al 2025 [28]	3	Early follicular phase Ovulatory phase Mid-luteal phase

Stage II results. Among 14 people invited to participate in the questionnaire, only 7 of them completed the Stage II (50%). 100% of the participants identified themselves as women. The most common answers are shown in table 2.

Table 2

Distribution of experts' answers by number and name of the menstrual cycle phases

Number of phases	2	3	7	4	6	3	3	4	4
Names of phases	FP LP	eFP lFP mLP	eFP mFP lFP O eLP mLP lLP	lPF O LP M	eFP lFP O eLP mLP lLP	DP O LP	eFP mlFP LP	Ml Fl Ol pLP	D R P S
Number of answers	-	-	1	-	-	6	-	2	5
Professional activity			1(OG)			2(OG) 2(cB) 2(cRG)		2(cW)	1(OG) 4(SP)

Note: FP – follicular phase; LP – luteal phase; O – ovulation; M – menstruation; D – desquamation; R – regeneration; P – proliferation; S – secretion. Periods (p) of the menstrual cycle phases: e – early phase; m – mid; l – late phase; p – post phase. Professional activity of the experts: OG – obstetrics and gynecology; SP – sports physiology; c – coach; B – biathlon; RG – rhythmic gymnastics; W – weightlifting. Cycles: – ovarian cycle; – uterine cycle; – mixed variant.

According to physiological data, during fertility, the menstrual cycle (MC) is regulated by a hierarchical complex interaction of all parts of the female reproductive system. The menstrual cycle regulation has a multilevel structure: 1st level of MC regulation – cerebral cortex and extrahypothalamic cerebral structures; 2nd level of MC regulation – hypophysiotropic zone of hypothalamus; 3rd level – anterior lobe of pituitary gland; 4th level – ovaries, where the ovarian cycle is divided into phases: follicular, ovulation, luteal; 5th level – target tissues (uterus, fallopian tubes, vagina, mammary glands, skin, bones, adipose tissue), where the uterine cycle is correlated with the phases: desquamation, regeneration, proliferation, secretion.

The differences in the experts' opinions are apparently associated with the peculiarities of the professional activity ensuring the emphasis on physiological processes occurring in different links of the reproductive system, conditioned by the level of regulation. The literature analysis covered the consideration of the ovarian cycle only. The experts' opinions mainly diverged on the adherence to consider the ovarian cycle (n=7, 50%), uterine cycle (n=5, 35%), mixed variant (n=2, 15%).

Conclusion. The menstrual cycle is an infradian (i.e. lasting more than one day), circamenial (i.e. lasting about a month) biological rhythm. During the menstrual cycle, there is a predictable periodic change in the concentration of the sex hormones produced by the ovaries – estrogen and progesterone. It is important to emphasize that there is considerable inter- and intra-individual variation in cycle length and hormone concentrations. In addition to their primary reproductive functions, estrogens and progesterone have been found to play a role in non-reproductive processes, affecting skeletal, cardiovascular and brain health. Thus, the menstrual cycle (more specifically estrogens and progesterone) has become a topic of interest to female athletes in terms of health and performance.

A significant part of studies in sports focuses on male population. Therefore, findings have often been incorrectly extrapolated to female athletes, leading to misconceptions about women's abilities and needs in sports. The reasons for this are, firstly, complex methodological issues faced by scientists in conducting such studies and, secondly, complexity of interpreting of various results frequently monitored in both separate studies and

when comparing different studies. Investigating the impact of the menstrual cycle phases on physical performance is an important component needed to develop women's evidence base in sport science. The development of this evidence base can improve understanding of how the phases can affect female athletes and inform how to design and implement training, recovery and monitoring programs for women with the phases in mind. A literature review and the expert survey revealed that researchers and experts identify between 2 and 7 phases with different names. Although identifying two phases is a useful tool, it does not adequately capture the diversity of hormonal changes characteristic of each. It is also common in menstrual cycle research to distinguish separate phases, each characterized by specific physiological changes. These phases include the early follicular phase, late follicular phase, ovulatory phase, early luteal phase, midluteal phase and late luteal phase. Therefore, further research is needed to obtain consensus among experts on the topic of the number and names of the phases. Until there is a consensus among experts, all studies involving women should be interpreted with caution.

Conflict of interest. The authors declare no conflict of interest.

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