Temporal and spectral indicators of heart rate variability of taekwondo athletes

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Abstract

Objective of the study was to determine the features in the regulation of the heart rhythm of taekwondo athletes in transitional training at the stage of sports improvement.

Methods and structure of the study. Taekwondo athletes of the Master of Sports (n=18) and candidates for the Master of Sports (n=2) of youth took part in the study at the end of the competition (fights were completed 2-3 weeks before the study). The temporal (variation range; stress index) and spectral parameters of heart rate variability were recorded using the Varicard hardware-software complex. Processing and analysis were carried out using the methods of mathematical statistics.

Results and conclusions. The values of the variational range in male taekwondo masters of sports on average in the group are 300.30±98.02 ms, in the group of girls 244.41±64.83 ms; the value of the tension index in taekwondo athletes is 96.29±41.91 c.u., in taekwondo athletes - 91.09±21.77 c.u., which does not indicate a significant decrease in the functional potential of athletes, at the same time only in 2 athletes from 20 found the optimal structure of the spectrum: HF> LF> VLF, the rest of the study participants have a different spectrum structure scheme and indicate a state of fatigue, overtraining, psycho-emotional stress.

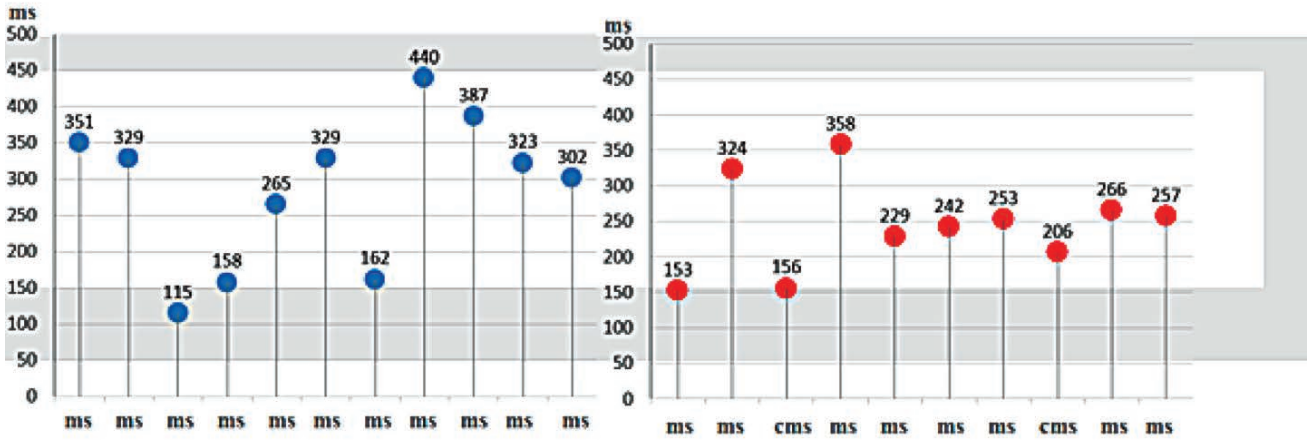
Analysis of mean group values of temporal and spectral frequency parameters of heart rate variability does not allow one to objectively judge the state of regulatory systems. When considering personal values of heart rate variability, it is possible to assess the degree of tension of regulatory systems, the tolerance of realized training loads, the reserves of adaptation to the conditions of training and competitive activities.

Keywords: *functional state, variational pulsometry, heart rate variability, taekwondo.*

Introduction. In recent years, most experts point out the need for a coach not only to know the method of analyzing the spectral parameters of heart rate variability (HRV), but also to be able to correctly apply it in the training process of athletes to control the functional state of an athlete, optimize training loads and recovery measures [1, 2].

Objective of the study was to determine the features in the regulation of the heart rhythm of taekwondo athletes in transitional training at the stage of sports improvement.

Methods and structure of the study. The study involved taekwondo masters of sports boys (n=10) aged 18-21 and girls Masters of sports (n=8) and 2 candidates for the Master of sports aged 17-21, the athletes performed training loads according to a single program. The study was carried out on the basis of a training center. To process cardiointervalograms and analyze heart rate variability, the hardware-software complex “Varicard” was used. The popularity of this complex is explained by the non-invasiveness of testing, the registration of the parameters necessary for the formation of conclusions, taking into account Western standards [3] and the methodology of Soviet and Russian specialists [1]. A 5-minute recording of the heart rhythm was carried out in comfortable conditions after collecting an anamnesis and a



Youth taekwondo fighters aged 18-21 Taekwondo girls aged 17-21

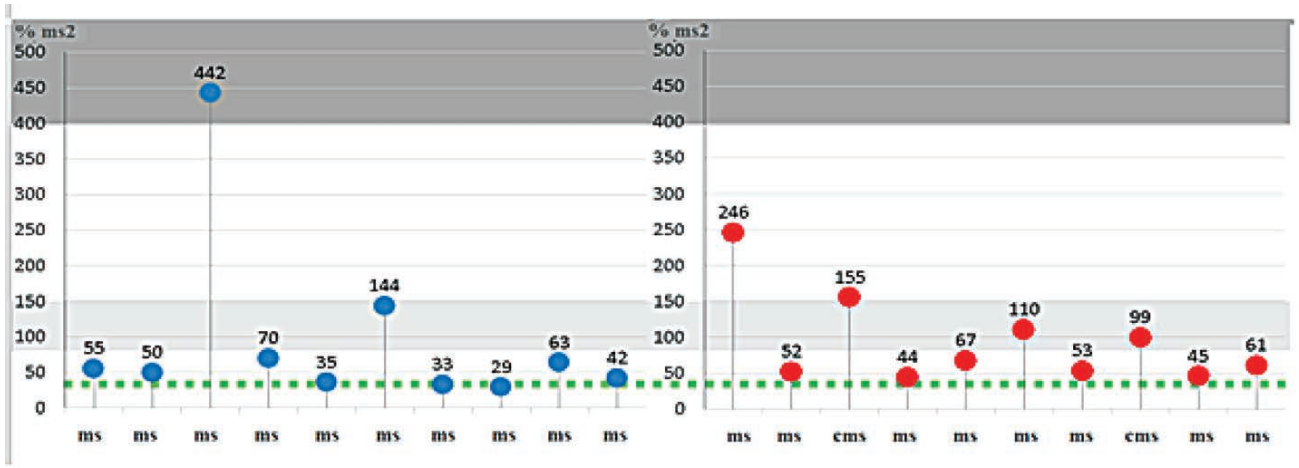
Figure 1. *Values of the variation range of taekwondo fighters*

5-minute rest. The temporal and frequency parameters of the heart rhythm were assessed in accordance with the "Standards of measurement, physiological interpretation, and clinical use" [3].

Results of the study and their discussion. MxDMn is an indicator of the variation range of cardiointervals, which indicates the state of the autonomic balance of the sympathetic and parasympathetic divisions, and is also sensitive to individual typological features of regulation and the activity of the sinus node. The predominance of the central contour of regulation, the strengthening of sympathetic regulation during mental or physical exertion is manifested by a stable rhythm, a decrease in the variation range [1]. The smaller the range of the variation range, the greater the activity of the central circuit of regulation. The values of this indicator in the group of boys are 300.30±98.02 ms, in the group of girls 244.41±64.83 ms, and are included in the range of values of healthy individuals of the corresponding age group - the gray contour in Figure 1, while there is information about more a narrow corridor for persons with an increased functional state - in Figure 1, a white background.

The personal values of boys have a greater spread than the values of girls (Figure 1).

The tension index characterizes the degree of tension of regulatory systems, namely, how much the activity of the central regulatory mechanisms prevails over the autonomous ones. This indicator is sensitive to increased tone of the sympathetic nervous system [1]. Average group values for the group of taekwondo fighters are 96.29±41.91 c.u., for the group of girls 91.09±21.44 c.u., which is in the optimal range of 80-150 c.u. (gray corridor in Figure 2), lower values are typical for athletes - the dotted line in Figure 2. When considering individual values for some athletes, the stress index in a boy and 2 girls indicates a state of tension in adaptation mechanisms with a tendency to



Youth taekwondo fighters aged 18-21 Taekwondo girls aged 17-21

Figure 2. *Tension index values for taekwondo athletes, (n=20)*

Table 1. *Values of spectral parameters of HRV of taekwondo athletes, (n=20)*

Youth taekwondo fighters aged 18-21	Name	TP	VLF	LF	HF	Taekwondo girls aged 17-21	Name	TP	VLF	LF	HF
	V.N.	7780	1557	2060	4163		V.N.	TP	VLF	LF	HF
	L.K.	9514	3876	1748	3890		L.K.	1683	114	881	688
	A.D.	550	83	246	221		A.D.	6255	1159	2263	2832
	V.N.	8365	723	3889	3753		V.N.	2771	686	1398	688
	T.M.	12349	2890	5612	3847		T.M.	6132	1440	1766	2926
	V.S.	2530	1114	890	526		V.S.	5392	1812	1218	2362
	Sh.V.	7587	2282	2710	2595		Sh.V.	3846	530	1860	1933
	S.S.	11497	2316	2373	6808		S.S.	6186	923	1238	4025
	Kh.V.	2690	565	339	1785		Kh.V.	5764	759	1657	3348
	M.D.	12795	8121	3267	1407		M.Д.	7480	1490	1764	4226
	M	7565,6	2352,5	2313,4	2899,7		M	3883	993	1401	1464
	m	1442,36	778,30	555,70	665,23		m	4939,3	945,5	1544,7	2449,1
	s	4327,09	2334,89	1667,10	1995,68		s	605,16	168,02	131,88	419,71

increase the activity of stress-realizing systems, one Master of Sports - in Figure 2, the value in the dark gray zone is 442 c.u. exceeds the damage threshold, which is considered to be 400 c.u.

An increase in the value of the stress index is often accompanied by a decrease in the indicators of the spectral frequency analysis of HRV, which is observed in the athlete A.D. – voltage index 442 c.u., the value of the total power of the spectrum and the power indicators of high-frequency and very high oscillations of the spectrum are reduced (table 1), which indicates a state of stress.

According to Shlyk T.I. with the same total power of the spectrum, the order of distribution of the components of the spectrum can be different [1] and normally the structure of the spectrum corresponds to the scheme: HF>LF>VLF. We have such a ratio when analyzing the average group spectral parameters of boys and girls taekwondo athletes; when considering the data personally, such a scheme of the spectrum was recorded only in 2 athletes. 7 taekwondo fighters and 3 sportswomen have spectrum structure VLF>LF>HF. The ratio LF> VLF>HF was found in 3 boys and 2 girls; the structure of the spectrum - VLF>HF>LF was noted in 2 taekwondo and one taekwondo. The last three schemes described indicate a state of fatigue, overtraining, psycho-emotional stress. Due to the fact that the performances at the competitions ended 2-3 weeks before the examination, we can assume a state of fatigue, overtraining.

Analysis of the ratio and quantitative expression of the components of the spectrum on average for groups does not allow us to see the imbalance, respectively, to correctly assess the condition of athletes.

Conclusions. It is shown that it is not correct to control a group of highly qualified taekwondo practitioners working even according to one program according to the averaged HRV data, because the average group data of girls and boys in our study indicate the optimal state, which is refuted by a personal analysis of the results of the examination of athletes. Thus, the assessment of: the tension of the heart rhythm regulation systems, the degree of tolerance of the performed loads, the reserves of adaptation to the conditions of training and competitive activity in order to optimize the educational and training process requires a personal interpretation of the data of variational pulsometry.

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