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DEVELOPING AN ALGORITHM FOR BUILDING INDIVIDUAL TRAINING PROGRAMS FOR HIGHLY QUALIFIED MULTI-SPORT ATHLETES AT THE STAGE OF DIRECT PREPARATION FOR WINTER SEASON COMPETITIONS

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

The purpose of the study was to develop and experimentally justify the effectiveness of the algorithm for building individual training programs for highly qualified multi-sport athletes at the stage of direct preparation for the main competitions of the winter season.

Materials and methods. Five highly qualified multi-sport athletes, whose sports qualification is the Master of Sports of Ukraine, took part in the pedagogical experiment. The mean age of the participants was (M±SD) 25.2±1.79 years. The main goal of the formative stage of the experiment (2020-2021) was to develop programs for the structural units of the training process (training classes, microcycles, mesocycles, and the stage of direct preparation for the main competitions) based on the developed algorithm for building individual programs. We have developed six consecutive steps for the purpose of achieving full preparation of athletes for major competitions.

Results. The implementation of an individual program at the stage of direct preparation for winter season competitions is effective and enables qualified multi-sport athletes to reach the peak of their sports form during participation in the competitions of the Ukrainian indoor heptathlon championship. This is evidenced by the achieved statistically significant differences ($p<0.05$) in all indicators of physical and functional fitness compared to the ascertainment stage of the experiment. The increase in indicators was 2.8-4.4% in the running tests, 4.0-4.2% in the tests reflecting speed and strength abilities, 6.6 % in the strength control exercise. We note a statistically significant ($p<0.05$) positive increase during the formative stage in the indicators of physical performance of multi-sport athletes within the range of 5.8-6.0 % and in the indicators of aerobic productivity within the range of 4.4-4.5%.

Conclusions. The use of the algorithm for building an individual program of preparation for competitions of highly qualified multi-sport athletes orients the coach and athlete towards achieving the desired sports result in the shortest way with economical and rational use of training equipment at the most difficult and responsible stage of direct preparation for the main competitions. Compliance with the stated provisions of the algorithm made it possible to rationally plan and choose the best option for building the training process.

Keywords: combined events, multi-sport athletes, training process, programming, stage of direct preparation, algorithm.

Introduction

Modern trends in the development of combined events are primarily characterized by a significant variety and scale of competitions, continuous development, financial and rating incentives. In this regard, the search for actual approaches to improving the system of training athletes in order to increase the effectiveness of the training process and achieve high competitive results constitutes a primary task (Guthrie, 2003; Platonov, 2006; Ganse & Degens, 2021).

To date, domestic decathletes have not yet come close to the high positions of the world ranking, as evidenced by

the existing records of Ukraine in certain types of combined events. Over the last decade, only one decathlete, Oleksii Kasianov, represented the Ukrainian team at the European, World and Olympic Games. Other leading multiathletes managed to reach during this time only the level of Master of sports of Ukraine. Therefore, the situation that has developed recently in Ukrainian combined events is characterized by an obvious contradiction between the desire of coaches and athletes to find new technologies for building the training process and the insufficient scientific base and outdated methodological provisions of athletic combined events (Bobrovnik, 2014; Kutek & Akhmetov, 2018; Platonov, 2020).

The domestic practice of training highly qualified track and field athletes, compared to the international practice (Thompson, 2009) has a number of organizational and technological inconsistencies. In particular, this refers to the insufficient observance in the preparatory period of the principles of overload, reversibility and specificity in the training process in order for the purpose of improving sports results (Bompa, Haff, 2009; DeWeese et al., 2015; Kutek et al., 2018), the lack of orientation of athletes towards the adequate use of mechanisms of energy provision of training loads (Wilmore et al., 2012; Liang, Xiao, 2014; Santos et al., 2021), lack of adequate control of adaptive mechanisms for the development of physical performance of athletes in the prevention of overfatigue, overtraining and sports injuries (Zemper, 2005; Meron & Saint-Phard, 2017), focusing on the identification and priority development of individual successful competitive disciplines (Kenny et al., 2005; Bilić & Balić, 2015; Pavlović & Idrizović, 2017).

Analysis of the available literature indicates the prospects of using an individual approach in the training process of highly qualified athletes. In particular, Kozina et al. (2015) presented the concept of individualization based on the definition of the leading factors in the individual structure of preparedness and individual dynamics of competitive activity, on the basis of which appropriate technologies for increasing the focus of the training process were individually implemented. In their work, Kozlova et al. (2020) analysed and compared individual anthropometric characteristics and biomechanical indicators of long jump technique by athletes from Ukraine and China. As for athletics combined events, the research by Dobrynska (2015) substantiates the modelling of competitive activity as a basis for individualizing the construction of multi-year training of women in heptathlon.

Taking into account the fact that combined events is technically the most difficult and physically demanding athletics discipline, as well as taking into account the limited number of thorough national studies of the problem of individualizing the training process of multiathletes at the stage of direct preparation for competitions, there is a natural need to develop an algorithm for building individual training programs for highly qualified multiathletes.

Research hypothesis: it was assumed that the development of an algorithm for building individual training programs for highly qualified multiathletes for the main competitions will allow to systematically and purposefully influence the adaptive resources of athletes to obtain delayed training effects and high sports results.

The purpose of the study was to develop and experimentally justify the effectiveness of the algorithm for building individual training programs for highly qualified multiathletes at the stage of direct preparation for the main competitions of the winter season.

Material and methodology

Participants

5 highly qualified multiathletes, whose sports qualification is the Master of Sports of Ukraine, took part in the pedagogical experiment. The mean age of the participants was (M±SD) 25.2±1.79 years. The study was approved by the ethics committee of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, and all procedures were in accordance with the Declaration of Helsinki. Informed consent for participation in the experiment was obtained from the participants.

Research organization

The study was conducted from 2019 to 2021. The scheme of a sequential pedagogical experiment was used.

During the ascertainment stage of the experiment (2019-2020), pedagogical observation of the training process was carried out in combination with timing of training work. This made it possible to determine the volume of training loads and their distribution for different types of training of multiathletes (Adamchuk et al., 2021).

The main goal of the formative stage of the experiment (2020-2021) was to develop programs for the structural units of the training process (training classes, microcycles, mesocycles, the stage of direct preparation for the main competitions) based on the developed algorithm for building individual programs. The basis of the development of the algorithm of the individual program is based on the analysis of data from the literature, own long-term experience of direct participation in training and competition activities in athletics combined events, the results of the ascertainment stage of the experiment regarding the peculiarities of the athletes' response to the groups of training tools used and their combination and influence on the energy supply systems of the training process. Thus, we have developed six consecutive steps for the purpose of achieving full preparation of athletes for major competitions (Fig. 1).

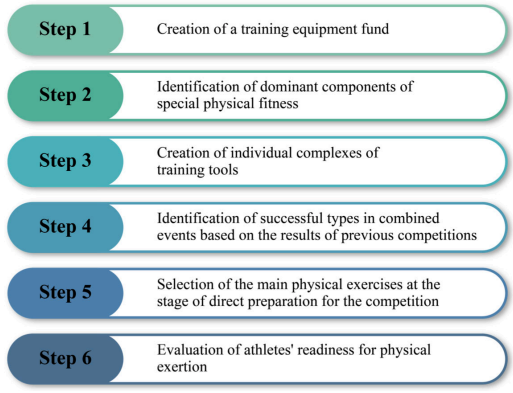

Fig. 1. Algorithm for building an individual training program for competitions of highly qualified multiathletes in combined events

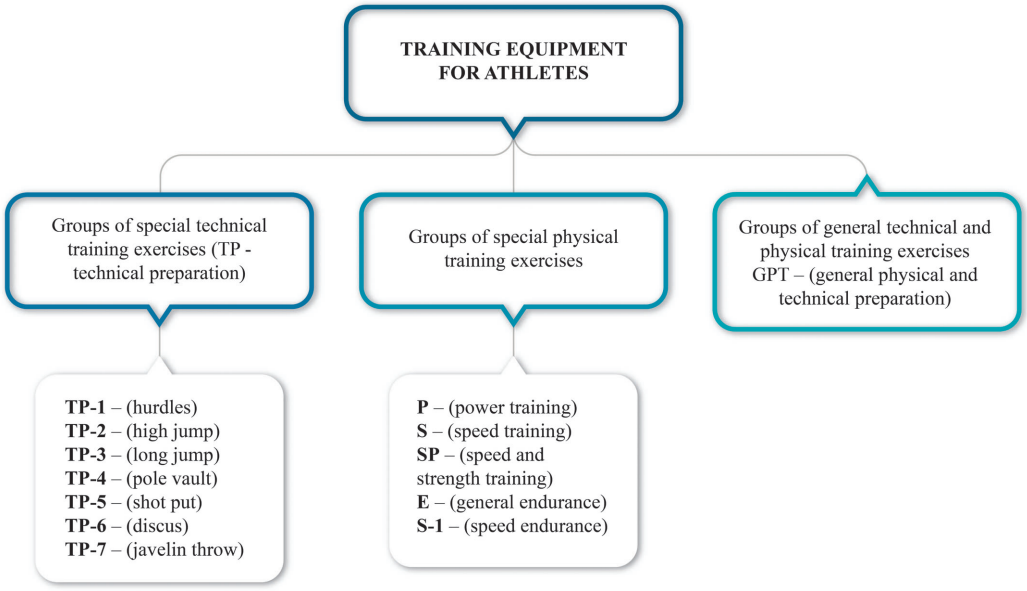

Fig. 2. Classification of means of training work in athletics combined events

Step 1. The selection of physical exercises was determined by the specifics of athletics combined events disciplines and previous experience in their use. The unequal response of different athletes to the same physical loads (Drozdovska, 2013), as well as the existence of individual growth limits of adaptation to certain physical loads were also taken into account. As this limit is approached in the process of training, the rate of increase in function slows down and stops at a certain amount of load. Any further continuation of training causes a disruption of adaptation, that is, the development of a state of overtraining. Therefore, in the developed algorithm, the requirement of creating individual training funds based on a overall, long-term and comprehensive assessment of the impact of special physical exercises on the athlete's body is met.

When forming the classification of training tools of qualified multiathletes, the division of physical exercises into groups of special training, which is used in foreign practice (Guthrie, 2003; Thompson, 2009) was used (Fig. 2).

Step 2. It is known that for highly qualified athletes in the period of preparation for the competition, the main attention should be focused on increasing performance in the sports to which the athlete has a pronounced tendency to develop. But on the way to achieving this goal, uneven development of special physical qualities is often observed in such athletes during the standard training process. Discrepancies in the variability of the used means of different predominant orientations within a specific athletics discipline revealed by specialists determine the distribution of athletes according to the type of group models of competitive activity: the first type of athletes includes multiathletes who are mainly able to achieve high results in athletics throws and who possess a high level of strength and speed-strength capabilities; the second type includes athletes who achieved high results in the running types of the program and have high speed or endurance; the third type is characterized by achieving high results in athletics jumps, possessing high capabilities of the alactic and lactic energy supply system as well as a high level of speed and strength qualities (Dobrynska, 2015).

In our study, only the second and third types of mutiathletes were found. The obtained data were used for planning the content and ratio of training tools at the stage of direct preparation for the main competitions of the winter season. The results of the previous macrocycle tests were used to determine the individual dominance of the components of the athletes' special physical fitness.

Step 3. On the basis of selected types of competitive activity and dominant components of special physical fitness, individual sets of training tools are created for the stage of direct preparation for the competition. During the formation of individual programs, the logical sequence of performing exercises of different orientations was necessarily taken into account, and namely: special endurance exercises were performed after speed exercises, general endurance exercises were performed after speed-strength exercises, special endurance exercises were performed after general endurance exercises and strength exercises were performed after speed exercises. Training exercises were combined into groups by taking into account the energy systems of muscle activity, effects on basic physical qualities, improvement of technical skills in individual types of multiathetes, competitive disciplines in general.

Taking into account that the stage of direct preparation for the competitions of the winter season of multiathetes consisted of two mesocycles – a control-preparatory one (included a 7-day introductive microcycle, 7-day impact microcycle, 7-day recovery microcycle and 3-day impact microcycle) and a pre-competition one (included a 4-day restorative microcycle, 3-day impact microcycle, 4-day restorative microcycle); in tab. 1, we give an example of a rational combination of groups of special exercises in the pre-competitive mesocycle.

Step 4. For optimal individual training of track and field athletes, it is recommended to focus mainly on the development of successful disciplines, while maintaining at the

Table 1. Variants of a rational combination of groups of special physical exercises in training sessions of the pre-competition mesocycle

Options for combination of physical exercises	Directions of influences			
	Energy systems	Basic physical qualities	Technical skills	Competitive disciplines
S TP – 5 TP – 2	Alactic Alactic Alactic	Speed,speed and strength quality	Sprint, putting, jumping	100 m, shot put, high jump
TP - 1 TP - 4 SP	Alactic Alactic Alactic	Speed, speed and strength qualities, coordination	Hurdles, jumping	110 m hurdles, pole vault
TP - 3 S-1	Alactic Lactic	Speed and strength qualities, speed endurance	Jumping, running	Long jump, 400 m
TP – 3 TP 6/7 P	Lactic Alactic Alactic	Speed and strength qualities, power qualities	Jumping, throwing	110 m hurdles, javelin throw or discus throw
TP 6/7 E	Alactic Aerobic	Speed and strength qualities, general endurance	Throwing, running	Javelin throw or discus throw, 1500 m

Notes: TP – special technical preparation: TP-1 – hurdles; TP-2 – high jump; TP-3 – long jump; TP-4 – pole vault; TP-5 – shot put; TP-6 – discus; TP-7 – javelin throw; P – power training; S – speed training; SP – speed and strength training, E – general endurance; S-1 – speed endurance

Table 2. Program of the 7-day impact microcycle of the control-preparatory mesocycle

Types of training	Days of the microcycle						
	1st	2nd	3rd	4th	5th	6th	7th
General physical training (GPT)	GPT 1.1(a) – 25^{4}	GPT 1.1(a) – 25^{4}	GPT 1.1(a) – 25^{4}	–	GPT 1.1(a) – 25^{4}	GPT 1.1(a) – 25^{4}	–
Special physical preparation (P, S, S-1, SP, E)	S-1.4(b) – 20^{10}	P 1.4(a) –15^{4} P 1.5(a) –15^{5}	S-1-1.7 – 15^{14}	–	SP-1.2 – 10^{6} SP-1.3 – 10^{6}	P1.2 – 8^{7} P1.4(a) – 8^{7}	–
Technical preparation (TP)	TP-3.3(a) – 15^{7} TP -3.7 – 15^{10} TP-5.1(b) – 5^{5} TP-5.2(b) – 25^{6}	TP-4.3(a)–40^{7} SP-1.5 – 25^{10}	TP-2.3 – 15^{7} TP-6.1– 20^{5} TP-6.2– 22^{6}	–	TP-1.14 – 30^{10} TP-7.1(b) – 10^{4} TP-7.2(b) – 15^{5}	S-1.1(a) – 25^{7} S-1.6(a) – 15^{8}	–
Competitions	–	–	–	–	–	–	–
Σ of the training work, min	105	120	97	–	100	81	–
VLC*, points	730	765	647	–	635	507	–
ICtl**, points/min	6.95	6.38	6.67	–	6.35	6.25	–

Notes: * VLC – value load coefficient was calculated as a result of multiplication of the duration of the exercise by its intensity in points depending on the heart rate (Kostiukevich, Shchepotina, Shynkaruk et al., 2020): intensity of exercise with the heart rate 114 bpm was evaluated in 1 point; 120 bpm – 2 points; 126 bpm – 3 points; 132 bpm – 4 points; 138 bpm – 5 points; 144 bpm – 6 points; 150 bpm – 7 points; 156 bpm – 8 points; 162 bpm – 10 points; 168 bpm – 12 points; 174 bpm – 14 points; 180 bpm – 17 points; 186 bpm – 21 points; 192 bpm – 25 points; 198 bpm – 33 points; ** ICtl – intensity coefficient of training load was determined as a ratio between CVL and the duration of a training session in minutes (Adamchuk et al, 2021); record of the exercise TP-3.7 – 1510: TP-3.7 – code of the training exercise; 1510 – duration of exercise in minutes (15) and intensity of exercise in points depending on the heart rate (10); GPT – general physical training; P – power training; S –speed training; SP – speed and strength training, E – general endurance; TP – special technical preparation: TP-1 – hurdles; TP-2 – high jump; TP-3 – long jump; TP-4 – pole vault; TP-5 – shot put; TP-6 – discus; TP-7 – javelin throw; S-1 – speed endurance

achieved level the disciplines lagging behind in the results shown (Dobrynska, 2015). Individual successful combined events disciplines are identified on the basis of the analysis of the results of repeated responsible competitions. We analysed the competitive activity of a group of multiathletes and identified successful disciplines for each of them based on the results of competitions at different levels.

Step 5. In order to achieve the highest sports result in the algorithm, it is determined to be expedient during the stage of direct preparation for the main competitions of the season to concentrate efforts on increasing adaptation only to the most successful individual competitive disciplines and dominant components of special physical and technical training using the minimum number of basic physical exercises in

the main part training class. This is motivated by preventing the dissipation of energy expenditure on the simultaneous development of adaptation to several competitive disciplines in one session. A sample of a microcycle program with an accented effect on leading physical qualities (speed-strength quality) is presented in the table 2.

Step 6. The experience of training multiathletes in track-and-field at the current stage shows that an indispensable condition for achieving the highest results in responsible competitions is the performance of training and competitive loads at the level of the maximum physical capabilities of the body, which in sports of higher achievements is defined as training in the overload mode. In practice, this means that during intensive training, the athlete makes maximum use of hidden energy resources which is demonstrated by the increase in fatigue. Therefore, when determining the functional state of athletes after completing a certain stage of training according to an individual program based on the developed algorithm, an assessment of their physical state is necessary.

Experimental substantiation of the effectiveness of the developed algorithm was carried out with the help of pedagogical testing using the following test exercises (Adamchuk et al., 2021; Kostiukevych, Lazarenko, Shchepotina et al., 2021):

- *30 m sprint (assessment of speed abilities):* starting 10-15 m run and then running over a distance of 30 m with time taken into account; the best result from two attempts was taken into account, the rest interval was 3-5 min;
- *running for 200 m and 200 m after 1 min of rest (speed endurance assessment):* overcoming two segments of the distance of 200 m with a rest interval of 1 min; the total time of overcoming two sections was determined; the test was performed once;
- *triple long jump from a standing position (assessment of speed and strength qualities):* alternately pushing off with one leg and the other from the starting line, 3 consecutive jumps were performed, the last of which was into the pit for landing; the total length from the starting line to the landing place was measured; the best result from three attempts was taken into account;
- *throwing a shot with two hands from below (assessment of speed and strength qualities):* from the starting position, standing facing the direction of throwing, holding the ball with two hands from below, feet at shoulder width apart with the front part of the foot on the segment; throwing the core was performed from below-forward; the best result from three attempts was taken into account;
- *squatting with a barbell on the shoulders (assessment of strength qualities):* squatting and standing up to the starting position with the maximum weight for each athlete; 1 attempt was given;
- *the running version of the* $PWC_{170(V)}$ test (estimation of physical capacity and aerobic productivity of the body): according to the method for conducting a run-based variant of the test $PWC_{170(V)}$ the athletes performed two 5-minute run loads by overcoming the distances of 700-900 and 1100-1300 m accordingly, with their heart rate being recorded at the end of the first and second load (the period of rest between run loads made 5 minutes). $PWC_{170(V)}$ was determined using the formula:

$$PWC_{170(V)} = V_1 + (V_2 - V_1)\frac{170 - f_1}{f_2 - f_1}, \quad (1)$$

whereas: V_1 and V_2 represent run speed during the first and second run loads (determined as a ratio between the distance length and the time for overcoming the distance), m/s;

f_1 and f_2 represent heart rate immediately after the first and second run load, bpm.

The following formula was used to convert $PWC_{170(V)}$ in m/s into PWC_{170} in kgm/min:

$$PWC170=417 \cdot PWC_{170(V)}-83, \quad (2)$$

Absolute index of maximum oxygen consumption (VO_2max, ml/min) was determined using the formula:

$$VO_2max=1{,}7 \cdot PWC_{170}+1240, \quad (3)$$

Relative index of maximum oxygen consumption (VO_2max(rel), ml/min/kg) was determined as a ratio of an absolute index to the body mass of the studied athletes.

Pedagogical testing of athletes was carried out at the beginning and at the end of the stage of direct preparation for competitions in the process of performing the main training work.

Statistical analysis

Mathematical processing of the results was carried out using the "Data Analysis" package of the MS Office Excel computer program (Albert et al., 2017; Byshevets et al.., 2019; Kostiukevych, Lazarenko, Vozniuk et al., 2020). Descriptive statistics were used, which included the determination of the arithmetic mean (M) and the mean square deviation (SD). Statistical reliability in the difference between the results of pedagogical testing of multiathletes at the beginning and at the end of the ascertaining and formative stages of the pedagogical experiment was determined by the non-parametric Wilcoxon T-test. Differences between groups were considered statistically significant at $p<0.05$.

Results

In order to objectively evaluate the advantages of the used algorithm for building individual training programs for highly qualified multiathletes at the stage of direct preparation for competitions, a comparative analysis of the indicators of physical and functional fitness of athletes was carried out in a formative experiment (table 3).

The autumn-winter period of preparation for the competition had a slightly shorter duration than the spring-summer period, but despite this, we obtained positive changes in the indicators of physical and functional readiness, which appeared to be greater than those determined at the ascertainment stage of the experiment.

The analysis of the obtained data allows us to note that there were positive changes in all indicators of physical fitness, but at the stage of the formative experiment they were more significant when compared to the stage of the ascertaining experiment. As we can see, the increase in results

Table 3. Indicators of physical and functional preparedness of multiathletes at the stage of direct preparation for winter season competitions at different stages of the experiment

Indicators of physical and functional fitness	Research phase	Output data		Final data		Changes (ΔM)		T	p
		M	SD	M	SD	Absolute	%		
Running for 30 m on the move, s	AE	3.05	0.17	2.96	0.09	0.09	2.9	0	<0.05
	FE	2.98	0.07	2.85	0.08	0.13	4.4	0	<0.05
Running 200 m and 200 m after 1 min of rest, s	AE	49.95	1.15	49.89	1.00	0.06	0.1	2	>0.05
	FE	49.70	0.64	48.33	0.52	1.37	2.8	0	<0.05
Triple jump from a place, m	AE	8.88	0.54	8.98	0.46	0.10	1.1	1	>0.05
	FE	8.89	0.18	9.25	0.27	0.36	4.0	0	<0.05
Throwing a shot with two hands from below, m	AE	15.05	0.52	15.72	0.44	0.67	4.5	0	<0.05
	FE	15.54	0.34	16.20	0.79	0.66	4.2	0	<0.05
Squatting with barbell, kg	AE	134.0	6.4	135.0	4.3	1.00	0.7	4	>0.05
	FE	136.0	25.7	145.0	12.9	9.00	6.6	0	<0.05
$PWC_{170(V)}$, m/s	AE	4.65	0.71	4.76	0.64	0.11	2,3	1	>0.05
	FE	4.79	0.59	5.07	0.54	0.28	5.8	0	<0.05
PWC_{170}, kgm/min	AE	1856.6	293.5	1902.9	269.6	46.3	2.4	1	>0.05
	FE	1914.5	245.9	2030.0	225.4	115.5	6.0	0	<0.05
VO_2max, ml/min	AE	4396.2	498.9	4474.9	458.3	78.7	1.8	1	>0.05
	FE	4494.6	418.0	4691.0	383.1	196.4	4.4	0	<0.05
VO_2max (rel) , ml/min/kg	AE	52.8	7.5	53.7	8.0	0.9	1.7	1	>0.05
	FE	53.8	5.3	56.2	4.9	2.4	4.5	0	<0.05

Notes: $PWC_{170(V)}$ is a running version of the test; PWC_{170} is an indicator of physical working capacity; VO_2max is an absolute indicator of maximum oxygen consumption; VO_2max(rel) is a relative indicator of maximum oxygen consumption; AE is an ascertainment experiment; FE is a formative experiment; AE – ascertaining experiment; FE – forming experiment

at the stage of the ascertainment experiment ranges from 0.1-4.5% without significant changes ($p>0.05$) in such tests as running 200 m and 200 m after 1 min of rest, triple jump from a standing position and barbell squats. At the same time, at the stage of the formative experiment, the final indicators, in comparison with the initial ones, improved by 2.8-6.6% with a significant difference ($p<0.05$). At the same time, the increase in indicators in running tests was 2.8-4.4%, in tests reflecting speed and strength abilities it was 4.0-4.2%, in strength control exercise it was 6.6%.

Today, an idea of the functional fitness of athletes has already been clearly formed, which is defined as a set of those characteristics and properties of the body that directly or indirectly determine work performance in competitions. Achieving a high level of functional fitness is ensured by specific adaptation to the appropriate type of sports activity. The importance of understanding the content and control of functional readiness is determined by the fact that the capabilities of an athlete are the capabilities of his body. The training process is aimed at their training and modification which will ensure an increase in working capacity (Wilmore et al., 2012; Karaulova et al., 2018; Shchepotina et al., 2021; Bezmylov et al., 2022).

Indicators characterizing the functional preparedness of multiathletes demonstrate positive dynamics both during the ascertaining and formative stages of the experiment. In particular, the increase in results at the ascertainment stage ranges from 1.7 to 2.4% without significant changes ($p>0.05$). We note a statistically significant ($p<0.05$) positive increase during the formative stage in the indicators of physical performance of multiathletes within the range of 5.8-6.0% and in the indicators of aerobic productivity within the range of 4.4-4.5%. It should be taken into account that, as scientists note, the absolute indicator of maximum oxygen consumption VO_2max is more important for athletes who perform at short and medium distances, and the relative one is more important at long and ultra-long distances. The reliability of the change in the results in the formative experiment was determined by all indicators ($p<0.05$) which indicates the success of using individual programs that were developed according to the outlined algorithm in combined events at the stage of direct preparation for competitions.

Discussion

In connection with the lack of standard training programs for multiathletes at the stage of maximum realization of individual capabilities, experts give priority to an individual approach to building an annual training cycle for highly qualified athletes (Platonov, 2006; Bompa & Haff, 2009). This primarily concerns the selection and differentiated use of training tools. But the development of this direction has not received a comprehensive theoretical-methodical and practical solution until recently. Competitive athletics exercises that exist in multiathletes differ in structure, nature of energy supply, duration and force of action, therefore they

make extremely high and diverse demands on the systems of the athlete's body. Given the lack of generally accepted principles of building an individual training program at the stage of maximum realization of individual capabilities in athletics combined events, athletes and coaches of their own choice form individual complexes of training tools or try to borrow training methods of European or world record holders.

Qualified multiathletes use in their training from 300 to 400 physical exercises, but the applied groups of exercises are the individual assets of successful athletes and, as a rule, cannot be successfully used by other athletes (Guthrie, 2003; Bobrovnik, 2014). This was confirmed during a confirmatory experiment, when standard sets of physical exercises for various types of athletics were not effective enough in training multiathletes participating in the study (Adamchuk et al., 2021). Thus, in the developed algorithm, unified approaches to the selection of adequate training tools are defined by creating individual funds of special physical exercises and individual training complexes for use at the stage of direct preparation for important competitions.

In the studies of many authors, it is emphasized that the most important modern problems of successful training of multiathletes are the study of the physiological mechanisms of adaptation of the body to intense physical exertion and the justification of effective methods of programming and management of the training process in relation to the assessment of the functional state of athletes (Kenny et al., 2005; Thompson, 2009; Wilmore et al., 2012). These provisions are taken into account when developing an algorithm for building individual programs for the stage of direct preparation for competitions and programming models for training sessions, microcycles and mesocycles. In training sessions, we followed the principles of overload, reversibility and specificity as the main conditions for achieving the highest sports results (Platonov, 2020). In the training programs, an expedient distribution of the size and intensity of the training load was planned, depending on the individual response of the athletes.

The developed and experimentally substantiated algorithm represents a significant contribution to the scientific work regarding the theoretical and methodological foundations and features of the practical implementation of an individual approach in the process of training highly qualified athletes (Dobrynska, 2015; Kozina et al., 2015; Kozlova et al., 2020).

The obtained results indicate a significant improvement of the studied indicators of functional and physical fitness at the stage of the formative experiment which we associate with the balanced distribution of work and rest in training classes, the positive influence of all qualitative and quantitative components of training tools due to the algorithm we developed for building individual programs of highly qualified multiathletes at the stage of direct preparation for competitions. In general, the obtained results complete the available scientific data regarding the peculiarities of the construction of the training process of highly qualified multiathletes during the stage of direct preparation for competitions and the dynamics of indicators of physical and functional fitness of athletes (Zwols & Sierksma, 2009; Bilić & Balić, 2015; Dobrynska, 2015).

In general, the approach to programming the training process of athletes tested in previous studies (Shchepotina et al., 2021) was also implemented in the process of training highly qualified multiathletes. Thus, the developed algorithm for building individual programs at the stage of direct preparation for competitions can be recommended for use in the practice of training multiathletes.

Conclusions

1. The use of the algorithm for building an individual program of preparation for competitions of highly qualified multiathletes orients the coach and athlete towards achieving the desired sports result in the shortest way with economical and rational use of training equipment at the most difficult and responsible stage of direct preparation for the main competitions. Compliance with the stated provisions of the algorithm made it possible to rationally plan and choose the optimal option for building the training process.

2. The implementation of an individual program at the stage of direct preparation for winter season competitions is effective and enables qualified multiathletes to reach the peak of their sports form during participation in the competitions of the Ukrainian indoor heptathlon championship. This is evidenced by the achieved statistically significant differences ($p<0.05$) in all indicators of physical and functional fitness compared to the ascertainment stage of the experiment. The increase in indicators in the running tests was 2.8-4.4%, in the tests reflecting speed and strength abilities – 4.0-4.2%, in the strength control exercise – 6.6%. We note a statistically significant ($p<0.05$) positive increase during the formative stage in the indicators of physical performance of multiathletes within the range of 5.8-6.0% and in the indicators of aerobic productivity within the range of 4.4-4.5%.

Prospects for further research can be seen in the development of individual training programs for multiathletes at the stages of multi-year training.

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Conflict of interests

The authors state that there is no conflict of interests.

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РОЗРОБКА АЛГОРИТМУ ПОБУДОВИ ІНДИВІДУАЛЬНИХ ПРОГРАМ ПІДГОТОВКИ ВИСОКОКВАЛІФІКОВАНИХ БАГАТОБОРЦІВ НА ЕТАПІ БЕЗПОСЕРЕДНЬОЇ ПІДГОТОВКИ ДО ЗМАГАНЬ ЗИМОВОГО СЕЗОНУ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 10 с., 3 табл., 2 рис., 33 джерела.

Мета дослідження – розробити й експериментально обґрунтувати ефективність алгоритму побудови індивідуальних програм підготовки висококваліфікованих багатоборців у легкій атлетиці на етапі безпосередньої підготовки до головних змагань зимового сезону.

Матеріал і методи. Основною метою формувального етапу експерименту (2020-2021 рр.) була розробка програм структурних одиниць тренувального процесу (тренувальних занять, мікроциклів, мезоциклів, етапу безпосередньої підготовки до головних змагань) на основі розробленого алгоритму побудови індивідуальних програм. Нами розроблено шість послідовних кроків для досягнення повноцінної підготовленості спортсменів до головних змагань.

Результати. Виконання індивідуальної програми на етапі безпосередньої підготовки до змагань зимового сезону є ефективним і дає змогу кваліфікованим багатоборцям вийти на пік спортивної форми на час участі в змаганнях чемпіонату України у приміщенні з семиборства. Про це свідчать досягнуті статистично значущі відмінності ($p<0,05$) в усіх показниках фізичної та функціональної підготовленості, в порівнянні з констатувальним етапом експерименту. Приріст показників у бігових тестах склав 2,8-4,4%, у тестах, що відображали швидкісно-силові здібності – 4,0-4,2%, у силовій контрольній вправі – 6,6%. Відзначаємо статистично достовірний ($p<0,05$) позитивний приріст упродовж формувального етапу в показниках фізичної працездатності багатоборців у межах 5,8-6,0% і в показниках аеробної продуктивності в межах 4,4-4,5%.

Висновки. Використання алгоритму побудови індивідуальної програми підготовки до змагань висококваліфікованих легкоатлетів-багатоборців орієнтує тренера і спортсмена на досягнення бажаного спортивного результату найбільш коротким шляхом при економному та раціональному використанні тренувальних засобів на найбільш складному та відповідальному етапі безпосередньої підготовки до головних змагань. Дотримання викладених положень алгоритму дозволило раціонально спланувати й обрати оптимальний варіант побудови тренувального процесу.

Ключові слова: легкоатлетичне багатоборство, багатоборці, тренувальний процес, програмування, етап безпосередньої підготовки, алгоритм.

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