

Some approaches to the training process of footballers considering functional capacity of the female body in different phases

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Abstract. The article deals with physiological approaches to the training process of footballers in accordance with the possibilities of the female body in different phases of the ovarian-menstrual cycle (OMC). The purpose is to substantiate the correction of the training process in accordance with the state of the body of footballers in different phases of the OMC in the preparatory period. The task was to develop approaches to planning the training process of footballers in the "strong" and "weak" phases of the OMC. The following research methods were chosen for solving the tasks: the analysis of library and e-resources; paraclinical methods (instrumental-functional: pulsometry, tonometry, electrocardiography, computerized spirometry, laboratory).

The survey engaged 40 women footballers of I grade at the age of 18-20. In each of the five phases of the OMC all the subjects underwent a planned set of studies: determination of hormonal state, pulsometry and tonometry indices, bioelectric activity of the heart (ECG), computer spirometry. The obtained results were used to determine the phase changes peculiarities of the studied parameters of the cardiorespiratory system and central hemodynamics and to develop recommendations for optimizing the training process by its planning in accordance with the functional capabilities of the body in different phases of the OMC. The results of the library and e-resources analysis, and own data on index changes, during the OMC, of the state of the cardiorespiratory system, central hemodynamics, physical fitness, special preparedness and morphofunctional characteristics of the surveyed footballers obtained at previous stages of the study became the basis of the approach differentiation while planning the training process designed for women's football teams at different stages of the preparatory period in accordance with the functional capabilities of the female body in each of the phase cycle.

Keywords: women footballers, ovarian-menstrual cycle, cardiovascular system, respiratory system, physical fitness, training process.

Introduction.

The basis of the athletes' modern training is the systematic approach - the synthesis of the functional systems theory and the adaptation theory that allows obtaining significant information about the functional state of the athletes' body during the training process and use the obtained data for its correction (Buchtiy, 1989; Platonov, 2004; Fales 2000, Alexeyeva 1997, Barabasz 2009).

The system of sports training for female football players needs to be improved and built taking into account the biological features of the female body, the most important of which is the hormonal reorganization during the ovarian-menstrual cycle (OMC) (Posholienchyk, 1987; Radzijeviskiy, 1990; Barabasz, 2009).

Analysis of recent research. According to the modern data, the female body of fertile age during the ovarian-menstrual cycle (OMC) produces estrogens and progesterone, the terms of production and the influence of them on the body are different (Budzyn, 2009; Radzijeviskiy, 1990; Mallo, 2008). Thus, estrogens intensify protein metabolism, promote the growth of muscle mass, positively affect the trophism of the myocardium, increase the shock and minute volume of blood; under their influence the sympathetic department of the autonomic nervous system is activated, vascular tone increases, CNS excitability and aggressiveness increase. At the same time, progesterone contributes to a certain decrease in the intensity of metabolic processes. However, it increases the functional activity of the thyroid gland, activates the parasympathetic part of the autonomic nervous system, promotes pulse rate, increases blood pressure, and increases the frequency of respiration (Popel, 2005; Shakhlina, 2001).

Consequently, under the influence of estrogen, I phase of OMC has a high level of adaptation to physical activity, the cardiovascular system is characterized by significant potential and economization of myocardial function. It can be argued that during I phase of OMC the sportswoman's body has a rather high potential for physical activity.

Estrogens are active at the beginning of the second phase of OMC. Under their influence, the cardiovascular system of sportswomen can withstand considerable physical activity, but the compensatory

possibilities of the myocardium are not sufficient. Although the high permeability of the respiratory tract and the insignificant energy expenditure on the work of the respiratory muscles ensure good adaptation of the respiratory system to physical activity, its compensatory capabilities are little. Since physical activity is largely dependent on the state of the cardiovascular system, insufficient compensatory possibilities of the myocardium indicate that although the II phase is "strong," the female body is able to withstand vigorous but short-term physical activity.

From the beginning of the third phase and until the end of OMC, the female body is under the influence of progesterone. Therefore, during III phase of OMC, compensatory mechanisms of the myocardium are intense, the respiratory system is not sufficiently adapted to physical activity, and the functioning of the respiratory muscles is ineffective. In general, the adaptive and compensatory capabilities of the body are small, which gives grounds to consider the third phase of OMC "weak" (Budzyn, 2009; Alexseyeva, 1997).

In IV phase of OMC, the cardiovascular system of sportswomen is characterized by a significant increase in potential and adaptive capacity; the functional readiness of the respiratory system to exercise is the highest, creating the physiological preconditions for prolonged and significant physical activity (Budzyn, 2008; Shakhlina, 2001). During V phase of OMC, additional regulatory mechanisms are needed to ensure the functioning of the myocardium, as its reserve capacity is negligible. The respiratory system has low functional readiness for physical activity, rapid depletion of reserves. After loading, the consistency of permeability of various caliber bronchial tubesis disturbed: the maximum permeability of large bronchi with the simultaneous minimum permeability of middle-sized bronchial tubes can create preconditions for the emergence of various (mainly obstructive) respiratory disorders. At the end of the cycle, spasm of small vessels worsens the blood supply to the myocardium and adversely affects the reactivity of the bronchi-pulmonary complex. The obtained data give reason to consider V phase of the cycle "the weakest" (Budzyn, 2008; Radzijeviskij, 1990; Shakhlina, 1998). Thus, physiologically deterministic periodic variations of the potential, adaptive and compensatory possibilities of the female body contribute to the differentiation of training loads in accordance with the functional capabilities of sportswomen in each of the phases of OMC.

The purpose

To substantiate the correction of the training process according to the body's state of the women footballers in different phases of OMC in the preparatory period.

Task. 1. To develop approaches to planning the training process of women footballers in the 'strong' phases of OMC.

2. Develop approaches to planning the training process of women footballers in the 'weak' phases of OMC.

The following research methods were chosen for solving the tasks:

1. Analysis of library and e-resources;
2. Paraclinic methods (instrumental-functional: pulsometry, tonometry, electrocardiography, computer spirometry, laboratory).
3. Methods of mathematical statistics.

Organization of the research.

The research was conducted on the basis of the Department of Football at Lviv State University of Physical Culture. Instrumental examinations were carried out on the basis of the Diagnostic Center of Lviv Railway. In order to verify the phases, the content of estrogens and progesterone in venous blood was determined in the radioisotope laboratory of the Lviv Regional Clinical Hospital.

The survey engaged 40 athletes of the 1st grade at the age of 18-20.

In each of the five phases of OMC all the subjects underwent a planned set of studies: determination of hormonal state, pulsometry and tonometry indices, bioelectric activity of the heart (ECG), computerspirometry. The obtained results were used to determine the of phase changes peculiarities of the studied parameters of the cardiorespiratory system and central hemodynamics, and to develop recommendations for optimizing the training process by its planning in accordance with the functional capabilities of the organism in different phases of OMC.

After conducting initial (background) surveys, women footballers were random divided into an experimental group (EG) and control group (CP) in 20 people in each. The training of the EG footballers was carried out taking into account the peculiarities of the female body and its capabilities in each of the five phases of the OMC. The developed approaches to training provided differentiation of physical activity and directing of training process depending on the phase of a specific biological cycle. In particular, during II and IV phases of OMC the main focus of the training process was the development of strength, speed-strength and speed qualities. Particular attention was paid to the "weak" I, III and V phases of OMC, during which we recommended developing flexibility and stressed the need to avoid physiologically inappropriate exercises in these phases. The CP women footballers were trained according to the recommendations set out in the manuals for men of the same age and sports qualification.

Discussion and result

The results of determining the hormonal state and the state of central regulation, the activity of the ovaries in the examined EGs and CGs in each of the OMC phases are presented in Table 1.

Table 1

The content of prolactin and female sex hormones in blood serum of the examined aged 18-20 during the biological cycle (n = 40)

OMC phases	Groups	Prolactin, (nanogram/ millilitre)	Progesterone, (nanomole/ litre)	Estradiol,(nanomole/ litre)
1	2	3	4	5.
I menstrual	EG	13.37±0.25	1.00±0.28	0.21±0.02
	CG	12.89±0.10	1.51±0.03	0.21±0.02
II post-menstrual	EG	15.02±0.57	1.57±0.42	0.40±0.02
	CG	14.01±0.07	2.31±0.02	0.41±0.02
III ovulatory	EG	15.59±0.78	5.56±0.09	0.70±0.03
	CG	16.68±0.06	5.44±0.03	0.68±0.02
IV post-ovulatory	EG	18.06±0.30	12.41±0.37	0.67±0.15
	CG	17.53±0.02	13.07±0.01	0.71±0.03
V pre-menstrual	EG	16.34±0.48	8.14±0.50	0.59±0.02
	CG	17.01±0.02	7.45±0.02	0.57±0.03

As it can be seen from the above data, the content of all the studied hormones in individuals of both groups was within the norm limits for women of fertile age, so intergroup differences between the values of the studied indices we have not been established. The obtained results (confirmation of the presence in the blood serum of female sex hormones and prolactin, and the fluctuations in their concentration during OMC) allowed conducting a further examination of the selected contingent.

An analysis of changes in the bioelectric activity of the cardiac muscle confirmed the distribution of the OMC phases to "strong" and "weak" ones (Table 2). At the same time both those and others were not homogeneous. Thus, I and V phases of the OMC were characterized by greater potential of the myocardium than III phase; there were signs of the atrium compensatory mechanisms tension. However, in the first phase of the cycle, there was a coordination disorder of myocardial activity and its insufficient ability to recover from physical activity, and in V phase, due to the reduction of reserve capacity of the ventricles, there was clearly a need for the inclusion of additional compensatory mechanisms. It was established that in the "strong" phases of the biological cycle, the atrial-ventricular conductivity was better than that of the "weak" ones, and the manifestations of the compensatory mechanisms action in the myocardium were smaller; in IV phase of the biological cycle, the potential of the myocardium was greater than that in the second phase.

According to the results of the computer spirometry of women footballers during OMC, indices of FVLC (functional vital lung capacity),FEC₁(forced exhalation capacity),CMS (capacity maximum speed) and BC(breathing capacity) were within the limits norm of sex and age. The main differences in the functioning of the external respiration apparatus were manifested in the process of comparing its indices defined in different phases of OMC. In particular, the lowest FVLC indices in rest state were detected in III and V phases of OMC, the highest in II and IV phases (in both cases p < 0.05 relative to the parameters obtained in phase V) (Fig. 1).

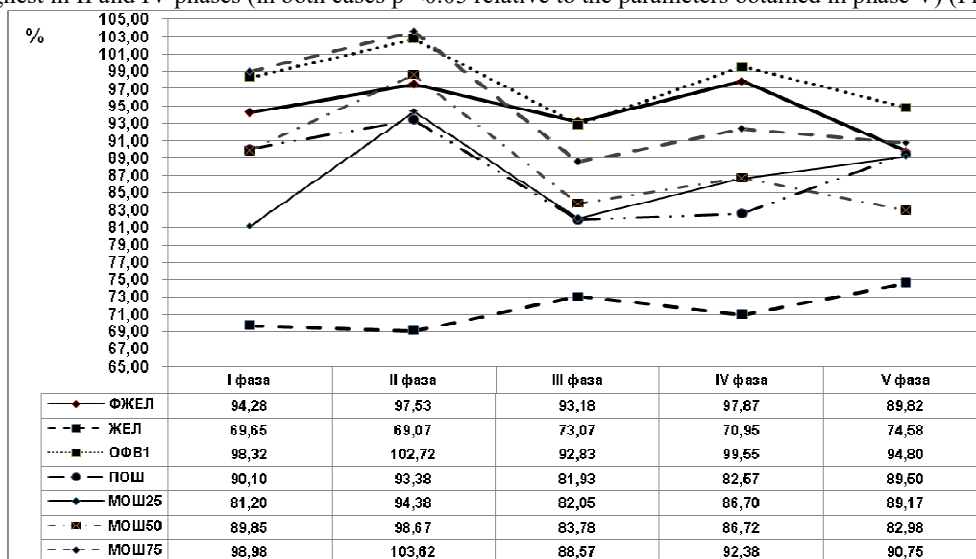


Fig. 1. Dynamics of some indices of the external respiration function in women footballers aged 18-20 during OMC (state of rest)

In all phases of OMC, VLC indices were somewhat lower than the proper values. The highest values of VLC in rest state were achieved in III and V phases of OMC. The FEC_1 index for all phases of OMC was within the normal range. At the same time, the highest values of the mentioned index in the rest state were found in II phase (102.72 ± 10.43 liter, $p < 0.05$ relative to the parameters obtained in III phase, and $p < 0.05$ relative to V phase) and in IV phase (99.55 ± 12.23 liter); in III and V phases of OMC the parameters of the discussed index were smaller.

The highest SC_{sin} in rest state were observed in the first and second phases of OMC (respectively, 90.1 ± 10.36 and $93.38 \pm 4.72\%$, relative to the parameters of III, IV, V phases $p < 0.05$); the lowest value of the discussed index was in III phase ($81.93 \pm 18.99\%$, in relation to the results of the first and second phases $p < 0.05$).

Indices of the beginning, middle and end of exhalation CMS_{in} indices were within norm limits during all phases of OMC and had similar dynamics. The index of CMS_{25} in rest state was the smallest in III phase of OMC ($82.05 \pm 17.83\%$). The highest values of the discussed parameter were established during II phase of the biological cycle: the digital values of CMS_{25-75} in rest state were significantly higher than during III, IV and V phases of the cycle ($p < 0.05$). In the third phase of OMC, compared with the rest of the phases, the level of permeability of large bronchi (CMS_{25}) in rest state was insignificant ($82.05 \pm 17.83\%$).

In the rest state, the highest digital values of the BC indices were found in III phase of the biological cycle (0.68 ± 0.3 liter), the lowest - in IV phase (0.58 ± 0.3 liter), the lowest BF was observed in I and III phases of OMC (respectively 15.05 ± 2.53 inhalation/min, $p < 0.05$ relative to the values of this index in II and IV phases of OMC, and 14.97 ± 1.26 inhalation/min, $p < 0.05$ relative to the values of the indices in IV and V phases).

While developing differentiated approaches to training, we took into account the data obtained in each of the phases of the biological cycle characterizing the reserve, potential and adaptive capabilities of the women footballers' body. The reason was the results of changes in morpho-functional parameters, indices of the cardiorespiratory system, the state of central hemodynamics, physical capacity and special preparedness during OMC. The specifics of women football, the football players' conditioning, and the regularities of improving various qualities were taken in account. Considerable attention was paid to the psychological and medical-biological means of recovery, of which the preference was given by auto-genous training, sleep and rest, special respiratory exercises, improvement of microclimate in a team, etc. To accelerate recovery processes after intensive loads, the method of arbitrary muscle relaxation was used that was based on the successive relaxation of the largest muscle groups followed by synchronous inhibition of the central nervous system. Among the medico-biological means, we chose those that activate protein synthesis and were aimed at the restoration of vitamin balance, and also contribute to faster restoration of work capacity and increase the functional state of the body (various types of massage, aqua procedures).

The purpose of the preparatory period was to form the basis for the general and special readiness of women footballers for the further successful resolution of the main tasks of the sports session. By structure, it consists of 3 stages: general-preparatory, special-preparatory, pre-competition. The sequence of stages, their duration and character are determined by the development regularities of the women footballers' fitness and the need to solve the specific tasks of the training process.

The general preparation stage is the basic in the system of football players' training. The training of athletes during this period takes place in the conditions of the training session. Average duration of the general preparation stage is 6 weeks.

During the general preparation stage the training should be directed at the versatile physical conditioning of athletes. During workouts the greatest amount of time is devoted to exercises that contribute to the restoration and further development of endurance, speed and strength qualities, flexibility, coordination of movements. In particular, specific means (ball exercises) are aimed at restoring the coordination of movements and the rhythm structure of the main technique elements: ball passes, dribbling, kicks, etc. Technical and tactical exercises (TTEs) should be conducted individually, in twin and triplets. The coordination complexity of exercises should increase gradually. It is advisable to use a wide range of nonspecific means: exercises with burdens, crosses, jumps, acrobatics, aerobics, etc. The correlation between the training means should be the following: 65% of the exercises are non-specific, while exercises of a specific nature - 35%. Training cycle of general preparatory stage usually lasts six days of workouts and one day of rest (6 + 1).

During I (menstrual) phase of the biological cycle, the training load should be mainly supportive. At the same time, the significant potentialities that a female body has in this phase allow developing endurance and flexibility. The methodical features of the trainings are to reduce their volume and intensity, moderate load on the cardiovascular system, and the insignificant (low) intensity of exercise. During this period, more attention should be paid to the development of flexibility - the ability to perform movements in the joints with as much amplitude as possible. It is expedient to perform stretching exercises lasting from 15-20 seconds to 2-3 minutes. The duration of rest intervals between exercises or set of exercises should range from 10-20 seconds to several minutes. Such lessons are directed, both on the development of flexibility, and on increasing the functional capacity of the body to future growing physical activity. The training should be in accordance with the high potential and reserve capacities that the female body disposes of in I phase of OMC. The proportion of non-specific exercises (without a ball) can be 50-70%, specific (with a ball) - 25-40%. Technical and tactical training

should be carried out during 40-60% of the workout time. Recommended duration of exercises without martial arts is 70-80% of the total amount of the workout time, exercises with martial arts - 20-30%, the intensity of the load - within 50-55%, the load volume - the average. During the discussed phase of OMC, it is advisable to restrict exercises for the abdominal area, vigorous exercises, exercises for large groups of muscles (trunk, hips), and jumps. Duration of the workouts should not exceed 60 - 70 minutes. The workouts should be conducted once a day. After the workout we recommend to have a rest in the form of slow walking, exercises for relaxation. Light massage (shoulder girdle, hip and leg muscles) and psychological and pedagogical means (autotraining) are helpful for restoration.

In II (post-menstrual) phase of the cycle, the functional capabilities of the cardiorespiratory system and the potential of the body as a whole are significantly increased. It is advisable to use means that promote the development of speed and speed-strength qualities, endurance, agility, and flexibility. Exercises are performed mostly without a ball (80%) and with martial arts (70-90%). It is advisable to perform technical and tactical training during 40-60% of the workout time. Endurance, agility, and flexibility should be developed. The intensity of the load should be within 50-55%, the load volume is submaximal. It is desirable to extend the duration of the workouts to 90 minutes. In order to have active rest between series of exercises it is necessary to make pauses, during which women footballers are recommended to perform exercises of restorative nature - stretching, self-massage of those muscle groups that were most involved in the work. As a rest after the workout it is advisable to take water procedures (sauna, hot baths, and warm shower), apply manual massage of the leg muscles, psychological restoration.

Since during ovulation (III phase of OMC) functional capabilities of the organism decrease, training sessions should be mainly supportive it is advisable to continue to develop flexibility. Exercises that promote the development of speed-strength qualities and endurance are acceptable when applying average loads. It is necessary to limit the exercise for the abdominal area, vigorous exercises, and jumps. During the workouts, the exercises of technical and tactical nature should prevail. It is advisable to reduce the duration of the workouts to 60-70 minutes. The amount of training load without a ball is 60-65%, with a ball - 35-40%; technical-tactical training varies in the range of 40-60%, the coordination complexity of exercises without martial arts is 80-90%, exercises with martial arts - 10-20%. The intensity of the load decreases to the level characteristic for I phase of OMC (50-55%). In order to restore after the workouts, we recommend water procedures (sauna, underwater shower-massage), manual massage of shoulder and thigh areas, psychological means.

In IV postovulatory phase of the cycle, the functional capabilities of the body of the women footballers are quite high. During the training sessions emphasis should be placed on the use of exercises that promote the development of strength and speed-strength qualities, endurance, agility, and coordination. It is recommended to use exercises with burdens, jumps, to use methods of continuous and interval exercises. Load volume should be submaximal and maximum intensity with the focus of training on improving physical and technical readiness. The share of non-specific exercises (without a ball) should be 70-80%, the exercises with the ball - 20-30%; technical and tactical training should vary in the range of 20-30%. The coordination complexity of the workouts without martial arts should not exceed 30%, with martial arts - 70-90%. The intensity of the load is desirable to increase to 70-75%, the duration of the training - 90 minutes. After training, it is necessary to apply a set of rehabilitation measures: a sauna, a bath, vibratory massage of the leg muscles, contrast showers, and psychological means.

The V (pre-menstrual) phase is characterized by a significant decrease in the functional capabilities of the body. During V phase the means of supportive nature in moderate mode are used, they do not include significant loads, jumps, sharp movements, falls, and exercises with burden. The volume of the load without a ball should be in the range of 55-70%, with the ball - 30-45%. Technical and tactical training varies within 40-55%. The coordination complexity of exercises without martial arts is 30%, with martial arts - 10-20%. Load intensity is minimal and does not exceed 45-55%. Considering the increased excitability of the psycho-emotional sphere ("pre-menstrual syndrome"), psycho-emotional stress, and stressful situations should be avoided. In this phase, the duration of the workouts should not exceed 60 minutes. For restoration it is recommended to use such means as warm showers, aqua massage, manual massage of the shoulder girdle area and back, and psychological and pedagogical means.

Conclusions

The analysis of scientific literary sources and own research convincingly testify to the division of the OMC phases into "strong" (II and IV) and "weak" (I, III, V). During "strong" phases, the anabolic processes prevail in the body, the activity of the cardiovascular and respiratory systems are activated, and the compensatory and reserve capacities of the organism increase. In these phases of OMC, the differentiation of approaches to the training process at the general preparation stage involves the development of speed, speed-strength qualities, endurance, and agility. Recommended exercises are following: with burden and jumps; intensity of physical activity should be submaximal and maximum.

In "weak" phases, the functional capabilities of the body are reduced, and training sessions should be mainly supportive. It is recommended to develop the body's overall endurance and flexibility, and to avoid physiologically inappropriate in these phases exercises.

Prospects for the research are the further application of differentiated approaches to the training of women football teams in the annual training cycle.

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