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Original Article

Influence of training process on the psychophysiological state of young male judo players

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Abstract:
Problem Statement: This work is aimed at studying the dynamics of psychophysiological characteristics of 15–16-year-old male judo players during their training process. Approach: A total of 24 male judo players (mean age = 15–16 years) volunteered for this study. Their psychophysiological characteristics were measured twice – at the beginning and at the end of their annual training cycle. Purpose: The psychophysiological characteristics were tested to define trait and state anxiety, to self-evaluate their emotional state, aggressiveness and proneness to conflicts, and the variability of the judo players` heart rate.Results: The annual training cycle contributed to decreasing the levels of judo players` trait and state anxiety; most of the sportsmen demonstrated an average level of anxiety. The training process contributed to the increase of emotional state self-evaluation for most of the judo players; the frequency of positive and negative aggressiveness was lowered as well as the levels of apathy and proneness to conflicts. At the beginning of the training process, the athletes` heart rate variability was mostly influenced by the sympathetic part of the nervous system. At the end of the one year training cycle, the judo players` cardiovascular system was much more regulated by the parasympathetic part of the vegetative nervous system. At the end of the training period, the standard deviation influenced by training process was 80.56 ± 6.57 ms, which also shows an increase in neurotony. When the training process began, most judo players were registered to have a permissible level of functional state (41.7%). A third of all athletes were characterized to have a suboptimal functional state. When the annual training cycle was over, most judo players were characterized as having a suboptimal functional state (58.4%). The number of athletes with a suboptimal functional state increased by up to 2.5 times; there were no sportsmen with negative or optimal limit of functional state. Conclusion: Training process contributed to the young judo players` psychophysiological state optimization. At the end of the one year judo training cycle, there appeared a positive dynamics in psychophysiological characteristics and functional state, which suggests a high adaptation level to physical and psychological loads.
Keywords: psychophysiological characteristics, trait anxiety, state anxiety, aggressiveness, heart rate variability, young males, training process, judo

Introduction

Currently, sports impose high requirements on the functional state of an athlete. Training process is aimed at realizing a sportsman`s potential and at achieving the high level of both functional and psychological readiness for competitions [4, 8, 10, 22, 24].

The specific character of sport activities in judo requires certain psychological preparedness of a player and his personal characteristic features [3, 11, 13, 26]. Thus, the training process is mainly concentrated on achieving the high level of technical and tactic readiness of judo players [8].

Little attention has been paid to the psychological preparation of judo players [3,4,5,22]. Typically, only one of the components of psychological preparation (e.g., emotional stability and motivation) was considered by researchers. The state of an athlete's psychophysiological readiness and its dynamics during the training process and while preparing for competitions have not been considered in the research literature. Therefore, managing the psychophysiological training of judo wrestlers by monitoring their psychophysiological status is relevant for the judo theory and practice.

The research on the athletes` psychological preparation originates from the works by A.Ts. Puni, the main focus of which was the education of moral and volitional qualities, and this direction is still being developed [14] . In the 70–80s of the 20th century, this direction was replaced by an emotional one [21]. The research on motivational sphere [3, 20, 23, etc.] with an attempt to individualize the psychological preparation of athletes in a particular sport [4, 8, 25, etc.] predominates in today's concepts of the athletes` psychological preparation.

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In recent years, it is considered that psychophysiological preparation of an athlete should provide optimal adaptation to training and competitive loads. At the same time, many aspects of the problem of optimizing the psychophysiological status of judo players, taking into account modern trends in the development of sports, still require an in-depth study. To effectively organize the training process, it is necessary to meet challenges of an athlete`s fitness to fulfill the loads, of excluding a sportsman`s negative states, and of high motivation in doing judo [18]. All abovementioned issues can be solved by evaluating a player`s psychophysiological state during the training process [5, 6, 7, 12, 14].

Evaluating a psychophysiological state of a judo player during the training process allows to define the safety margin of body`s functional systems and timely make corrections to a sportsman`s training system [16, 19, 23]. This work aimed at studying the dynamics of psychophysiological characteristics of 15–16-year-old male judo players during their training process.

The research objectives are to define the initial level of psychophysiological characteristics of 15–16-year-old male judo players and to evaluate the influence of the training process on their psychophysiological state.

Materials and methods

A total of 24 male judo players (mean age = 15–16 years) volunteered for the study. Their psychophysiological characteristics were measured twice – at the beginning and at the end of their annual training cycle. This study was performed in accordance with the ethical standards approved by the Russian Academy of Sciences. In addition, all participants signed an informed consent form. The following methods were used in the study: theoretical analysis and generalization of data from research and methodological literature, tests for assessing the level of psychological readiness, and variational cardiointervalometry for assessing the general functional state and for analyzing the functional state of the autonomic nervous system according to certain parameters of an athlete's cardiac rhythm. This research was performed for a year and a half at the Ishim P.P. Ershov Teachers Training Institute (branch) of University of Tyumen, Russia and at the Youth Sports School of the Ishim District.

The Spielberger et al. trait and state anxiety questionnaire adapted by Ju.L. Khanin was applied to evaluate both trait anxiety and state anxiety of athletes. The testing of psychophysiological state also included defining the players` self-esteem of emotional state (by A. Wessman and D. Rix), which is the most effective for defining an athlete`s emotional state for a definite period of time, the evaluation of personal aggressiveness and conflict proneness by the method of Eu.P. Ilyin and P.A. Kovalyev, and measuring the judo players` heart rate variability [1, 21]. The psychophysiological testing device “Psychophysiologist” (produced by “Medicom MTD” in the town of Taganrog, Russia) was used for heart rate variability measuring. A total of 128 cardio intervals were registered for the players. The average number of RR intervals, mean-square deviation, the maximum and minimum points, the mode and the level of functional state were measured.

The functional state was evaluated based on the heart rate variability level, which allowed to classify it into the following levels of functional states: critical (=0.001), negative (>0.001), marginal (>0.1), permissible (>0.37), suboptimal (>0.64), and optimal (>0.80).

The data were analyzed using the «Statistica 6.0» software package. The arithmetic mean, standard deviation, and arithmetic mean error were calculated; the significance of differences was determined by Student's t-test.

Results

To evaluate the influence of the training process on the psychophysiological state of young male judo players their trait and state anxiety levels were studies. Trait and state anxiety scores at the beginning and at the end of the training season are shown in Table 1.

Table I Trait and state anxiety scores of judo players (mean age = 15–16 years) at the beginning and at the end of the training season (M ± m)

Anxiety scores	The beginning of training season		The end of training season	
	State anxiety	Trait anxiety	State anxiety	Trait anxiety
High	68,42±1,7*1	71,71±1,01*	52,0±2,0	50,66±1,76
Moderate	37,0±1,52	40,0±2,30	38,87±2,32	38,57±2,12
Low	25,0±1,0	29,5±0,5	25,0±1,0	27,0±1,0
Group average	53,33±5,60*	56,75±5,48*	38,75±2,80	39,66±2,67

Note: The significance of differences between the indicators at the beginning and end of the training season: * $P \leq 0.05$

At the beginning of the training season, the judo players (mean age = 15–16 years) were registered to have a high level of state anxiety and trait anxiety (Table 1). At the end of the training season, the judo players were registered to have a moderate level of anxiety (38.75 points); a high level of state anxiety and trait anxiety was registered for 16.7% of the athletes. At the end of the training season, 66.6% of the judo players were registered to have a moderate level of anxiety. The average score of state anxiety was 38.87 points.

Consequently, the one year’s training season contributed to the decrease of the judo players` state and trait anxiety scores; most of the athletes were registered to have a moderate anxiety score.

At the beginning and at the end of the training season, the judo players were tested using the method of defining the players` self-esteem of emotional state. Interpretation of the self-esteem of emotional state test included both the general evaluation of states (which reflects their expressiveness, the level of the judo players` emotional lift or exhaustion) and certain testing scales. The total score of emotional states showed that at the beginning of the training season, 8.3% of the judo players characterized their self-esteem as being high, 75.1% characterized it as being moderate, and 16.6% of the judo players evaluated their emotional state as being low.

Therefore, at the beginning of the training season, most judo players were characterized as having a moderate score of emotional state. The final score of emotional state for the end of the season showed that 66,6% of the players esteemed their state as the high one, 33.4% named it moderate and there were no athletes who regarded their emotional state as low at the end of the training season. The results obtained allow concluding that the training process contributed to the increase of the emotional state level for most of the athletes. At the beginning and at the end of the one year training season, the judo players (mean age = 15–16 years) were also tested to evaluate their personal aggressiveness and conflict proneness using the method of Eu.P. Ilyin and P.A. Kovalyev. The four scales of the method (i.e., inflexibility, irascibility, susceptibility, and suspiciousness) were used to define the players` personal aggressiveness general score. The mean age of 15–16 years is characterized by the higher score of conflict proneness owing to the instability of emotional reactions and behavior. A total of 33.3% of the judo players were registered to have a higher level of conflict proneness at the beginning of the training season, 50% showed a moderate level of conflict proneness, and 16.7% showed a low level of general conflict proneness. Therefore, the evaluation of personal aggressiveness and conflict proneness using the method of Eu.P. Ilyin and P.A. Kovalyev showed that at the beginning of the training season, 30% of the athletes had a higher level of positive aggressiveness and conflict proneness. Positive aggressiveness included the evaluation of personal characteristics such as self-assertion and inflexibility. A higher level of positive aggressiveness was registered in 8.3% of the judo players; 75% of the athletes had a moderate score of positive aggressiveness, 16.7% had a low score of positive aggressiveness. One year training season allowed to decrease the number of judo players with a high score of positive aggressiveness by a factor of two. When comparing the results of testing negative aggressiveness at the beginning and at the end of the season, it is determined that owing to the training process, the number of judo players with a high level of negative aggressiveness decreased by a factor of two. At the end of the one year training season, there were no athletes with a high score of conflict proneness at all. A moderate score of conflict proneness was determined for 66.7% at the end of the study. At the same time, 33.3% of the judo players had a low score of conflict proneness. Consequently, at the end of the training season, all evaluated psychophysiological characteristics indicated a higher level of psychological preparedness of the judo players. One of the vital body systems that can limit the development of a sportsman`s adaptive reactions to training process is the cardiovascular system [2, 15]. A certain level of sportsman`s body functions is achieved by the dynamics of its regulatory systems [19, 20, 25]. This research uses a statistical analysis to study the heart rate variability to evaluate the influence of training process on adaptive reactions and functional status of the judo players (Tables 2 and 3).

Table II Functional state of the judo players` heart rate variability (mean age = 15–16 years) at the beginning and at the end of one year training season **(M ± m, δ, Cv)**

Scores	At the beginning of the season			At the end of the season			Veracity (p)
	M±m	δ	Cv	M±m	δ	Cv	
Heart rate (beats per minute)	71,26±2,02	9,89	8,86	68,46±2,50	12,24	13,44	p>0,05
M (ms) Mathematical expectation	746,33±16,05	78,52	10,66	860,23±13,19	64,51	14,88	p<0,05
Mode (ms)	758,84±17,70	86,59	10,16	836,42±19,65	96,12	18,48	p<0,05
Standard deviation (ms)	49,86±4,84	23,68	36,23	80,56±6,57	32,16	38,26	p<0,05

The average scores of the judo players` heart rate variability (mean age = 15–16 years) were standard for their age; during the one year training season, the scope of heart rate decreased and was 68.46 ± 2.50 beats per minute (BPM). The scores of mathematical expectation of the judo players at the end of the training season statistically increased. One of the basic indicators of heart rate variability is the mode (Mo). The minimum Mo was registered at the beginning of the season, which indicates the dominant influence of the sympathetic part of the vegetative nervous system. At the end of the one year season, the judo players were registered to have higher influence from the parasympathetic parts on the regulation of their cardiovascular system; Mo was 836.42 ± 19.65 ms. Standard deviation is one of the principal characteristics in the mechanisms of heart rate regulation. Normally, standard deviation is 40–80 ms. Its decrease below normal indicates a strong neurotic emotional tension. At the beginning of the training season, the athletes` heart rate was approaching its lower limit of normal. At the end of the training season, the heart rate score was 80.56 ± 6.57 ms, which indicates the hypersthenia of the parasympathetic vegetative nervous system. Table 3 shows the levels of functional state of the judo players` vegetative nervous system during their training season.

Table III Functional state of the judo players` vegetative nervous system (mean age = 15–16 years) at the beginning and at the end of one year training season (%)

One year`s training season	Functional status				
	1 – negative	2 – marginal	3 – permissible	4 – suboptimal	5 – optimal
At the beginning of the season	0	16,7	41,7	33,3	8,3
At the end of the season	0	0	20,8	58,4	20,8

Among the studied athletes, there were no athletes with a negative functional state. At the beginning of the season, most judo players had a permissible functional state (41.7%). Approximately a third all athletes were characterized by a suboptimal functional state. At the beginning of the season, 16.7% of the judo players had a marginal functional state, and only 8.3% of the sportsmen were registered to have an optimal functional state.

At the end of the one year training season, most of the judo players were characterized as having a suboptimal functional state (58.4%). The number of athletes with an optimal functional state increased by 2.5 times, and there were no athletes with a negative or marginal state. Therefore it can be concluded that the training process contributed to improving the functional state of the 15–16-year-old judo players, most of whom were characterized as having a suboptimal functional state of their vegetative nervous system.

Conclusions

The training season significantly influenced the psychophysical state of young male judo players. It contributed to the decrease of the players' trait and state anxiety; thus, most of them obtained a moderate anxiety score. In addition, the training process also helped increase the emotional state of the athletes; the personal aggressiveness and conflict proneness general score of 30% of the players at the beginning of the one year training season were high. At the end of the training, the judo players demonstrated lower scores of both positive and negative aggressiveness as well as lower scores of antipathy and conflict proneness.

The athletes had their minimum Mo scores at the beginning of the training season, which indicates the predominant influence of a sympathetic part of the vegetative nervous system. At the end of the season, the judo players demonstrated an increase in parasympathetic influences on the cardiovascular system regulation. At the end of the training season, the heart rate was 80.56 ± 6.57 ms, which indicates the strengthening of the parasympathetic part of the vegetative nervous system tone. At the beginning of the training season, most of the judo players (41.7%) had a permissible functional state score. At the end of the season, the majority of them (58.4%) were characterized as having a suboptimal functional state. The number of athletes with an optimal functional state increased by 2.5 time, and no judo players had both negative and marginal functional state levels.

The obtained results allow to conclude that the training process contributed to improving the young male judo players` psychophysiological state. The theoretical significance of this study is that it deepens and expands the knowledge in the field of theory and methodology of martial arts regarding the possibilities of optimizing the psychophysiological status of athletes in terms of increasing the effectiveness of the training process of judo players. This knowledge allows to conduct applied work to study ways of modernizing the training process.

The practical significance of this study is that it evaluated the effectiveness of a one year training cycle based on the dynamics of the psychophysiological indicators of young male judo players. The obtained results can be used in the educational and training process at youth sports schools, institutions of additional education, and in the professional athletes` training.

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