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Features of methods of physical and operational control of athlete using the «Information and diagnostic complex restoration of the functional state of an athlete»

Abstract. ***Purpose****: the study aims to determine the possibility of using the training process athletes some parameters of heart rate variability, reflecting the physical condition of athletes before and after different size loads, as well as the recovery process in skiing.* ***Material and Methods****: control of real-time reactions of the body of an athlete and an operational range of recovery tools using the «informational diagnostic complex restoration of the functional state of an athlete».* ***Result****: to study the formation of the main components of the recovery of an athlete in skiing at different stages of sports perfection.* ***Conclusions****: the experimentally determined the optimal ratio of means and methods of recovery of an athlete at the stages of long-term preparation, as well as the peculiarities of the recovery process in some structural formations and their conjugation.*

Keywords: *computer, control, heart rate variability, heart rate, pulse, psychoelectropuncture, skiers, athletes.*

Introduction. Training and competitive loads in modern sport reached such sizes that their further increase can become the reason of a failure of individual adaptation of sportsmen, a decrease in efficiency of the training process, a deterioration of sports results and an emergence of pathological changes in various functional systems of an organism at all variety of means and methods of training of sportsmen. The improvement of results in the majority of sports in the next decades will be caused by an application of more effective remedies and methods of diagnostics of processes of a restoration. The increase of productivity of sportsmen is closely connected with a volume and a character of training loads. The accounting of urgent reactions of a human body to this or that training load and, in particular, during a restoration allows to increase the efficiency of classes by the optimization of norms of loading depending on his specific features.

The training process is often connected with big physical activities and even overloads after which sportsmen do not always manage to be restored completely that brings to physical and often to psychological injuries (because of a constant fatigue the psychological spirit of a sportsman on training, on competitions weakens, the desire to train disappears and the whole complex of other adverse factors appear).

Recently the psychoelectropunctura was widely used. "Psychoelectropunctura" (from Greek *Psyche* – a soul, electro - and lat. *punctura* – a prick, in abbreviated form PEP) –is a diagnostic and therapeutic method which represents a combined use of techniques of psychocorrection and electropunctura. Psychoelectropunctura is a method of psychophysiological correction of the psychophysiological development which doesn't correspond to an "optimum" model of maintenance of a homeostasis of a human body on the accepted system of criteria, has a synergetic effect at a simultaneous action of words-incentives on subconsciousness and impulses of a small electric current on the biologically active points (BAP). The PEP method is realized in the device "Harmony-1" and the program "EURASIA" [8].

The use of PEP "Harmony-1" and the program "EURASIA" was offered for the definition of a degree of an imbalance of functioning of systems of an organism of the sportsman and the establishment of the demanding activation of activity of an organism of the sportsman in the work. For this purpose we used the author's portable device SG-3 which can be used in field conditions [8].

It is known that the heart rate (HR) is the physiological parameter, the most available to registration reflecting processes of the vegetative regulation in the cardiovascular system. Dynamic characteristics of a cardiac rate (CR) allow estimating the expressiveness of shifts of sympathetic and parasympathetic activity of the vegetative nervous system (VNS) at changes of a physical condition of a person.

Data of the variability of heart rate (VHR) can be useful to understanding of chronological aspects of trainings of sportsmen and moments of time of the optimization of a physical state as they reflect vegetative influences on a heart system. VHR can also give important information on the deterioration of physical condition of sportsmen as a result of the influence of various factors [6–8].

Communication of the research with scientific programs, plans, subjects. The work is performed according to the Thematic plan of the research works for 2013-2015 on the subject "Scientific and methodical bases of the use of information technologies at training of specialists of the branch of physical culture and sport" (number of the state registration is 0111U003130).

The objective the research: the definition of possibility of the use in the educational-training process of sportsmen of some parameters of variability of a cardiac rate reflecting a physical condition of sportsmen before and after loadings, various in size, and also recovery process in skiing.

Material and methods of the research. During the conducted research we solved a problem of the delimitation of the parameters of VHR of sportsmen at rest and after physical activity on a correlation rhythmography (skaterogramma) and histogram of a ratio of quantity of RR-intervals in various intervals of their duration.

The portable handheld skaterograph SG-3 which is developed on the basis of Kharkov state academy of physical culture which allows determining VHR indicators by the analysis of a number of cardiocycles (NN-intervals) by the method of a sliding selection, and also the analysis of a standard duration of (3 minutes) selection was used in the work[1; 2].

13 skiers-racers of different qualification took part in the researches. From them are: 4 – the masters of sports (MS), 6 – candidates for the master of sports (CMS), 3 – sportsmen of the Ith sports category (I cat.).

The measurement of the background parameters VHR at rest at sportsmen was taken before physical activity in a sitting position in 2–3 hours prior to performance or before training. The second measurement was taken after a performance at competitions or after a training load. Before the second measurement the sportsman carried out not less than 5 minutes massage with the use of different metal needles applicators of Lyapko which are a new technique for relaxation of muscles and restoration of breath. Then the sportsman had a rest sitting within 5 minutes before the stabilization of a rhythmogramma (without a slow trend of HR).

We accepted the level of intensity of physical activity during the performance of exercises of skiing for maximum if HR kept at the level of 190-210 bpm^{-1} within more than 7 minutes during the performance of an exercise at masters of high qualification. For skiers of low qualification the range of increase of HR was determined 175–190 bpm^{-1} within not less than 5 minutes.

The essence of a correlation rhythmography consists in the creation of a graphic arrangement of points, each of which corresponds to a duration of two next R-R intervals, thus the ordinate of a point corresponds a current, and an abscissa – to the subsequent R-R interval [2]. In norm the two-dimensional skaterogramma has a form of an ellipse extended along a longitudinal axis.

Such form of an ellipse means that some size of the unaccounted nature of arrhythmia is added to respiratory arrhythmia [3]. At a sinus arrhythmia the middle of an ellipse of skaterogramma can be determined by a meaning of an indicator of the statistical analysis of a heart rhythm – mode. Mo – mode, the most often met value of duration among N-N intervals which are equivalent to duration of pauses between reductions of heart rates indicating the dominating level of functioning of sinus knot. At sympathicotonia a value Mo decreases (the correlation field moves by the beginning of coordinates), at vagotonia– increases (the cloud of skaterogramma moves to the right on a bisector from the beginning of coordinates) [3].

Geometrical methods allowing receiving the law of distribution of cardiointervals as random variables are also used for the analysis of VHR. Thus the distribution of duration of cardiointervals is displayed on a histogram.

The diagram will be with a narrow basis and a sharp top (excessive) in stressful situations, and also at pathological conditions. The asymmetric diagram is observed at transition processes, violation of stationary process. The polyconic diagram testifies to a nonharmonic rhythm (extrasystole, vibrating arrhythmia).

Geometrical methods allow estimating the variability of a heart rhythm by means of the following parameters: mode, amplitudes of mode and variation scope. As corresponds to the quantity of RR-intervals which meet most often, it allows estimating a real condition of systems of regulation of a patient.

The additional calculated parameters are used to estimate an extent of adaptation of the cardiovascular system to various factors and to define an extent of regulation of these processes.

Results of the researches and their discussion. Results of the conducted researches of indicators of VHR of skiers-racers showed that the area of an ellipse of skaterogramma at rest and its location depends on qualification of an athlete. The middle of skaterogramma could be on the right from a point of intersection of coordinates (1,0 s; 1,0 s) at athletes of high qualification (Mo=1,1 s) or on the left from a point of intersection of coordinates (0,75 s; 0,75 s) at sportsmen -skiers of the I category and CMS (Mo=0,7). After physical activity the sizes of an ellipse decreased, and it moves on a bisector by the beginning of coordinate axes. The research revealed that Mo makes 500 ms after physical activity of the maximum intensity at sportsmen-skiers of high qualification , and Mo-550 ms is at sportsmen of the I category and CMS. The area of an ellipse of skaterogramma considerably decreased in sizes and in a form and could turn into a point at Mo<500 ms.

It is known that an emission of blood from heart and a pulsation of vessels depend on a breath depth. On a breath the systolic volume of emission decreases from the left ventricle and inflow of blood to a heart increases. It is followed by the increase of pulling a wave of blood from the periphery. Thus, there is an additional wave in the pulse movement of blood – respiratory when in a rhythm to a breath (with a smaller frequency, than a pulse rate) height of a pulse wave of blood changes. So, the parasympathetic system has the modulating impact on activity of the sympathetic system [5]. At the present stage the practical use of methods of the analysis of VHR in sport helps to solve effectively many problems of a diagnostic and predictive profile, an assessment of functional states, control of efficiency of recovery influences, etc. However opportunities of this methodology aren't exhausted and its development proceeds.

Conclusions:

1. The results of the research showed that a complex use of skaterograph "SG-3" and PEP "Harmony-1" and the program "EURASIA" allows defining in real time a state the morphofunctional systems of an organism which are most subject to the process of exhaustion. It is completely confirmed in skiing where the result in competitions depends on the coordination of rational breath and physical actions.

2. The received preliminary results allow speaking about the possibility of optimization of the mode of physical activity as in the organization of training process, and the optimization of the mode passing of a distance in the conditions of competitions.

Prospects of further researches are connected with an expansion of a practical use of a method of the analysis of VHR by means of the portable device SG-3 in different types of sport for the operational solution of a problem of estimation of a functional condition of an organism of a sportsman, and also the control of adaptation processes. A further introduction is directed on an automation of the process of measurement of VHR and a computerization of statistical processing of an experimental skaterogramma.

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