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The study of informational content of special physical and technical parameters of preparedness of qualified athletes

Abstract. *This author is analyzing the informational content, which characterize the special physical and technical preparedness of qualified high-jumpers with a running start. **Purpose:** to study the most informative parameters of special physical and technical preparedness of qualified high-jumpers with a running start and to determine their correlation with the sports result. **Material and Methods:** analysis and generalization of scientific literature, pedagogical observation (interview, survey), factor analysis and correlation analysis. 27 leading trainers of Ukraine took part in the research. **Results:** it has been estimated that 35% of trainers consider inexpedient to use current parameters on special physical and technical preparedness of high-jumpers with a running start due to the low level of informational content of the obtained data and doubtful correlation with the sports result. **Conclusions:** The selected the tests of special physical and technical preparedness, which are necessary to further develop the methodology of forecasting the effectiveness of high-jumpers.*

Keywords: *informational content, reliability, management, parameters, training.*

Introduction. The effective functioning of a control system is impossible without the information about a condition of the system which is operated; without the implementation of a transfer of this information to a place of its processing for the purpose of the improvement of teams of management; the realization of teams of management, control by their efficiency.

At the management of such difficult dynamic system where a coach acts as a long-term sports preparation and as the operating subsystem - a sportsman, it is necessary to consider all main regularities of management. Different, often changeable conditions of a sportsman have to be considered constantly by entering of amendments into the program of training under the influence of the most various factors. These tasks are solved on the basis of the use of tests of special physical and technical fitness due to which the operating system has to receive the information about an effect which is reached by this or that action of a coach.

The modern educational and training process of the qualified jumpers in height from running start has a difficult structure of the interconnected components which are directed on the improvement of special physical fitness, technical skill, education of strong-willed qualities [1–3; 6; 8].

The greatest efficiency of the process of sports training is provided by the directed development of special physical qualities and the improvement of technical skill of sportsmen at different stages of preparation [2; 3; 6; 8].

The search of the most informative parameters of special physical and technical fitness is actively conducted by experts for the purpose of control of the educational and training process which allow finding out a degree of preparedness of sportsmen for the following programs of training [1–3; 5–7].

Communication of the research with scientific programs, plans, subjects. The scientific research was conducted according to the thematic plan of the research work of Ivan Franko Zhitomir state university and according to the subject 2.3.5.1 p. “The improvement of theoretic-methodical bases of management of the system of training of sportsmen of high-speed strength sports” of the Built plan of the research work in the sphere of physical culture and sport for 2006-2010 of the Ministry of Ukraine for family, youth and sport. The number of state registration: 0108U008210.

The objective of the research: to investigate the most informative parameters of special physical and technical fitness of the qualified jumpers in height from running start and to establish their connection with sports result.

Material and methods of the research. The carried-out analysis of the informational content of a large number of parameters of special physical and technical fitness of sportsmen showed that all of them are important characteristics which define sports result in total. At the same time it was necessary to define the most informative among this large number of parameters. The factorial and correlation analysis was used for

this purpose because the main objective of the factorial analysis is the allocation of the most informative and significant parameters from some certain set of casual parameters.

Unlike the majority of known works, the factorial analysis is considered from positions of the analysis of orientation and the sizes of a multidimensional correlation ellipsoid of a full vector of special physical parameters of sportsmen in this work [2].

Results of the researches and their discussion. The questioning of the leading coaches of Ukraine was carried out for the performance of this part of the work. It became clear that 35% of coaches consider the inexpedient use of the existing parameters on a special physical fitness of jumpers in height from running start through the low level of the informational content of the obtained data and the doubtful interrelation with sports result. About 32% expressed their opinion that the frequent application of testing brings to what it becomes a mean of preparation and thus it lost the value of the purpose of testing, besides the frequent application of tests is, in their opinion, the instrument of a fast entry into a condition of sportswear. 90% of coaches consider that it is necessary to carry out an especially individual approach to an assessment of special physical fitness of sportsmen, and criteria respectively have to be specific and inherent only in these sportsmen. All 100% of respondents would like to have objective techniques at the order, which would allow diagnosing special physical fitness of pupils with the smallest expenses of time.

It is established that one of the unresolved problems of the pedagogical control is the absence of technology of carrying out testing, the standardization of the analysis of the received results, and the existence of a large number of tests which are applied at different stages in the training process of jumpers in height from running start, doesn't meet the requirements of reliability and informational content which doesn't give the chance to carry out the exact forecasting of productivity and to introduce the necessary amendments in the process of preparation.

The used methods of an assessment of a ready state of sportsmen don't allow applying, taking into account specifics of the main competitive exercise, them as objective criteria at different stages of preparation. At the same time the tendency to an intensification of the training process, the emphasis in work of coaches on the achievement of the planned level of preparation by a sportsman allows the optimization of a control system of the training process which is carried out by means of the systematic control, forecasting, with the use of a complex of informative and reliable tests which adequately display specifics of the motive activity of a sportsman, and also the correction of training programs.

Our researches testified that a large number of tests which are applied at different stages of a long-term training process don't meet the requirements of reliability and informational content.

Therefore, we didn't manage to establish a degree of reliability for Cooper test (12-minute run on a track of a stadium) because it is applied only by certain sportsmen and only disposable in the first half of October; besides the test was nonspecific for jumpers. It wasn't succeeded to establish a degree of reliability and for such tests as a breakthrough of a bar, a throw of a shot of 4 kg by two hands from below, a tenfold jump from a place from a foot on a foot and a lot of others.

The definition of a degree of reliability of some sprint exercises of high intensity (run of 60 m, 80 m, and 100 m) also caused difficulties that are explained by the negative relation to them from the side of sportsmen in connection with considerable efforts to the mobilization at an orientation to show good results. We observed a similar situation both rather some jumping and power quick tasks.

So, in particular, experts have a thought that it is possible to jump above if show the best result in the exercise "knee bending - rising with a bar on shoulders". However athletes of the extra-class, who increased the personal achievement in the given exercise-test, didn't show good results in jumps. Besides, the whole group of talented jumpers in height was compelled to leave and at the moment leaves sport through injuries of knees which arose and arise when performing this exercise. Our researches found out that a direct link between achievements in this exercise and competitive results isn't present. And nevertheless the excess emphasis on the development of power qualities played the negative role. And today we lose a large number of perspective jumpers who use this test.

We selected from a large number of control tests what have the greatest communication with sports result at different stages of long-term preparation and evidence-based of the theoretical and practical point of view (the correlation coefficient from $r=0,462$ till $r=0,964$ respectively): run of 30 m from a high start; sprinting speed (10 m with a rush); a jump up from a place from two feet; a long jump from a place from two feet; a triple

jump from a foot on a foot from a place; a jump up, standing on a take-off foot at the expense of a move of other foot; a jump up from three steps of running start (tab. 1).

The analysis of results of the researches certifies that tests of high-speed and power character have a high coefficient of correlation with a high jump (a jump up from a place from two feet – $r=0,626-0,784$; a long jump from a place from two feet – $r=0,619-0,657$; a triple jump from a foot on a foot from a place – $r=0,701-0,732$), but only at the level from beginners to a standard of the II category. The correlation coefficient considerably decreases which has a communication with high-speed and power parameters with the growth of qualification. At the level from the I category to masters of sports of the world class the high coefficient of correlation is found with high-speed parameters (run on 30 m from a high start – $r=0,652-0,691$; run on 10 m with a rush – $r=0,667-0,715$) and exercises which have viability with the main sports exercise by the structure (a jump up, standing on a take-off foot, at the expense of a move of the second foot – $r=0,715-0,865$; a jump up from three steps of running start – $r=0,877-0,964$).

Table 1

Communication of the most significant tests of special physical preparation with a result in high jumps (the correlation coefficient)

Indicators	Result in high jumps, m								
	1,15-1,20	1,30-1,45	1,45-1,55	1,55-1,65	1,65-1,75	1,80-1,90	1,90-1,98	1,98-2,08	2,28-2,41
Run on 30 m from a high start	0,462	0,473	0,489	0,504	0,625	0,634	0,652	0,673	0,691
Sprinting speed (10 m with a rush)	0,513	0,564	0,573	0,576	0,582	0,641	0,667	0,682	0,715
A jump up from a place from two feet	0,626	0,634	0,658	0,773	0,784	0,595	0,539	0,513	0,504
A long jump from a place from two feet	0,619	0,622	0,639	0,657	0,561	0,543	0,521	0,503	0,482
A triple jump from a foot on a foot from a place	0,701	0,710	0,716	0,732	0,606	0,592	0,565	0,525	0,504
A jump up, standing on a take-off foot, at the expense of a move of the second foot	0,614	0,627	0,636	0,643	0,675	0,702	0,715	0,721	0,865
A jump up from three steps of running start	0,716	0,730	0,743	0,761	0,772	0,823	0,877	0,931	0,964

Note. Coefficients are significant: $r=0,410$, $P=0,05$; MSWC – $r=0,470$, $P=0,05$.

The most informative parameters were selected on the basis of the correlation analysis from a total number of technical characteristics (the correlation coefficient from $r=0,426$ till $r=0,991$ respectively): running start speed before pushing away, speed of a departure of the general center of gravity (GCG) of a body of a sportsman at the time of a separation from a support, a corner of a departure of GCG of a body of a sportsman, pushing away a phase duration, departure height of GCG of a body, an impulse of force of pushing away (tab. 2).

As results of the researches of the dynamics of the aged changes of key parameters of technique of a high jump at different stages of a long-term preparation testify that the time of pushing away is reduced, running start speed before pushing away increases, an impulse of force which is followed by the essential growth of speed of a departure of GCG of a body of a sportsman at the time of a separation from a support increases in a corner of a departure of GCM of a body of a sportsman with the increase of a result. This dynamics is especially traced on the example of height of a departure of GCG of a body of a sportsman.

Communication of the most significant indicators of technical preparedness with result in high jumps (the correlation coefficient)

Indicators	Result in high jumps, m								
	1,15–1,20	1,30–1,45	1,45–1,55	1,55–1,65	1,65–1,75	1,80–1,90	1,90–1,98	1,98–2,08	2,28–2,41
Running start speed before pushing away	0,512	0,506	0,527	0,604	0,609	0,673	0,867	0,962	0,974
Speed of a departure of GCG of a sportsman at the time of a separation from a support	0,625	0,641	0,652	0,701	0,754	0,786	0,892	0,914	0,963
A corner of a departure of GCG of a body of a sportsman	0,574	0,587	0,616	0,722	0,763	0,802	0,874	0,957	0,986
Pushing away a phase duration	-0,426	-0,438	-0,473	-0,506	-0,536	-0,695	-0,786	-0,962	-0,973
Departure height of GCG	0,884	0,856	0,895	0,903	0,932	0,965	0,987	0,984	0,991
An impulse of force of pushing away	0,472	0,514	0,563	0,615	0,679	0,751	0,832	0,886	0,892

Note. Coefficients are significant: $r=0,410$, $P=0,05$; $MSWC - r=0,470$, $P=0,05$.

The analysis of the aged dynamics of the improvement of technical characteristics was shown that these characteristics change unevenly. In tab. 3 the data are provided to a gain of the main technical characteristics of a high jump during the different age periods. The rate of a gain of technical characteristics was calculated by a formula [2]:

$$W = \frac{100 \cdot (V_2 - V_1)}{0,5 \cdot (V_1 + V_2)} \%,$$

where W – is the size of rate of a gain in %, V_1 – is the sign size at the beginning of the studied period, V_2 – is the sign size for the end of the studied period.

The greatest rate of a gain of technical characteristics is observed in the age from 10 till 12 years old. So, the rate of a gain of speed of running start of 11-year-old sportsmen made 9,1%, speed of a departure of GCG – 9,1%, a corner of a departure of GCG – 2,2%, a departure height of GCG – 16,0%, an impulse of force of pushing away – 29,4%, the time of pushing away decreased by 7,6%. The change of these characteristics also explains the greatest rate of a gain of productivity in high jumps in this aged period (16,4%). The second jump of a gain of technical characteristics is observed in 15-year-old age: the rate of a gain of productivity made 8,4%, running start speeds before pushing away – 4,6%, speed of a departure of GCG – 7,1%, a corner of a departure of GCG – 2,1%, departure height of GCG – 8,1%, an impulse of force of pushing away – 12,7%, and the time of pushing away decreased by 4,4%.

The rate of a gain of technical characteristics increases almost linearly from 12 years old till 14 years old, and the decrease in the rate of a gain of these parameters is observed from 16 years old.

Conclusions:

1. The problem of the definition the most informative special physical and technical parameters is one of the most important problems of the improvement of management of a long-term training of sportsmen-jumpers.

2. A very uniform structure of the group in understanding of the parametrical proximity of sportsmen is observed in the group in the analysis of training of jumpers in height from a running start. Special physical parameters are “quasidetermined” with a small dispersion, – that predetermines their parametrical proximity. The last circumstance makes the increased requirements to the accuracy of the spectral algebraist analysis of correlation matrixes of parameters ($\epsilon < 10^{-12}$).

Table 3

Indicators of a gain of the main technical characteristics and result in high jumps during the different aged periods

Indicators	Age in years							
	10	11	12	13	14	15	16	17
The sports result, m	1,17	1,38	1,52	1,62	1,72	1,87	1,94	2,01
An absolute gain	–	+0,21	+0,14	+0,10	+0,10	+0,15	+0,07	+0,07
The rate of a gain, %	–	16,4	9,7	6,4	5,9	8,4	3,7	3,5
Running start speed before pushing away, m·s ⁻¹	4,39	4,81	5,15	5,41	5,61	5,87	6,07	6,32
An absolute gain	–	+0,42	+0,34	+0,26	+0,20	+0,26	+0,20	+0,25
The rate of a gain, %	–	9,1	6,8	4,9	3,6	4,6	3,4	4,0
Speed of a departure of GCG of a sportsman at the time of a separation from a support, m·s ⁻¹	3,02	3,51	3,71	3,92	4,09	4,39	4,57	4,76
An absolute gain	–	+0,49	+0,20	+0,21	+0,17	+0,30	+0,18	+0,19
The rate of a gain, %	–	9,1	5,5	5,5	4,5	7,1	4,0	4,3
A corner of a departure of GCG of a body of a sportsman, gr.	48,92	50,03	50,42	51,01	51,37	52,46	52,70	52,94
An absolute gain	–	+1,11	+0,39	+0,59	+0,36	+1,09	+0,24	+0,24
The rate of a gain, %	–	2,2	0,8	1,2	0,7	2,1	0,5	0,5
Pushing away a phase duration, s	0,27	0,25	0,24	0,24	0,23	0,22	0,20	0,20
An absolute gain	–	–0,02	–0,01	0	–0,01	–0,01	–0,02	0
The rate of a gain, %	–	7,6	4,2	0	4,3	4,4	9,5	0
Departure height of GCG, m	0,46	0,54	0,59	0,65	0,71	0,77	0,81	0,85
An absolute gain	–	+0,08	+0,05	+0,06	+0,06	+0,06	+0,04	+0,04
The rate of a gain, %	–	16,0	8,8	9,7	8,8	8,1	5,1	4,8
An impulse of force of pushing away, H·s	106,40	143,17	169,42	200,27	249,09	282,92	320,35	349,93
An absolute gain	–	+36,77	+26,25	+30,85	+48,82	+33,83	+37,47	+29,58
The rate of a gain, %	–	29,4	8,4	16,6	21,7	12,7	12,4	8,8

3. The spectral analysis of correlation matrixes of parameters confirms a theoretical conclusion about the maximum number the most informative special physical parameters which equals 7: run of 30 m from a high start; sprinting speed (10 m with a rush); a jump up from a place from two feet; a long jump from a place from two feet; a triple jump from a foot on a foot from a place; a jump up, standing on a take-off foot, at the expense of a move of other foot; a jump up from three steps of running start.

4. The most informative parameters were selected on the basis of the correlation analysis from a total number of technical characteristics (the correlation coefficient from $r=0,426$ till $r=0,991$ respectively): running start speed before pushing away, speed of a departure of the general center of gravity (GCG) of a body of a sportsman at the time of a separation from a support, a corner of a departure of GCG of a body of a sportsman, pushing away a phase duration, departure height GCG of a body, an impulse of force of pushing away.

5. The analysis of results of the researches allowed finding out that fact that the dynamics of the aged changes of key parameters of technique of a high jump at different stages of a long-term preparation is unequal and depends on the age period.

6. The inclusion in the block of control of the limited number of parameters which adequately display the solution of tasks of stages of preparation allow finding out, whether the sportsman reached desirable standards for the transition to the following programs of training, that is to answer a question: the decision or not solved tasks to a stage. Besides, techniques of forecasting of the productivity of jumpers, selected tests of special physical and technical fitness are necessary for the subsequent development in height.

Prospects of the subsequent researches. The conducted researches testify to the need of the subsequent definition of the most informative parameters of special physical and technical fitness for all high-speed and power types of track and field athletics.

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