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Age-Related Peculiarities of Psychophysiological States and Stress Resistance in Elite Wrestler

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Abstract: Among the numerous studies devoted to the study of perception and information processing are no data on effects of these processes are age differences in conditions of sport activity. In this paper we studied the influence of psycho-emotional stress and different levels of stress on the mental processes of psychophysiological functions perception and information processing of wrestlers in different age. 19 elite athletes with two groups (aged 19–24 and 27–31), members of the Ukrainian National Team in Greco-Roman wrestling were examined. The perception and processing of visual information, the balance of the nervous system and psycho-emotional stability were studied. The deterioration of neurodynamics functions in emotional stress situations was more evident in older age group of wrestlers comparing with the younger age group of wrestlers due to age weakening of afferent system of information perception, analysis, and processing. The connection between the age in elite wreslers and stress resistance to psycho-emotional tension was recorded. In particular, it reflected in considerable changes in heart rate regulation in older age group of wrestlers comparing with younger age group of wrestlers where the optimal reaction of heart rate regulation to psycho emotional tension was observed.

Key words: age-related, psychophysiological states, stress resistance, wrestlers

1. Introduction

Modern development of sports science is characterized of elaboration of different biotechnologies which influence on maximum performance of athletes in competition conditions (Michenko et al., 2007; Pavlik, 2002; Platonov, 1997). All of this technologies include the peculiarities of individual ability of human. But, sports activity as extreme of human activity is related with psycho-emotional factors which influence on the efficacy of sporting results (Dornic and Dornic, 1987; Collardeau et al., 2001). Considering that psycho-physiological functions constitute a major link of formation of psycho-emotional reactions in the situations of extreme conditions, it is logical to expect a connection between level of stress resistance and psychophysiological functions of perception and information processing.

In last decade Olympic sports are characterized by the presence of older athletes who have reached high athletic results. The age of champions and runners-up of International championships in some Olympic sports could be 36–42 years in individual sports and up to 52 in such sports as horseback riding and sailing.

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The aim of the study research of the age-related peculiarities of psychophysiological states and the characteristics of stress resistance to psycho-emotional tension in elite wrestlers

2. Material and Methods

A total 19 elite athletes, members of the Ukrainian National Team in Greco-Roman wrestling took part in the research. The athletes were divided in two groups according to their age. 12 athletes age 19–24 were placed in one group and 7 athletes age 27–31 in another group.

The experimental study was approved by the Ethics Committees for Biomedical Research with accordance the ethical standards of the Helsinki Declaration. Consents for research in writing form were given by the athletes according to the recommendations to Ethics Committees for Biomedical Research.

The psychophysiological states were studied by complex tests with different parameters of visual perception and information processing.

Information perception and processing were studied by using the methodology "perception speed" which is included in apparatus-program diagnostic complex "Multipsychometr-05". The methodology "perception speed" evaluates the speed and accuracy of identifying geometric figures, comparing the given fragments with the set-up targets. Special test signal is integrated into program (figure's fragment constitutes to 75% or 50% of the whole). In addition, this methodology allows evaluating the schematic formation of visual perception, human's ability to reflect the general configuration of the object or occurrence formed in a certain time frame. The design of all test trials in this methodology is identical: 4 numbered target figures were placed in the centre of the area within visible margins. Each figure contained 4 equal intervals, and above them the figure's fragment was placed and it contained 2–3 intervals. The task for the athlete in research was to determine which of the given target figures was the particular fragment part of. The athlete was answering the question by pressing the button (with according number) on a special digital keyboard, the component of apparatus-program diagnostic complex "Multipsychometr-05" (Korobeynikov et al., 2010).

The tests results reflected productivity, speed, accuracy and efficiency. A criterion of productivity indicates the speed of perception and processing, and depends on mobility of nervous processes. The higher the productivity, the higher are the mobility of nervous processes and the speed of information perception and processing. Relative frequency of wrong answers points to the efficiency of perception and processing: the lower this number is, the more effective these processes are. The speed with which athlete fulfills the task is essential indicator of speed and efficiency of perception and processing. High speed variables mean that the specified processes of perception and processing are mobile and effective (Zilberman, 1974; Van der Molen, 1996).

To determine the balance between acceleration and deceleration of the central nervous system we used the methodology called "Reaction to the Moving Object". Reaction to the moving object is a type of a complex sensory-motor reaction which in addition to sensor and motor periods includes period of relatively complicated processing of a sensory signal by central nervous system. This methodology is included in apparatus-program psycho-diagnostic complex "Multipsychometr-05".

In this test all examined athletes were offered 2 pointers — dynamic (target) and static (marker), and each athlete was expected to define the local area in the space. When the athlete in research reached the marker, he reacted by sending a discreet and timely signal to the monitor. The nature of those two modes is based on the fact that during the whole test the source of both pointers constantly remains in athlete's field of vision. It is believed

that advantage of accelerating (activating) processes over decelerating manifests itself in the tendency to carry out preventive actions. On the contrary, the advantage of decelerating processes (lower level of activation) leads to increased number of belated actions. The test results showed the indicators of accuracy, stability, excitability, and trend (by excitability). The balance of nervous processes is defined by a combination of 2 factors: correlation between advancing and impediment and value and sign of average deviation of the marker from the target at the moment of pressing the button.

The level of psycho-emotional resistance (stress tolerance) was determined by the results of test called "Stress Test" with analysis of information regarding the positioned selection of objects in appropriate cells in adopted mode. Thus, the certain time limit for selection of objects is reached and this creates psycho-emotional informational tension (load). This methodology is included in apparatus- program psycho-diagnostic complex "Multipsychometr-05". The results of the tests allowed determining the criteria of stress resistance, capacity and impulsiveness (Korobeynikov, 2002).

Heart rate variability (HRV) provides non-invasive data about the autonomic regulation of heart rate in real-life conditions. HRV, reflecting cardiovascular control exerted by both parasympathetic and sympathetic nervous system, has been used to evaluate modifications of autonomic functions due to acute exercise or training (Baevskiy and Ivanov, 2001; Korobeynikov, 1995).

All data acquisitions were performed in the morning. The subjects were given enough time to relax before the test. HRV profile of athlete was characterized, with statistical and frequency analysis, during supine rest and 90º upright positions for 5 min. RR intervals were recorded and analyzed before completing the rest experimental tasks. No instruction was given regarding respiration.

An ECG signal was recorded with computer-based method "Polar" (HRV Analysis). As a general parameters of HRV analysis were studied spectral characteristics: VLF, LF, HF and LF/HF.

Statistical analysis was performed with the help of programming package Statgraphics 5.1 (Manugistics, Inc.). Since the data obtained in research didn't correspond to the normal distribution of studied data, the methods of nonparametric statistics of Wilcoxon rank-sum test were applied (Rebrova, 2000). To reflect data distribution we used interquartile range, thus specifying first quarter (25%) and third quarter (75%).

3. Results

As a seen the Table 1 illustrates median of perceptive speed variables of the athletes in different age groups. Comparing the groups according to perceptive speed test results, it's important to point out the actual differences in the indicators of productivity and efficiency (Table 1).

Table 1 Medians of Variables of Perceptive Speed of the Athletes in Different Age Groups (n = 19)

Variables	First Age Group (n = 12)			Second Age Group (n = 7)		
	Median	Lower Quarter	Upper Quarter	Median	Lower Quarter	Upper Quarter
Productivity (secret unit)	21.50	18.50	22.00	19.00*	14.00	20.00
Speed (stimuli/min)	4.39	3.91	5.10	4.00	3.17	4.98
Accuracy (secret unit)	0.88	0.79	0.92	0.88	0.75	
Efficiency (secret unit)	72.84	54.49	82.80	66.95*	47.36	74.80

Note: * - $p < 0.05$, comparing with the first age group of the athletes.

This demonstrates the higher level of information processed by athletes in the younger age group and confirms the superior capabilities of cognitive functions of the athletes in this group.

The Table 2 data analysis indicates that there are no actual distinction between age groups in the measurements of accuracy and stability. This means that age component doesn't really matter in the measurement of efficiency of execution of the motor tasks with external stimulus in conditions of psycho-emotional stress.

Table 2 Medians of Variables of Balance of Nervous Processes in Different Age Groups (N = 19)

Variables	First Age Group (n = 12)			Second Age Group (n = 7)		
	Median	Lower Quarter	Upper Quarter	Median	Lower Quarter	Upper Quarter
Accuracy (secret unit)	2.76	2.41	3.04	3.97	2.86	4.85
Stability, cV (%)	3.28	3.02	3.96	3.00	2.55	4.57
Acceleration (secret unit)	-0.28	-1.10	0.37	-1.27*	-3.60	0.01

Note: * - $p < 0.05$, comparing with the first age group of the athletes.

The Table 3 reflects the data of stress resistance in different age groups.

Table 3 Medians of Variables of Stress Resistance in Different Age Groups (N = 19)

Variables	First Age Group (n = 12)			Second Age Group (n = 7)		
	Median	Lower Quarter	Upper Quarter	Median	Lower Quarter	Upper Quarter
Stress Resistance (secret unit)	88.27	79.01	90.33	109.20*	102.83	118.35
General Efficiency (secret unit)	1.09	1.07	1.13	1.10	0.92	1.15
Impulsiveness (secret unit)	-0.04	-0.06	0.00	-0.03	-0.06	0.00

Note: * - $p < 0.05$, comparing with the first age group of the athletes.

According to Table 3, there is no actual distinction in variables of general intensity and impulsiveness in different age groups. In the same time, there is actual distinction in variables of stress resistance in different age groups. Stress resistance is determined by the ratio of average capacity of visual analyzer in the beginning of the test to the capacity in the end of the test. In other words, the variables of stress resistance indicate the possibility of maintaining of sufficient level of capacity of visual sensor system in situations of psycho emotional stress. Thus, the athletes of a younger age group showed better results of stress resistance comparing with older age group (Table 3).

The average meanings of stress resistance in athletes with different style of strategy of the fight in combat are presented in Figure1.

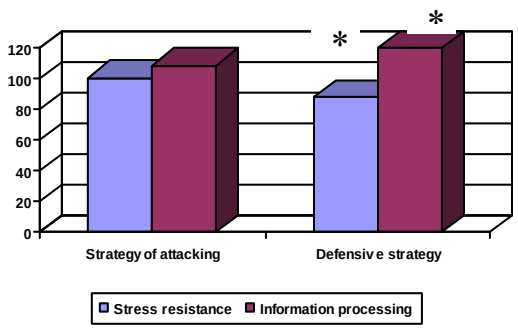

Figure 1 Average Meanings of Stress Resistance in Athletes with Different Style of Strategy of the Fight

The analysis of Figure 1 showed that the athletes with defensive strategy of the fight has reduction of stress resistance and increasing of information processing speed in comparison to athletes who has attacking strategy.

The Table 4 reflects the medians of spectral characteristics of heart rate variability in the beginning and in the end of psycho emotional tension in different age groups.

Analysis of data of Table 4 confirms that there is an actual distinction in heart rate variability HF and LF/HF between different age groups in the beginning of psycho-emotional loading. Actually higher variables of HF confirm the preeminence of parasympathetic activation of heart rate regulation in younger age group. Reduced variables of LF/HF in younger age group indicate the optimization of vegetative balance of sympathetic and parasympathetic influences on heart atrium pacemaker.

Table 4 Medians of Spectral Characteristics of Heart Rate Variability Showed by Athletes of Different Age Groups in Dynamic of Psycho-Emotional Load (N = 19)

Variables		First Age Group (n = 12)			Second Age Group (n = 7)		
		Median	Lower Quarter	Upper Quarter	Median	Lower Quarter	Upper Quarter
Mean RR (ms)	in the beginning	1034.25	455.18	1202.70	1009.50	1008.70	1156.60
	in the end	901.15	469.90	995.25	781.40$^{\&}$	781.40	871.70
VLF (ms^2)	in the beginning	4285.00	1396.50	10839.50	9239.00	4802.00	10398.00
	in the end	3262.00	2598.50	8553.50	1722.00$^{\&}$	1722.00	1977.00
LF (ms^2)	in the beginning	2405.00	1785.50	2591.00	2474.00	2428.00	3906.00
	in the end	1924.00	1558.50	3359.50	2843.00	1400.00	2843.00
HF (ms^2)	in the beginning	2166.00	1358.00	2697.00	1428.00*	1276.00	2586.00
	in the end	1199.50	517.00	2808.00	2843.00*$^{\&}$	1400.00	2843.00
LF/HF	in the beginning	1.21	0.70	2.30	1.73*	1.51	1.90
	in the end	2.382$^{\&}$	1.296	3.96	8.811*$^{\&}$	2.966	8.81

Notes: * 1. * - $p < 0.05$, comparing with the first age group of the athletes. 2. & $p < 0.05$, comparing to the beginning of the loading.

4. Discussion

It is possible to conclude, that athletes in younger age group (19–24 years) show more productive visual perception and higher efficiency of visual information processing comparing with older age group (27–31 years). We can also state that there is a correlation between elite athletes' age and cognitive component in perception and information processing.

Spearman's correlation analysis confirms this conclusion: there is a connection between the variables of perceptive speed and age. Analysis verified, that the younger age group showed just one actual correlative connection between age and speed ($r = -0.37$, $p < 0.05$). The correlative analysis of older age group showed just one actual correlative connection between age and accuracy. ($r = -0.31$, $p < 0.05$).

The measurements of acceleration show the actual differences between age groups (Table 2). According to actual scale, median of acceleration in the first age group reflects the balance of acceleration and deceleration of nervous processes. In the second age group, acceleration median indicates the prevalence of acceleration of nervous processes (Table 2).

Therefore, athletes in a younger age group (19–24 years) show the balance of nervous processes of acceleration and deceleration. This balance is in agreement with the presence of higher productivity of visual perception and visual information processing efficiency comparing with older age group (27–31 years).

Consequently, prevalence of acceleration processes in older age group leads to deterioration of visual information perception and processing.

The conducted analysis of correlation between age and data reflecting the balance of nervous processes in different age groups showed higher coefficient values of correlation in older age group. Hence, the correlation coefficient between age and stability in younger age group was $r = 0.52$, $p < 0.05$, while in older age group this criterion was $r = 0.87$, $p < 0.05$. Likewise, correlation coefficient between age and acceleration in younger age group was $r = 0.43$, $p < 0.05$, while in older age group it was higher and amounted to $r = 0.65$, $p < 0.05$.

We arrived to conclusion that deterioration in the state of neurodynamic functions in the situations of psycho emotional stress in the older age group of elite athletes is not so much the deterioration of afferent compound of perception system, information analysis and processing, but in fact efferent motor compound. Besides, with aging, the connection between effectiveness of visual perception and information processing are improves (Korobeynikov, 1995).

The conducted analysis of correlation between athletes' age and stress resistance indicates the presence of actual correlation coefficients only in variables of stress ($r = 0.42$, $p < 0.05$) in younger age group. The established fact confirms the connection between age and data of stress resistance to psycho-emotional stress. The athletes of older age group didn't show actual connection between age and stress resistance.

Therefore, the conducted research of elite athletes confirmed that there is age deterioration in stress resistance capacity in situations of psycho-emotional stress.

Spectral characteristics of cardio intervals were studied to determine the age distinctiveness of heart rate vegetative regulation in situations of psycho-emotional stress.

Psycho emotional loading leads to heart rate boost (Mean RR), the increase of low-frequency (VLF) and high-frequency (HF) heart rate variations in older age group (Table 4). This fact indicates the influence of heart rate central contour of regulation in the situations of psycho emotional tension with simultaneous activation parasympathetic link of vegetative regulation and renin-angiotensin-aldosterone system. In the same time the shift of vegetative balance (LF/HF) towards sympathetic activation of vegetative regulation of cardio intervals takes place. Thus, psycho emotional tension on athletes in older age group causes significant changes in heart rate variability signifying the stress type of loading.

In younger age group the changes of vegetative balance were noticed (LF/HF), and that indicates the amplifications of sympathetic activation of heart rate regulation, although the absolute changes are twice the variables of older age group (Table 4). This indicates the optimal reaction of heart rate regulation system to psycho-emotional tension.

5. Conclusions

(1) The connection between the age in elite athletes and stress resistance to psycho-emotional tension was recorded. In particular, it reflected in considerable changes in heart rate regulation in older age group comparing with younger age group where the optimal reaction of heart rate regulation to psycho emotional tension was observed.

(2) The deterioration of neurodynamic functions in the situations of psycho-emotional tension was determined in older age group comparing to younger age group due to age weakening of afferent part of perception, analysis and information processing.

(3) The athletes with defensive strategy of the fight has reduction of stress resistance and increasing of information processing speed in comparison to athletes who has attacking strategy.

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