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CHARACTERISTICS OF THE FUNCTIONAL READINESS OF PROFESSIONAL FEMALE ATHLETES INVOLVED IN MODERN PENTATHLON

ABSTRACT. The article shows the results of the study considering the issues of functional readiness of highly qualified sportswomen specializing in modern pentathlon. The data obtained in the course of the study show a fairly high level of functional readiness of the studied subjects. In the process of the research, the most informative indicators of the functional readiness of pentathletes were determined – speed at the level of anaerobic exchange threshold, maximum heart rate, maximum lactate concentration.

KEYWORDS: modern pentathlon; sports training; highly qualified female athletes; functional readiness; ergospirometric studies.

Introduction. Modern pentathlon can rightfully be considered one of the most beautiful Olympic types of all-around sports. Belarusian and Russian athletes, as a rule, are among the strongest all-around events in the world. At the World Championships from 2017 to 2021, athletes of the national teams of Russia and Belarus won gold medals – G. Gubaidullina, A. Prokopenko, O. Silkina [1–3].

The problem of effective training planning in modern pentathlon has become more difficult due to the fact that recently the competition rules have changed more than once. According to the new format (2022), modern pentathlon competitions are held almost without a break between included competitive exercises, and the largest tournaments include three stages of the competition. At the same time, the duration of the competition period and the high density of competitions should also be taken into account.

All of the stated above significantly increases the intensity of the competitive struggle and, according to a number of authors [4–7], only athletes with high functional readiness of the most important body systems can show high results in all-around sports.

Thus, the control of the functional readiness of athletes, which reflects the success of the body's adaptation to the training loads presented, is very relevant in the system of sports training of highly qualified athletes.

In its turn, the determination of the most informative indicators of functional readiness will allow the coach to assess the functional state of the athlete's body in a short time and make timely adjustments to the training process, avoid overtraining and accelerate recovery processes.

The purpose of the study: to study the features of the functional readiness of highly qualified female athletes specializing in modern pentathlon.

Methods and organization of the study. The study involved highly qualified athletes specializing in modern pentathlon.

To assess the functional readiness of female athletes, we used a test with a stepwise increasing load. Athletes after a standard warm-up performed the proposed test, simulating the final competitive exercise of the modern pentathlon – the combined relay.

Registration of parameters of gas exchange and external respiration was carried out using a portable ergospirometer "Cortex MetaMax 3B" (Germany). We recorded the

following parameters: vital capacity (VC, ml), heart rate at rest (HR, beats/min), heart rate at the level of exchange metabolism threshold (HR (AT), beats/min), maximum oxygen consumption (VO_{2max}, ml/kg/min), maximum heart rate (HR_{max}, beats/min).

Also, the concentration of lactate (La_{max}, mmol/l), the speed at AT (anaerobic exchange threshold) (V HR, m/s), and the life index (LI) were determined.

The study of the dynamics of lactate concentration in the blood was carried out after running each segment using a portable device Lactate Scout (Germany).

Results of the study and their discussion. As the analysis of the obtained data showed, the average value of lung capacity (VC) in qualified female pentathletes was 4107±245,66 ml, the heart rate at rest (HR) was 57,71±3,61 beats/min, the heart rate at the level of anaerobic exchange threshold (HR (AT) was 179±4,92 beats/min, maximum oxygen consumption (VO_{2max}) 55,25±5,27 ml/min/kg, as well as the maximum heart rate (HR_{max}) 191,4±8,55 beats/min. The maximum concentration of lactate (La_{max}) 9,68±1,75 mmol/L. We also determined the average speed at AT (V HR (AT), this indicator was 4,45±0,21 m/s.

Analyzing the variability (V%) of the studied indicators, it is possible to identify the indicators of the maximum concentration of lactate (La_{max}) – 18,08 % and the maximum oxygen consumption (VO_{2max}) – 9,54 %, which have the highest significant coefficient of variation. In the rest of the studied indicators, only a slight spread of values was determined.

Considering the most informative characteristics of the loads and performance of athletes involved in individual sports, the authors identify the following indicators: the speed of movement at the level of AT (anaerobic exchange threshold), the power of work and oxygen consumption at the level of AT.

Specialists especially single out the speed of movement at the level of AT, defining it as the relationship between the speed at which the maximum steady state for lactate (4 mmol/L) appears and the level of aerobic performance. The better the athlete is prepared, the higher the speed that the athlete is able to maintain for several tens of minutes, with the most stable state of lactate [4].

To determine the most informative indicators of the functional readiness of pentathletes, we studied the correlation between the results in the types of modern pentathlon and the indicators of functional readiness (Table).

Table – Correlation (ρ) between the results in the combined relay race and indicators of functional readiness

Indicators	Combined relay race		
	Total time	Running	Shooting
Maximum oxygen consumption (VO_{2max}, ml/kg/min)	–0,488	–0,388	–0,332
Speed at the level of anaerobic exchange threshold (V HR, м/сек)	**–0,587**	**–0,731**	**0,537**
Heart rate at the anaerobic exchange threshold (HR (AT), beats/min)	–0,067	–0,198	0,446
Resting heart rate (HR, beats/min)	0,353	0,199	**0,656**
Maximum heart rate (HR_{max}, beats/min)	**–0,515**	**–0,553**	–0,034
Maximum lactate concentration (La_{max}, mmol/l)	**0,505**	**0,634**	**–0,544**

Note: bold font indicates coefficients that have a statistically significant (at P<0,05) correlation.

Due to the fact that a number of functional indicators, in particular anaerobic threshold, are specific and should be measured using only competitive exercises as an advantage,

and the study of gas exchange and external respiration parameters was carried out in the process of performing a test simulating a combined relay race (5×600 m), the correlation was determined by us only between the results in the combined relay race and indicators of functional readiness.

It should be noted that there was a statistically significant correlation ($p<0,05$) between the results shown by female athletes in the events included in the combined relay race and functional readiness indicators. Thus, a high negative correlation was found between the result in running (5×600 m) and the speed indicator at anaerobic exchange threshold ($\rho = – 0,731$). This indicator (V HR (AT)) reflects the functional deployment of metabolic reactions of the athlete's body with energy supply with the predominant formation of rapidly excreted metabolites, which preserves energy reserves for anaerobic finishing acceleration, this fact is confirmed by a high negative correlation of the indicator with the result.

The maximum heart rate determines the volume of circulating blood and the power of its transport function, especially at frequencies up to 175–180 beats per minute, which, in our study, fell within the boundaries of the anaerobic exchange threshold, which explains the average correlation with the result ($\rho = –0,553$).

The maximum oxygen consumption indicator is very variable and can vary significantly depending on the condition of the athlete and many subjective factors, which resulted in its moderate negative relationship with the result ($\rho = –0,388$).

A positive correlation (average) was found in the indicator of the maximum concentration of lactate ($\rho = 0,634$).

The result shown by the athletes in the combined relay (total time) also negatively correlates (average correlation) with the indicators of speed at anaerobic threshold ($\rho = –0,587$) and maximum heart rate ($\rho = –0,515$), positively correlating with the indicator of maximum lactate concentration ($\rho = 0,505$).

Thus, the higher the speed indicator at the anaerobic exchange threshold is, the less time the athlete spends on running the distance (negative correlation). At the same time, the higher the maximum concentration of lactate, the worse the result in running.

The result shown in shooting is positively correlated (average correlation) with the indicator of heart rate at rest ($\rho = 0,656$), negatively with the indicator of the maximum concentration of lactate ($\rho = –0,544$). The data obtained deserve attention, but in our opinion, it requires clarification in the form of additional studies.

Conclusion. The data obtained in the course of the study indicate the achievement of a sufficiently high level of functional readiness of highly qualified female pentathletes at the stage of preparation for the main competitions.

Particular attention should be paid to the speed indicator at the level of the anaerobic exchange threshold (V HR (AT). This indicator can be defined as integral, the study of its dynamics will allow to control both physical and technical and functional readiness. Its integral essence makes it possible to combine a time period understandable for a coach and the result of adaptive training shifts in the systemic processes of an athlete's energy supply in the form of lactate concentration in capillary blood. The relative simplicity of this testing work should also be noted, which does not require the use of a gas analyzer and maximum loads on the athlete's body, which provides the most comfortable and physiological test conditions, as well as its high reproducibility and low sensitivity to exogenous and endogenous deviating factors.

Diagnostics of functional readiness allows assessing changes in the physical condition of athletes and, as part of the individualization of sports training, will allow to offer individual recommendations for correcting training loads.

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ПОВЫШЕНИЕ УЧЕБНО-ТРЕНИРОВОЧНОГО ПРОЦЕССА ФИЗИЧЕСКОЙ ПОДГОТОВКИ ДЕВУШЕК В ХОККЕЕ НА ТРАВЕ

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INCREASING THE PHYSICAL FITNESS OF GIRLS' FIELD HOCKEY PLAYERS IN TRAINING COURSES

АННОТАЦИЯ. Анализ физической подготовки девочек-подростков, занимающихся хоккеем на траве.

КЛЮЧЕВЫЕ СЛОВА: физическая подготовленность; технико-тактические качества; скоростные качества; храбрость; физические возможности.

ABSTRACT. Analysis of physical fitness of teenage field hockey girls.

KEYWORDS: physical fitness; technical and tactical qualities; speed qualities; bravery; physical abilities.