Examination Of Psychophysiological Condition Of Highly Skilled Sportsmen

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Abstract: In the performed research the bases for the new approach development to the solution of individualization problem of the training process of highly skilled sportsmen of various specialization are laid. The basis of the offered approach is the complex analysis of the key factors influencing sports effectiveness at different stages of the training process. The performed analysis of parameters of heart rate variability (hereinafter HRV) detected increase of adaptable possibilities of the sportsmen who demonstrated high results in the current season at competitive period. The greatest tension of the organism functional systems of these sportsmen is observed during the precompetitive period. The greatest tension of functional systems of the organism of the sportsmen who have shown low or satisfactory sports result in the current season was fixed in the competitive and precompetitive periods. Reliable difference of VHR indications of sportsmen with various productivity are more distinctly shown in the end of precompetitive and during the current competition periods which is connected with raised physical and psycho-emotional loadings specific for the given periods.

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Introduction

In sports medicine and pedagogics the term "differentiated approach" is meant the organization of study and training process according to typical and specific features of the sportsmen allowing as much as possible to realize their motor, psycho-functional and creative potential. In the scientific and pedagogical literature there is a considerable quantity of the researches devoted to study of the issue. At the same time the majority of them is devoted to the study of young sportsmen training and peculiarities of their organism adaptation to training loads of various orientation [1,2-3].

Taking into consideration that development of individual programs (especially at the stages of initial sports specialization) is thought to be hard enough challenge, the basic indications have been distinguished, which are the most significant for a certain stage of training and the certain sports specialization, thus sufficiently reflecting specific features of the sportsman: morph- function indicators, level of biological maturity and development of motor qualities, mental and personal features, technical and tactical elements of training and competitive activity, a choice of strategy of training loads arrangement considering adaptation peculiarities to them etc. [6-8].

Thus, the analysis of the specialized literature has shown that despite carried out researches, there is still no uniform technology of training process arrangement at the stages of long-term training of sportsmen on the basis of differentiated approach.

For this problem solution one of the most important tasks from the position of methodology is

the choice from numerous criteria of efficiency of the most informative on which the training system should be based on. Taking into account the main objectives of professional sport [9] the following parameters correspond in the most degree:

1. Achievement of high sports result during the optimum age periods.
2. Revealing of the major factors influencing the level of sports mastership (efficiency) at various stages of training.
3. Adequacy of training influences to adaptable possibilities of the sportsman's organism .

For effective realization of the differentiated approach to training process arrangement, considering individual and typological features of sportsmen, the last two criteria are the most significant.

As the main task of our researches was developing methods of diagnostics of psycho-functional condition of training system of highly skilled sportsmen, and in the subsequent researches we investigated the power (functional) and personal and mental indicators which mostly impact on their sports efficiency. Technical and tactical factors are mostly attributed to the coach prerogative (in this work - taking into account the specific features revealed by us during preliminary examination of

sportsmen, and corresponding practical recommendations).

The purpose of the work:

Study the features of the functional condition of highly skilled sportsmen during preparation, competitive and transition periods of the training process. In connection with the set purpose the complex functional examinations of sportsmen have been executed.

Methodology and theoretical part

For estimation of the level of the functional condition of the examined the method of analysis of heart rate variability (hereinafter HRV) was used. The examinations were performed at all stages of the training process. For revealing the level of a psycho-emotional condition 8-colour Lyusher test was used. The assessment of the levels of the general, personal and situational anxiety was performed under Spielberger test. Also the conventional psycho-diagnostic techniques were applied (Cattell's Sixteen Personality Factor Model, "SACS", "Adaptability", "Career Anchors Questionnaire", a short intellectual test). For revealing the level of the psycho-physiological condition such techniques as simple and complicated visually-motor reactions (hereinafter SVMR and CMVR), reaction to moving object (hereinafter, RMO), dosed out tepping-test were used.

We have studied adaptable possibilities, psychological and psycho-physiological condition of 45 sportsmen of both sexes (average age 20,2 years) of high qualification and various sports specialization - 1-4 year students of Physical Training Faculty in "Physical training" specialty of Zhetysu State University named after I.Zhansugurov and pupils of Regional boarding school for gifted in sport children. All sportsmen were divided into 3 groups: 1 group – the sportsmen developing their speed and power qualities (judo, 35 people); 2 group - the sportsmen training for endurance (football, 45 people); 3 group - the sportsmen developing power qualities (weightlifting, 25 people). All sportsmen were examined under obligatory planned medical examination on the base of which they were attributed to the group of "practically healthy" who have not contra-indications for raised physical activities.

For assessment of the level of the functional condition of the examined the method of analysis of heart rate variability (hereinafter HRV) was used. The examinations were executed with a help of a diagnostic complex «HNS - micro» ("Neirosoft", Russia).

For revealing the level of the psycho-emotional condition widely known tests of Lyusher, Spilberger were used. The level of the psycho-physiological condition was investigated by use of express diagnostics of the functional condition of the central nervous system of the human and forecasting his working capacity on the basis of indicators chronoreflex meter - dynamic characteristics of time SVMR and CMVR, reactions to moving object. The technique is realized in the form of computer program and requires only no more than 5 minutes for execution and can performed repeatedly as does not cause the effect of exhausting training.

For study the strategies and models of coping-behavior a personal questionnaire «SACS» (stress-overcoming conduct), psycho-diagnostic technique Cattell's Sixteen Personality Factor Model, a multilevel personal questionnaire (hereinafter, MPQ) "Adaptability" were used and a personal questionnaire " A career anchor" was used for revealing the structure of career orientations of the person and dominating orientation in a career choice.

Results of researches

We performed estimation of energetic (functional) factors by means of examination of indicators of heart rhythm variability.

At all stages of training process during sportsmen examination there were their own peculiarities. The time of beginning of precompetitive and competitive stages of weight-lifters depended on individual schedules of their participation in competitions (often considerably differing from each other), therefore these stages for different athletes began at various time. The competitive stage of football players lasted till the end of examination period of the current year. At all examined judo sportsmen training stages were held simultaneously: preparatory - till April, precompetitive - April-May, competitive - June-August, regenerative – from September. Therefore in the major presented results we refer to judoists examination because the whole examined group was in the same conditions.

At the example of examination of highly skilled judoists it is possible to trace dynamics of changes of HRV indicators at various stages of training process (in the preparatory, competitive and transition periods). The received results are presented in table 1.

Apparently from the received data, by the end of the preparatory period it is observed the decrease of heart rate (hereinafter HR), a vegetative rhythm index (hereinafter VRI), growth of the index of vegetative balance (hereinafter VB) and adequacy of regulation processes (hereinafter ARP). The value of the intensity index (hereinafter II) upon termination of the preparatory period increased. Indicators of average duration R-R of intervals (hereinafter RRNN), a standard deflection from average duration of intervals R-R between sinus rates (hereinafter SDNN) and variation coefficient (hereinafter CV) also increased.

Table 1 – VHR indicators of highly qualified jodoists at various stages of training process (n = 15)

VHR indicator	Stage of training process			
	preparatory	precompetitive p1 – p2	competitive p1 – p2 p1- p3	transition p1 – p2 p1- p3 p1 – p4
HR (beats/min)	63,57±1,38	61,79±1,35 ***	63,47 ±1,37 ** ***	62,47±1,78 **** **** ****
VP (standard unit)	64,26 ±5,32	72,31 ±4,68 ***	71,27±4,12 ** ***	76,72 ±5,41 **** ** ****
VRI (standard unit)	0,49±0,03	0,43±0,05 ****	0,44±0,06 * *	0,41±0,05 **** ** **
ARP (standard unit)	19,26± 1,24	23,36±1,49 ****	20,32±1,64 ** ***	21,16±1,74 **** * ***
II (standard unit)	28,62 ±2,76	37,52 ±3,02 ****	38,57±3,04 **** **	34,62 ± 3,92 * * ****
RRNN (MS)	1036,57±19,2	1083,81±22,8 ***	1048,64±31,2 ** ***	1073,44±28,9 **** **** ***
HRV indicator	Stage of training process			
	preparatory	precompetitive p1 – p2	competitive p1 – p2 p1- p3	transition p1 – p2 p1- p3 p1 – p4
SDNN (MS)	82,47±3,98	86,39±3,83 ***	84,38±3,64 ** ***	88,94±3,86 **** **
CV(%)	7,82 ±1,61	8,07±1,83 ***	7,68 ±1,53 * ***	7,86±1,24 ** **
HF (standard unit)	0,36±0,02	0,38±0,04 ****	0,36±0,04 ** ***	0,39±0,04 **** * ****
LF (standard unit)	0,14±0,03	0,15±0,04 ****	0,14±0,03 ** ***	0,12±0,03 **** * ****
LF/HF(%)	0,37±0,02	0,34±0,03 ***	0,36±0,03 ** ***	0,30±0,03 * * ****
* - p>0,5; ** - p>0,05; *** - p<0,05; **** - p<0,01				
Source: Dzhankuldukova A.D. (2013)				

These changes are connected with strengthening of activity of parasympathetic department of vegetative regulation and decrease of sympathetic influence. All this indicates of rearrangement of cardiovascular system activity for more economic mode at the expense of decrease of "central" influence of regulatory mechanisms. Indicators of capacity of high-frequency fluctuations (hereinafter HF) upon

termination of the preparatory period increased more expressively than indicators of low-frequency component of a spectrum (hereinafter LF), that indicates of high adaptable possibilities to the raised physical loads characteristic for this period of training process.

At the competitive stage the display of indicators decrease of the functional condition and increase of sympathetic influences is observed in comparison with precompetitive period that is connected with excessively high emotionally-psychological and physical activity connected with features of combat sports. Indicators of capacity of high-frequency fluctuations (HF) upon competitive period termination decreased against growth of ratio LF/HF that is connected with strengthening of sympathetic influences. These changes characterize the exhaustion state.

At the same time in the transition period the fast restoration of the functional condition connected with expressed strengthening of parasympathetic influences (decrease of VRI and II indicators against growth of VP and ARP) is observed. In comparison with the competitive period the growth of RRNN, SDNN, CV indicators is marked. Further the growth of indicators of capacity of high-frequency (HF) and low-frequency (LF) fluctuations is observed; ratio LF/HF decreased. The prevalence of parasympathetic department observed in the transition period indicates about improvement of mechanisms of regulation of cardiac activity. It confirms the specified above provision of "economizing" mechanisms of cardiac activity regulation (as changes of all indicators remained within standard) and testifies to the raised adaptable abilities of highly skilled sportsmen organism.

The basic indicator of efficiency of sports activity is productivity. In this connection we also carried out the analysis of indicators of the functional condition of highly skilled sportsmen taking into account success of their competitive activity. In table 2 the data of statistical analysis of HRV indicators of the football players who demonstrated high results in the preparatory and competitive periods during the current season are presented.

The sportsmen who successfully performed at the competitive stage displayed increase of adaptable possibilities during competitions period (reduction of tension index and amplitude of mode, increase of mode and variation scope). The contrary situation is observed at the sportsmen who showed low or satisfactory result in the competitive period. The revealed peculiarities (growth of intention index, decrease of the mode and variation scope) testify to tension growth of regulatory mechanisms with the expressed prevalence of sympathetic influences that is specific for the exhaustion condition.

Table 2 – HRV indicators of football players who demonstrated high and satisfactory results at various stages of training process

HRV indicator	Stage of training process			
	preparatory		competitive	
	sportsmen with high results	sportsmen with low results p1 – p2	sportsmen with high results	sportsmen with low results p1 – p2
Mode	0,79±0,02	0,80±0,03 *	0,89±0,03	0,71±0,04 ***
Mode amplitude	38,3±1,5	37,9±1,1 *	37,2±1,8	51,4±1,9 ***
Variation scope	0,22±0,01	0,23±0,01 *	0,31±0,02	0,21±0,02 ****
Intension Index (y.e.)	35,5±1,8	40,2±3,1 **	32,5±2,1	94,8±5,6 ****
* - p>0,5; ** - p>0,05; *** - p<0,05; **** - p<0,01				
Source: Dzhankuldukova A.D. (2013)				

The revealed differences were observed from the precompetitive period, however reliable distinctions were found out only during the competitive period. Thus, HRV indicators can be used for selection of the most trained highly skilled sportsmen to participation in responsible competitions in case of dynamic supervision in the preparatory and precompetitive periods. At the same time the most information value of HRV indicators (for reliable forecasting of sports productivity of highly skilled sportsmen) get only during the competitive period.

As during the precompetitive period the level of physical loads is equal (and sometimes it exceeds) to the level of physical loads during the competitive period, the changes shown by us during the competitive period can be possibly explained by emotionally-psychological tension of this given period which is difficult enough for simulating at the preparatory stage of the training process. In this connection the role of diagnostics and control of psychological and psycho-physiological condition of

highly skilled sportsmen at various stages of training process increases.

Discussion

In the coach work the important factor is the ability to control the condition of the sportsman, leaning not only on own experience, intuition and sports results, but also ability to use objective morphological, physiological indicators of functional systems of an organism. It will allow to plan the increase of readiness of sportsmen to adequate reserve possibilities and adaptable potential.

At the same time the individual approach application in practice is presented to be rather problematic. Therefore as an alternative at the initial stages of long-term training the differentiated approach with gradual transition to the individual approach at the stage of the higher sports skill should act.

It was proved that the influence and the significance of the major factors defining productivity at stages of long-term training of highly skilled sportsmen gradually changes from the most conservative (morpho-functional factors) to the most labile (personal and mental factors). The specified dynamics of influence of factors of productivity specifies to the coach about necessity of updating of long-term strategy of training process arrangement where the initial tactics directed on increases of motor potential of beginner sportsmen should be displaced to increase of reliability of competitive activity with increase of the sportsman qualification.

Conclusions

On the basis of the received results preliminary practical recommendations have been developed for coaches and sports doctors of teams on selection and control of the functional condition of highly skilled sportsmen at various stages of long-term training:

1. For highly skilled sportsmen during training process reorganization of cardiovascular system activity to more economic mode at the expense of decrease of "central" influence of regulatory mechanisms of change, strengthening of activity of parasympathetic department of vegetative regulation and decrease of sympathetic influence is characteristic.

2. During the preliminary period the functional condition of cardiovascular system of highly skilled sportsmen is characterized by activation of parasympathetic department of vegetative nervous system. During the competitive period activation of sympathetic department of nervous system and tension of regulatory mechanisms that is connected with increase in volume of psycho-emotional and physical activities is observed. The time of restoration of parasympathetic influences in a transition period testifies to the level of adaptable possibilities of an organism.

3. For successfully performed sportsmen the increase of indicators of adaptable possibilities in competitions is characteristic. At less successful sportsmen during the competitive period the tension increase of regulatory mechanisms with the expressed prevalence of sympathetic influences is observed.

4. For highly skilled sportsmen the growth of concentration and stability of attention to the competitive stage is characteristic. At the same time the specific features depending on sportsmen specialization (initially high values of both indicators and their increase during the competitive period of judoists are revealed; prevalence of the growth of concentration of attention of football players; the least low indicators at weight-lifters).

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