

Original Article

Innovative technologies based management of the training process of female athletes specializing in short distances running

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Abstract

Purpose: optimization of the training process' management system for the female athletes aged 19-23 years, specializing in short-distance running, using innovative technologies.

Material: analysis and generalization of scientific and methodological literature, sequential pedagogical experiment, testing of physical performance, aerobic capabilities, functional preparedness, methods of mathematical statistics. 8 elite female athletes specializing in short-distance running aged 19-23 were examined

Results: determined specific aspects of the dynamics of indicators of the functional preparedness of the female athletes' bodies in the preparatory period of the final macro-cycle of training. Developed an experimental program for the training process planning for improving of the female athletes' preparedness in preparation for the XXX Summer Olympic Games in London.

Conclusions: the obtained results indicated that introduction of this program into the preparatory period training process, taking into account the aspects of the dynamics of the female athletes' functional preparedness components and the nature of their correlation with the model characteristics, contributed to significant improvement in all indicators of the functional preparedness of examined female athletes. At the end of the preparatory period, deviations of these indicators from the model values amounted to only 2-6%. Demonstrated effectiveness of the innovative computer program use in the training process' management system, which contributed to getting the new quality information through the primary data processing, based on which the Ukrainian national track and field team coaching staff has made their optimal managerial decisions.

Key words: macro-cycle, functional preparedness, sports training.

Introduction

One of the key problems in the highest achievements sports is development of scientific basis for the training of athletes (Ajippo, et al., 2007; Mirzoev, et al., 2014). A characteristic feature of modern world track and field athletics, in particular in short-distance running, is the very high level of preparedness of female athletes and, as a result of this, constantly increasing closeness in sporting results in major international competitions (Čoh, et al., 2006; Borzov, 2014; Zinevych 2017). This implies requirements increase for the system of training female athletes specializing in sprint, which is based on introduction of modern scientific and pedagogical technologies in the training process, studying the advanced world experience in training of the top athletes (Bobrovnik, et al., 2008; Vrublevsky, 2008; Evtukh, 2010; Slawinski, et al., 2010).

In track and field athletics, especially in running, a high level of physical and functional preparedness plays decisive role in scoring top sports results (Karaulova, 2013; Bogdanovskaya, et al., 2014; Karaulova, et al., 2016). According to the leading coaches of the national track and field athletics team of Ukraine, special attention should be paid to improving these components of the preparedness of the highly qualified female athletes in the process of preparing for major international competitions. From the point of view of implementation of innovative technologies, this approach should be aimed at improving of the female athletes' training process management system. It should be based on the analysis and generalization of the highly qualified athletes training experience in preparation for the international starts – the Olympic Games, the world and European championships, as well as orientation of the training process on the group and individual model

characteristics of the competitive activity and preparedness of the world-class female athletes (Shinkaruk, et al., 2013; Boychenko, 2014; Dobrinska, 2015; Borzov, 2016).

The absence of objective data on the technology of the training process management of the highly qualified female athletes specializing in short distances running has determined the direction of this study.

Materials and methods

Participants: 8 elite female athletes specializing in short-distance running aged 19-23 (the sporting title of the Master of Sports of Ukraine and the International Master of Sports) were examined.

Research methods: analysis and generalization of scientific and methodological literature, sequential pedagogical experiment, testing of physical performance, aerobic capabilities, functional preparedness, methods of mathematical statistics.

During the research, in order to improve the functional preparedness of the athletes of the Ukrainian national track and field team in preparation for the XXX Summer Olympic Games in London, an experimental program for planning the training process was developed and implemented in the spring-summer preparatory period of the final macro-cycle.

Statistical evaluation of the results of the study was carried out based on the calculation of the arithmetic mean indicators, the standard deviation and the arithmetic mean error.

Evaluation of statistical hypotheses was carried out at the significance level of 5%. The reliability of the differences was estimated using the Student's t-test. Microsoft Excel (2010) licensed software was used for statistical data processing.

In the study, the computer program for fast assessment of the level of overall functional preparedness of the female athletes was used to assess the level of the female athletes' bodies' functional preparedness and its components. The algorithm of the survey within the framework of this program provided for performance of standard submaximal ergometer test PWC₁₇₀, as well as measurements of the length (cm) and the weight (kg) of the female athletes' bodies. The program carried out an automatic calculation of the total physical capacity value (oPWC₁₇₀), the aerobic capacity value (VO_{2max}), the values of alactic and lactic power and capacity, anaerobic exchange threshold (AET), heart rate at the threshold of anaerobic metabolism (HR TAM), total metabolic capacity (TMC), reserve capabilities (RC), efficiency of the muscular activity energy supply system (EES) and general level of functional preparedness (GLFP) of the female athletes' bodies. It should be noted that calculation of absolute values (aPWC₁₇₀) and relative (oPWC₁₇₀), physical performance, absolute (aMOC) and relative (rMOC) maximal oxygen consumption was carried out according to well-known formulas, whereas determination of values of alactic, lactic anaerobic power and capacity, anaerobic threshold exchange, heart rate at the threshold of anaerobic exchange, total metabolic capacity were carried out according to the formulas developed by the authors of the computer program. All quantitative values used in the program were calculated and distributed to functional levels: "low", "below average," "average," "above average," "high" [15].

In order to obtain the most objective information about the current level of functional preparedness of the female athletes participating in the study, the model characteristics of the functional preparedness indicators of the leading athletes were made, these were the female athletes of the national teams (USA, Jamaica, Germany, France, Belarus, Great Britain) in track and field athletics who were the winners and medalists of the largest international competitions (n = 10).

Results

The testing was carried out at the beginning (March) and at the end (June) of the spring-summer preparatory period of the fourth macro-cycle of the Olympic training cycle. The testing results of the female athletes of track and field team of Ukraine, conducted at the beginning of the spring-summer preparatory period of the macro-cycle, indicated a slightly reduced level of functional preparedness of the female athletes' bodies (some indicators of functional preparedness corresponded to the average and above the average functional levels). A very significant deviation in the parameters of their functional preparedness from the model characteristics was also recorded – from 5,4% to 16% (Table 1)

Table 1 Indicators of the functional preparedness of the female athletes of the national team of Ukraine in the beginning of the spring-summer preparatory period of the fourth macro-cycle (n = 8)

Indicators	Model characteristics	Beginning of the preparatory period	Δmodel, %	t	p
oPWC ₁₇₀ , kgm•min ⁻¹ •kg ⁻¹	25,18±0,30	21,57±0,20 (h)	14,35±1,20	10,05	<0,001
VO _{2max} , ml•min ⁻¹ •kg ⁻¹	67,70±0,27	62,02±0,34 (h)	8,39±1,60	13,03	<0,001
Alactic power, Watt•kg ⁻¹	11,36±0,15	9,99±0,17 (h)	12,06±1,51	6,05	<0,001
Alactic capacity, units	65,47±0,47	60,91±0,25 (h)	6,97±1,13	8,55	<0,001
Lactic power, Watt•kg ⁻¹	8,69±0,15	7,95±0,06 (h)	8,53±1,08	4,66	<0,001
Lactic capacity, units	55,26±0,54	50,27±0,27 (h)	9,03±1,12	8,29	<0,001
Anaerobic energy supply	63,93±0,47	59,83±0,25 (a)	6,41±1,13	7,63	<0,001

threshold, %					
HR TAM, beat•min ⁻¹	173,94±0,83	164,45±0,81 (a)	5,46±1,40	8,18	<0,001
Total metabolic capacity, units	237,10±2,42	210,39±1,43 (a/a)	11,27±1,16	9,50	<0,001
Reserve capabilities, points	87,83±1,76	75,57±0,37 (a/a)	13,96±1,02	6,83	<0,001
Efficiency of energy supply system, points	84,35±0,80	74,08±0,25 (a/a)	12,18±1,05	12,27	<0,001
Functional preparedness level, points	91,44±0,70	76,88±0,17 (a/a)	15,92±1,03	20,11	<0,001

Remark: h - high, a / a - above average, a - average functional levels; Δ model – is the deviation of the value of a single indicator from its model characteristics.

Experimental data became the basis for optimizing the management technology of the training process by correcting the training process in order to improve the level of functional preparedness of the female athletes' bodies.

Correction of the training process in the framework of the spring-summer preparatory period of the fourth macro-cycle was carried out based on redistribution of the training load volume of various orientations, depending on meso-cycles, stages of the preparatory period. Changes in the load volume were calculated in relation to the quantitative data of the load volume of the preparatory period of the third macro-cycle of the Olympic training cycle.

The main changes in the load planning were as follows:

- Volume of running with intensity of 80-85% of the maximum was increased by 42-150% (in the basic, control and preparatory, pre-competition meso-cycles of the spring-summer preparatory period), reduced by 100% (in the basic, control-preparatory meso-cycles of this period);

- Volume of running with intensity of 90-95% was increased by 78-120% (in the pre-competition meso-cycle of the spring-summer preparatory period), reduced by 100% (in the basic, control-preparatory meso-cycles of this period);

- Volume of the speed-power orientated exercises was increased by 3-150% (in the basic, control-preparatory, pre-competition meso-cycles of the spring-summer preparatory period), reduced by 55-100% in the pre-competition meso-cycle;

- Volume of force-oriented exercises increased by 61-100% in all meso-cycles of the spring-summer preparatory period;

- Volume of running with weights (5-20 kg) for 10-20 m distance was planned in all meso-cycles of the spring-summer preparatory period of the fourth macro-cycle preparation.

Re-examination of female athletes was conducted at the end of the spring-summer preparatory period. The results obtained were evidence that training process correction contributed to an effective optimization of the structural components of the female athletes' functional preparedness (Table 2).

Table 2 Indicators of the functional preparedness of the female athletes of the national team of Ukraine at the end of the spring-summer preparatory period of the fourth macro-cycle (n = 8)

Indicators	Model characteristics	Final	Δmodel, %	t	p
oPWC ₁₇₀ , kgm•min ⁻¹ •kg ⁻¹	25,18±0,30	23,90±0,23 (a/a)	5,09±1,26	3,40	<0,01
VO _{2max} , ml•min ⁻¹ •kg ⁻¹	67,70±0,27	64,51±0,35 (h)	4,72±1,64	7,15	<0,001
Alactic power, Watt•kg ⁻¹	11,36±0,15	10,92±0,29 (h)	3,88±2,15	1,37	>0,05
Alactic capacity, units	65,47±0,47	62,92±0,76 (h)	3,91±1,19	2,86	<0,001
Lactic power, Watt•kg ⁻¹	8,69±0,15	8,50±0,15 (h)	2,15±1,44	0,88	>0,05
Lactic capacity, units	55,26±0,54	52,52±0,45 (h)	4,96±1,30	3,93	<0,001
Anaerobic energy supply threshold, %	63,93±0,47	62,82±0,56 (a/a)	1,74±1,55	1,51	>0,05
HR TAM, beat•min ⁻¹	173,94±0,83	168,60±1,07 (a/a)	3,07±1,63	3,95	<0,001
Total metabolic capacity, units	237,10±2,42	224,74±2,61 (h)	5,21±1,47	3,47	<0,01
Reserve capabilities, points	87,83±1,76	82,56±1,05 (h)	5,99±1,17	2,57	<0,01
Efficiency of energy supply system, points	84,35±0,80	80,64±1,27 (a/a)	4,41±1,87	2,48	<0,05
Functional preparedness level, points	91,44±0,70	89,13±1,09 (h)	2,53±1,84	1,79	>0,05

Firstly, all the values of the structural components of the functional preparedness of the female athletes' bodies have increased from 2.5% to 16% compared to the beginning of the spring-summer preparatory period.

Secondly, according to the results of the final testing, qualitative changes in indicators characterizing the level of the female athletes' functional preparedness were registered; most indicators corresponded to a high

level of functioning, compared to the beginning of the preparatory period.

Thirdly, at the end of the spring-summer preparatory period, the deviations from the model characteristics of all indicators of functional preparedness were lower, from 1.7% to 6%, compared with the beginning of the preparatory period.

Discussion

In the process of studying the problem of training the high-class female athletes for major international competitions, the need for further optimization of the management system of the training process was shown. Based on the conducted research it is determined that the perspective direction of increasing the efficiency of the preparation process in short distances running is a complex study of the features of the dynamics of the female athletes' body functional preparedness. It is confirmed by a number of scientific papers in which it is proved that special physical preparation, the ultimate goal of which is to achieve the highest sport result, is aimed at developing the functional capabilities of the athletes' bodies capable of providing this result (Gagua, 2001; Zawiera-Koch, 2005; Mikhalev, et al., 2013; Kozina, 2018).

Therefore, the study of the features of this connection became the basis for the development of an experimental program for planning the training process in the spring and summer preparatory period of the final macro-cycle, taking into account the dynamics of the components of the female athletes' functional fitness within the macro-cycle and the nature of their correlation with the model characteristics.

Effective approach to the training process improvement was application of the innovative computer program, which has become one of the main components of the information support for the cycle of step-by-step management of the female athletes' training specializing in short distances running. The proposed algorithm for interpreting the indicators of the components of functional preparedness and integrated assessment of the overall level of functional preparedness allowed obtaining accurate, fact-based information immediately after control testing at various stages of the study.

To determine and assess the overall level of the female athletes' fitness in our study was first used integral quantitative indicator of the functional preparedness level, which included the values of the indicators of the main structural components of the functional preparedness of the high-class athletes' bodies. This indicator is one of the main integral criteria for assessing and predicting the effectiveness of the management of the training process of track and field female athletes - sprinters.

Developing evaluation criteria that characterize the necessary level of components of the female athletes' fitness at various stages of the training process allowed to significantly simplify the analysis of information received by coaches and athletes, which made it possible for the coaching staff of the Ukrainian national track and field team to make proper control activities in the process of training of the female athletes for the Olympic Games.

Conclusions

The study showed that achievement of higher sports results in the sprint due to effective management system of the training activities using innovative technologies to assess the level of functional preparedness of the highly qualified female athletes.

The presented results showed definite optimization of the level of functional preparedness of the female athletes' team of Ukraine and confirmed high efficiency of the training process-building program within the system of training for major international competitions. This allows recommending the developed program for practical implementation in the system of training athletes in this type of sports activities at the stage of the maximum realization of individual abilities.

More convincing confirmation of this was winning the bronze medals by the Ukrainian athletes in the XXX Summer Olympic Games in London in the 4x100 meters relay and the national record' establishment.

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