INDIVIDUALIZATION OF TRAINING PROCESS OF RUNNERS AT VARIOUS DISTANCES DEPENDING ON BIORHYTHMICS OF THEIR BODY

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Анотація

У статті представлені результати дослідження динаміки рухових якостей, емоційного стану і техніки бігу у спортсменок (n = 20), що спеціалізуються в бігу на різні дистанції, відповідно до фаз специфічного біологічного циклу.

Дані проведеного дослідження свідчать про наявність протягом овaріально-менструального циклу фазових змін показників рухових здібностей спортсменок. Встановлено також, що динаміка кожного з них має свої особливості, характерні для тієї чи іншої фази менструального циклу. Ці особливості ми пов'язуємо зі зміною функціонального стану органів і систем, від яких залежить рівень прояву різних рухових здібностей спортсменок. За результатами аналізу отриманих даних можна зробити висновок, що найбільш виразні зміни емоційного стану, що виражаються в погіршенні настрою, підвищення рівня тривожності, у спортсменок спостерігаються в передменструальній і менструальній фазах ОМЦ. Облік цього положення при побудові тренувального процесу може підвищити його ефективність без збільшення обсягу та інтенсивності застосовуваних навантажень.

Однак, перш ніж планувати обсяг навантажень за фазами овaріально-менструального циклу, слід визначити, який вплив кожна фаза має на фізичну працездатність, рухові якості, психо-фізіологічний стан конкретної спортсменки, оскільки встановлено, що ці показники носять в значній мірі індивідуальний характер.

Таким чином, планування тренувального процесу з урахуванням індивідуальних особливостей, властивих жіночому організму, дозволить не тільки забезпечити більш високу сумарну працездатність спортсменок і підвищення рівня спеціальної підготовленості, але і збереже їх репродуктивне здоров'я.

Ключові слова: спортсменки, овaріально-менструальний цикл, фази, рухові здібності, індивідуальні особливості, тренувальний процес.

Аннотация

В статье представлены результаты исследования динамики двигательных качеств, эмоционального состояния и техники бега у спортсменок (n = 20), специализирующихся в беге на различные дистанции, в соответствии с фазами специфического биологического цикла.

Данные проведенного исследования свидетельствуют о наличии в течение овариально-менструального цикла фазовых изменений показателей двигательных способностей спортсменок. Установлено также, что динамика каждого из них имеет свои особенности, характерные для той или иной фазы менструального цикла. Эти особенности мы связываем с изменением функционального состояния органов и систем, от которых зависит уровень проявления различных двигательных способностей спортсменок. По результатам анализа полученных данных можно сделать вывод, что наиболее отчетливые изменения эмоционального состояния, выражающиеся в ухудшении настроения, повышение уровня тревожности, у спортсменок наблюдаются в предменструальной и менструальной фазах ОМЦ. Учет данного положения при построении тренировочного процесса может повысить его эффективность без увеличения объема и интенсивности применяемых нагрузок.

Однако, прежде чем планировать объем нагрузок в соответствии с фазами овариально-менструального цикла, следует определить, какое влияние каждая фаза имеет физическую работоспособность, двигательные качества, психо-физиологическое состояние конкретной спортсменки, так как установлено, что данные показатели носят в значительной степени индивидуальный характер.

Таким образом, планирование тренировочного процесса с учетом индивидуальных особенностей, присущих женскому организму, позволит не только обеспечить более высокую суммарную работоспособность спортсменок и уровня специальной подготовленности, но и сохранит их репродуктивное здоровье.

Ключевые слова: спортсменки, овариально-менструальный цикл, фазы, двигательные способности, индивидуальные особенности, тренировочный процесс.

Problem statement. Training athletes is a complex and multifaceted process of effective use of a number of components that ensure the optimal level of its readiness for its main start. At the same time, the most important aspect ensuring the highest sport result is the search for rational forms of building training loads in the annual cycle and in its individual structural formations [1, 5, 7, 10]. At the same time, the individual approach is the potential factor of productive planning of the training process, which, first of all, should provide for biorhythmological features of the athlete's body, characterized by a variety of morphological, physiological and psychological changes [2, 13, 15].

However, the training process of women is particularly influenced by a specific biological cycle, accompanied by a number of morphological, physiological and psychological changes in the female body. That is why an individual approach is an important aspect of effective planning of the training process, ensuring the optimal level of training, taking into account the biorhythmological characteristics of athletes [3, 11, 15].

Thus, there is no doubt that the training process of athletes, and especially the highly qualified, requires special conditions of the body, planning training and competitive loads, the focus of specialized training. At the same time, individual changes in the mental and functional state of the organism, athletic performance and motor qualities throughout the childbearing period of a woman, to a large extent, depend on the cyclical nature of the functions of its reproductive system. Therefore, the knowledge and use in the practical activity of trainers of information about the features of biorhythmological patterns of the functioning of the organism of a particular athlete is of significant importance not only to improve her athletic performance, but also to preserve health.

Analysis of recent research and publications. It is an indisputable fact that domestic and foreign experts in the field of theory and methodology of physical culture and sports have accumulated enough theoretical and experimental experience to solve the problem in athletics [3, 5, 6, 11, 17]. However, some aspects of the theoretical basis for the construction and content of the micro and mesostructure of the training process of running short distances require a more thorough approach. The latter is due to the need to individualize and coordinate the direction and intensity of training effects in accordance with the biorhythmological characteristics of the female body.

Until now, the training activities of athletes, mainly based on the conventional methods for men. This is evidenced by the results of our surveys of coaches working with the female contingent, as well as the data obtained from the survey of female athletes [3, 13]. It is confirmed that the preparation of athletes do not take into account the morphological, functional and psychophysiological features of the female body, the reserves increase in special performance, and this can negatively affect their health, and as a result, the sports result.

According to some researchers, excessive training effects may contribute to overtraining in women to a much greater extent than in men [2, 3, 12, 18]. This assumption necessitates the normalization of loads, adequate to the operational and current state of the female body to prevent overtraining. Both the optimal planning of individually oriented training programs, and the choice of means and methods of development of motor abilities for a particular sportswoman should be aimed at improving the dynamics of its performance, functional capabilities of the main body systems and the course of recovery processes in various phases of the ovarian-menstrual cycle (OMC).

In addition, taking into account this position in the construction of the training process can improve its efficiency, in terms of ensuring the growth of motor capabilities of athletes, without increasing the volume and intensity of the applied loads [2, 8, 13, 18].

The aim of the study is to identify changes in the individual parameters of the level of motor qualities, emotional state and running techniques in athletes specializing in running at different distances, during their specific biological cycle.

Material and methods of research. In the study, conducted on the basis of the scientific research laboratory of the Olympic sports of the Gomel State University named after F. Skorina, athletes (n=20), specializing in running for short and medium distances, took part. A pedagogical experiment was conducted, during which, based on the analysis of the duration of the athlete's biological cycle and the comparison of the control and pedagogical testing data at the beginning and the end of the training macrocycle (10 months), the dynamics of their speed-strength indicators were studied.

During the full individual biorhythmologic cycle, the runners participating in the experiment for short distances, using electronic timekeeping and a digital video camera, determined the time, length and frequency of steps in the run at 30 m from the start and 150 m from the start. These distances athletes ran into each of the five phases of the OMC.

The phases of OMC were determined by the results of a special questionnaire. For instrumental control over power and speed-power capabilities of different muscle groups of athletes were used the method of computer tenzodynamography, namely, the recording and analysis of the curve of development of muscle force in time [3, 13]. Were recorded and processed tesnzodynamograms demonstration of the power of muscle groups that carry most of the load in the structure of the sprint racing of the muscles extensors of leg (EL) in the knee and hip joints and the plantar flexors of the foot (PFF).

The results of the study and their discussion. Daily examination of athletes allowed to find individual differences in their reactions to the same type of training load. The results of the experiment on the example of three athletes are shown in figure 1. Revealed that typical training effects cause runners mixed reactions to basic motor functions. This indicates that the current changes of the latter are predetermined not only by the nature of training loads, but also by other factors related to daily living conditions, the nature and diet, leisure, sleep, etc., as well as individual characteristics of the OMC. At the same time, these factors can largely neutralize the influence of training influences.

Thus, the results confirm the idea that training mesocycles should be built so that the content, means and methods of each microcycle fully correspond to the level of performance, individual ability to recover, as well as physical, functional and mental state of the body of the athlete, inherent in a certain phase of the OMC.

The analysis of the biological cycle duration in the athletes examined by us showed that depending on this parameter they can be divided into three groups: in the first (9 athletes) there was a 28-day menstrual cycle, in the second (4 athletes) – 31-day; in the third (7 athletes) – 21-day cycle. Based on this, the number of full training mesocycles in each of the three groups of athletes defined by us is different. Thus, in runners with a 21-day menstrual cycle, the annual macrocycle consists of 17 mesocycles.

Athletes whose CMC is 28 and 31 day manage to get 13 and 11 full mesocycles, respectively. At the same time, it is obvious that the shorter the CMC for female athletes, the fewer days in their microcycles are characterized by good and high performance. At 21-day OMC, the number of days with high efficiency is about 156, and at 28-day and 31 – day-208 and 223, respectively.

Consequently, the athletes with a 31-day cycle represent the most effective biological model for the implementation of training plans, while the girls with a 21-day cycle during the annual macrocycle days with good and high performance there are 77 less.

Comparison of the data of control and pedagogical testing at the beginning and end of the training

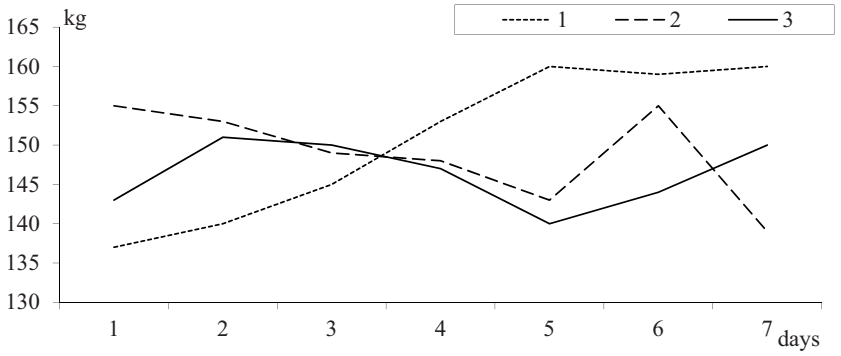

Fig.1. Daily individual reactions (indicators of the maximum strength of leg extensors in the knee and hip joints) in three runners at short distances (1, 2, 3) to the standard motor load in the macrocycle

cycle (10 months) showed differences (statistically unreliable for 5% of the significance level) in the growth of speed and strength parameters in runners with different biological cycles (table 1).

Table 1

Growth of speed-power and power indicators in runners with different biological cycle

Indicators	21-day cycle	28-day cycle	31-day cycle
Power	4,5±1,1%	5,1±2,1%	6,3±2,7%
Speed-power	6,3±2,5%	8,0±1,2%	9,2±1,0%

To determine the impact of the OMC on the motor quality of the runners during the year we conducted control and pedagogical testing, including 8 exercises of speed, speed-power and power character. In the process of comparing the dynamics of physical qualities of individual athletes in the phases of the ovarian-menstrual cycle, we, as well as in the case of different duration of the biological cycle, identified three groups of runners, each of which had its own characteristics of the manifestation of motor capabilities and psycho-physiological state in each phase.

In the menstrual phase, the athletes, conditionally assigned to the second and third group, slightly changed speed (running 30 m from a low start) and speed-power (long jump and triple from the place, the shot of the core 4 kg from the bottom-forward and over the head back) performance, separate power tests (bench press). At the same time, the health of the runners, representing the first group (it was the most numerous) was poor, fatigue quickly occurred, there was a lack of coordination of even the usual movements.

During the post-menstrual and post-ovulatory phases, which are usually attributed to the periods of manifestation of good performance, the subjects, referred to the 2nd group, speed, speed-power and power indicators were at the same level, while the representatives of the 1st and 3rd groups noted a desire to train and a good recovery. During the ovulatory phase, minor differences in health and attitude to training load in the second group of athletes were determined.

In the premenstrual phase in the first and some athletes of the second group observed a decrease in performance, deterioration of control over the accuracy of movement, poor vestibular stability. Manifested as irritability, unwillingness to train. Control and pedagogical testing showed a decrease in the results of all tests.

It should be noted that the majority of the subjects, which we referred to the first group, there was a premenstrual syndrome, which indicates that there were negative changes in the body. Probably, the reasons of this tendency can consist in certain omissions allowed by the trainer at the organization of training process in the puberty period.

Considering the painful condition of most sportswomen in the I and V phases, and some in the III rd, it is necessary in this period to reduce the volume and intensity of training loads, exclude exercises with straining, lifting large burdens, jumping exercises with a landing on a rigid support, as well as exercises with excessive flexibility and mobility.

Interesting data were obtained in determining the dynamics of the kinematic parameters of the running technique at 30 m from the stroke

Table 2

Dynamics of kinematic parameters of running technique at 30m from the move during the OMC phases in athletes in the annual training cycle

Structure of the annual cycle (periods, stages)	Phase / Options	I	II	III	IV	V
Base stage	running time, sec $\bar{x} \pm S$	3,18 0,03	3,14 0,02	3,20 0,03	3,13 0,02	3,19 0,03
	length of steps, m $\bar{x} \pm S$	2,03 0,02	2,06 0,01	2,05 0,02	2,06 0,01	2,03 0,02
	step frequency, s/sec $\bar{x} \pm S$	4,64 0,06	4,64 0,02	4,58 0,06	4,65 0,03	4,63 0,03
Specially-preparatory stage	running time, sec $\bar{x} \pm S$	3,14 0,03	3,10 0,02	3,15 0,02	3,08 0,01	3,16 0,03
	length of steps, m $\bar{x} \pm S$	2,04 0,02	2,07 0,01	2,07 0,02	2,07 0,02	2,04 0,02
	step frequency, s/sec $\bar{x} \pm S$	4,68 0,06	4,68 0,04	4,60 0,07	4,70 0,05	4,65 0,04
Competitive period	running time, sec $\bar{x} \pm S$	3,10 0,02	3,08 0,01	3,11 0,02	3,06 0,01	3,10 0,02
	length of steps, m $\bar{x} \pm S$	2,07 0,02	2,08 0,01	2,08 0,02	2,08 0,01	2,07 0,02
	step frequency, s/sec $\bar{x} \pm S$	4,68 0,04	4,68 0,02	4,63 0,05	4,71 0,03	4,68 0,04

Table 3

Dynamics of kinematic parameters of running technique at 150m from the start during the OMC phases in athletes in the annual training cycle

Structure of the annual cycle (periods, stages)	Phase / Options	I	II	III	IV	V
Base stage	running time, sec $\bar{x} \pm S$	17,12 0,08	16,82 0,05	17,08 0,07	16,90 0,06	17,10 0,06
	length of steps, m $\bar{x} \pm S$	2,09 0,02	2,13 0,02	2,10 0,02	2,13 0,01	2,10 0,02
	step frequency, s/sec $\bar{x} \pm S$	4,19 0,06	4,19 0,06	4,18 0,07	4,17 0,05	4,18 0,08
Specially-preparatory stage	running time, sec $\bar{x} \pm S$	16,90 0,05	16,73 0,06	16,82 0,06	16,79 0,04	16,85 0,07
	length of steps, m $\bar{x} \pm S$	2,10 0,03	2,13 0,02	2,12 0,02	2,13 0,01	2,10 0,03
	step frequency, s/sec $\bar{x} \pm S$	4,23 0,07	4,21 0,04	4,20 0,04	4,20 0,04	4,24 0,06
Competitive period	running time, sec $\bar{x} \pm S$	16,70 0,05	16,61 0,04	16,68 0,05	16,66 0,04	16,72 0,06
	length of steps, m $\bar{x} \pm S$	2,18 0,03	2,21 0,01	2,19 0,01	2,21 0,01	2,17 0,07
	step frequency, s/sec $\bar{x} \pm S$	4,12 0,05	4,09 0,03	4,10 0,04	4,08 0,03	4,13 0,04

and 150 m from the start during the phases of the OMC in athletes in the annual training cycle (Tables 2 and 3). The results of the research show that at all stages the best time is recorded in the II and IV phases, and the lowest results are in III and V. So, in the run at 30m on the move at the basic stage of preparation, the difference between the best time in phase IV and the worst in V is 0,06 s, on special-preparatory - 0,08 s, in the competitive period - 0,04 s (table 2). The result at this distance is more determined by the frequency of the running steps than their length.

So, if the difference in the length of the running steps at the base and special preparatory stages is 3cm (1.5%), and in the competitive period only 1cm (0.5%), then in the step frequency the differences reach 0.10 s/s (2.2%) on a special preparatory and 0.07 s/s (1.5%) in the base stages. In the competitive period, there is less variability in the analyzed indicators and with a practically stable step length during all phases of the OMC. The improvement of the result (by 0.04 s) occurs in the IV phase, in comparison with I, due to an increase in the frequency of the steps.

It is noteworthy that in the ovulatory (III) phase the lowest running speed is observed, while the step length does not change, in comparison with the most favorable II and IV phases. This can be explained by the fact that in the phase of ovulation, according to the principle of the dominant, all activities become secondary [4, 9, 15]. In this phase, even in more prepared athletes, the potential for functional reserves is reduced, coordination of movements, orientation in space is violated, and technical errors can be increased.

As for running at 150m (see table 3), the following picture is observed here. In all the analyzed stages of the annual cycle, the best result was noted in the post-menstrual (II) phase. The worst time was recorded at the basic and special-preparatory stages in menstrual (I), and in the competitive period in the premenstrual (V) phase. Moreover, the differences in the preparation stages in the results become smaller (0.20s - 0.17s - 0.11s), and the best result, in contrast to running at 30m on the move, corresponds to a large average step length.

It can be stated that the ability of an athlete to maintain an optimal amount of muscular effort for a long time while repulsing in a run of 150m more affects the improvement of the result, rather than an increase in the pace of running.

Characterizing the factors that increase the effectiveness of sports activities, the importance of the psychological aspect is noted, since it has long been known about the influence of positive and negative emotions on the success of the activity. It is shown [14, 16] that the reliability and effectiveness of athletes' performances at competitions are related, in particular, to their operational mental state. In connection with this, the study of emotional states, taking into account the peculiarities of the biological patterns of functioning female body allowed to scientifically substantiate an individual approach in the training process of athletes.

Of particular interest and importance is the definition of anxiety, as a reactive state of the athlete. Situational (reactive) anxiety is characterized by objectively experienced emotions of tension, anxiety, neuropsychic tension, accompanied by activation of the autonomic nervous system. This is an internal stable state of anxiety, as a behavioral response to certain life situations.

Table 4

Indicators of situational anxiety in athletes in different phases of OMC ($\bar{x} \pm S$)

Conventional units		Phase OMC	The reliability of the differences is the criterion Student (t)				
$\bar{x}$	S		Phase OMC				
			I	II	III	IV	V
39,3	8,3	I	X				
33,2	5,9	II	2,45*	X			
37,1	6,6	III	0,88	2,38*	X		
37,6	7,3	IV	0,45	2,66*	0,62	X	
42,3	7,8	V	0,106	3,28*	1,43	1,52	X

Notes:

1) * – differences are significant at $p<0.05$;

2) phase OMC: I – menstrual; II – postmenstrual; III – ovulatory; IV – postovulatory; V – premenstrual.

Table 5

Indicators of the emotional state of the test SAN athletes in the different phases of the OMC ($\bar{x} \pm S$)

Conventional units		Phase OMC	The reliability of the differences is the criterion Student (t)				
$\bar{x}$	S		Phase OMC				
			I	II	III	IV	V
23,7	7,3	I	X				
32,6	6,8	II	2,84**	X			
28,7	6,3	III	1,82	1,62	X		
31,9	7,1	IV	2,62*	0,96	1,60	X	
22,3	6,9	V	0,98	3,26**	2,96**	3,18**	X

Notes:

1) * – differences are significant at $p < 0.05$;

2) phase OMC: I – menstrual; II – postmenstrual; III – ovulatory; IV – postovulatory; V – premenstrual.

Analysis of the results of testing on the basis of the questionnaire C. Spilberger-Yu.L. Khanina [14] in athletes shows (Table 4) that the level of situational anxiety is high in the V phase and statistically significant ($p<0.05$) differs from the index in phase II. A condition clearly perceived and evaluated by athletes as a clear sense of anxiety, anxiety and fear manifests itself in the premenstrual phase. In the menstrual phase, the mental state is characterized by a feeling of dissatisfaction, fatigue, some emotional depression or tension. In general, this is confirmed by studies of athletes using the SAN method (Table 5), in which emotional coloration has a negative character with a predominance of negative emotions.

In the post-menstrual phase, the picture changes significantly, and subjectively athletes evaluated their emotional state as the most good. In most sportswomen, the emotional state is characterized by a sense of satisfaction, optimism, a desire for action.

In the ovulatory phase, changes are less pronounced. In this phase, it is difficult to determine the preferential direction of emotional reactions. Apparently, in the phase of ovulation in athletes can be observed diametrically opposite emotional states, depending on many external and internal factors. So, in this phase, a fairly high business activity, aspiration to activity - on the one hand, and inadequate stubbornness, dissatisfaction, rather high emotional tension - on the other. In the process of interaction, this state manifests itself in the initiation of conflicts, resentment, instability.

The postovulatory phase, according to the characteristics of the psychic states of the athletes in it, is very similar to post-menstrual phase. Their state here is characterized by a positive emotional background, some euphoria, the desire for new events, impressions.

Thus, based on the results of the analysis of the data obtained, it can be concluded that the most distinct changes in the emotional state, expressed in worsening mood, increasing anxiety, in athletes are observed in the premenstrual and menstrual phases of the OMC.

Conclusions from this study. The data of the conducted research testify to the presence of phase changes in the motor performance indicators of athletes during the CMC. It is also established that the dynamics of each of them has its own characteristics, characteristic for this or that phase of the menstrual cycle. These features we associate with the change in the functional state of organs and systems, on which the level of manifestation of the various motor abilities of athletes depends. However, before planning the volume of loads for the phases of the CMC, it is necessary to determine what effect each phase has on the physical per-

formance, motor qualities, psychophysiological state of a particular athlete, since it is established that these indicators are largely individual.

Thus, the planning of the training process, taking into account the individual characteristics inherent in the female body, will allow not only to ensure a higher overall performance of athletes and increase the level of special preparedness, but also to preserve their reproductive health.

Prospects for further research. It is planned to identify the pattern of changes in the composition of the body of athletes in different phases of OMC to determine the optimal orientation of training effects.

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