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GENDER CHARACTERISTICS OF THE REACTION TO THE TRAINING LOAD OF ATHLETES SPECIALIZING IN HAND-TO-HAND COMBAT WITH PARTIAL CONTACT WITH THE OPPONENT

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Purpose: is to compare changes in the psychophysiological characteristics of male and female athletes with different levels of training under the influence of training load.

Material and methods: the study involved 66 athletes, 42 of them were male and 24 were female, with different levels of training. We determined psychodynamic characteristics in athletes before and after training load with the help of standard methods.

Results: we defined the dynamics of psychophysiological characteristics in athletes caused by training load. The trained athletes showed a state of mobilization evidenced by a significant decrease in strength and mobility of nervous processes.There were no reliable changes in male beginners engaged in hand-to-hand combat. The trained female athletes showed no significant differences in the indicators before and after training load, but the female beginners significantly decreased all psychodynamic characteristics.

Conclusions: the obtained data showed some gender differences in the reaction to the training load in athletes specializing in hand-to-hand combat with a semi-contact. The training load led to the development of mobilization in trained athletes, while beginners of both sexes developed fatigue. There were no significant changes in the performance of the trained athletes.

Keywords: hand-to-hand combat, psychodynamic characteristics, genders peculiarities, risk predisposition.

Introduction

Hand-to-hand combat is an effective means of comprehensive physical and psychological development of modern youth. Hand-to-hand combat classes contribute to the formation of vital applied skills that provide appropriate training for young people, personnel in law enforcement agencies, the army, cadets and students of educational institutions specializing in certain areas [3,10,25].

Success in hand-to-hand combat requires athletes to have special physical qualities, which include strength and speed-strength training, speed of kicks and reaction to attacking actions of the enemy, special endurance and resistance to knocking movements, flexibility that ensures successful technical performance and techniques of hand-to-hand combat [5,10,25].

Most of these qualities depend not only on learning and training, but also on the functioning of body systems, such as the central nervous system, cardiovascular system, musculoskeletal system, vestibular system, etc. The peculiarities of the structure and functioning of these systems can promote success in hand-to-hand combat or limit the achievement of high results. In addition, the reaction of the athlete to the training or competitive load is important. In cases where the reaction is within the norm, the training process is adequate for the athlete's body [12,15,16]. If the training load causes unfavorable changes in the body systems that provide sports activities, it is necessary to work on changing training and rest regimes, or applying physical therapy to reduce the negative impact on the body of athletes and to achieve high results.

Assessment of the functional state of athletes is traditionally carried out with the help of indicators of the cardiovascular system [28], heart rate variability [2,16,24,30], central nervous system [1,5,11-14,19,33], vestibular [27,29] and other body systems. The biochemical characteristics of blood, urine, saliva [7,8,23] are also studied in the dynamics of the preparatory period and competitions.

Since not only men but also women are engaged in hand-to-hand combat with semi- contact with an opponent, the comparative assessment of reactions of athletes of different levels of training and different gerders to the training load is of considerable theoretical and practical interest. Training of men and women of each level in hand-to-hand combat takes place with the same load, regardless of gender. To prevent deterioration of functional state and overtraining, it is necessary to study the reactions of athletes to the test load taking into account their gender. This is especially true due to the current need to develop methods for predicting athletic performance and changing the functional state under the influence of training load.

The purpose of the work is to compare changes in the psychophysiological characteristics of male and female athletes with different levels of training under the influence of training load.

Material and Methods of the research

We observed 33 athletes specializing in hand-to-hand combat with semi-contact with an opponent (the 1st group included men (22 people) and the 3rd group included women (11 people). For comparison, we used the data of 33 athletes-beginners: 20 men (group 2) and 13 women (group 4). The age of all subjects was in the range of 18-23 years, which allowed to compare the results of the study.

The following psychophysiological characteristics were determined in all athletes before and after training load: functional mobility of nervous processes; strength of nervous processes, dynamics of nervous processes; time of simple visual-motor reaction; time of complex visual-motor reaction; anticipated time, delayed time, number of anticipated reactions, number of delayed reactions in determining the reaction to a moving object [1,4,6,15,18,19,24,32]. In addition, we determined the time of the spatial orientation and the spatial orientation speed. According to the results of the proofreading test, the levels of attention and fatigue were assessed. They are characterized by the time of viewing the test tables, the pace of the test (the ratio of the number of viewed characters to the time of the test) and the number of errors. All indicators of the state of the central nervous system were determined by standard psychophysiological methods [4,15,18].

The risk predisposition assessment was carried in male and female athletes with different levels of training and results in sports using the methodology developed by Adamovich R. G. and Kochin O. V. [1].

The test training load in all groups of athletes lasted 90 minutes. The structure of the test training and the level of training load were developed taking into account the expert opinion of 30 specialists in hand-to-hand combat, according to the physical fitness of male and female athletes [21].

The study of psychophysiological characteristics was performed using a computer chronoreflexometer developed by the company "ASTER-IT" (Kharkiv, Ukraine).

Statistical processing of the obtained results was performed using descriptive statistics (with the determination of mean values and root mean square error). In case of significant variance in the indicators, we determined the medians (Me) and quartiles (25%; 75%). Evaluation of the reliability of differences between the indicators was performed using non-parametric criteria. We used the Mann-Whitney test for independent samples and Wilcoxon for dependent samples. The significance of the obtained results was determined at the level of 95%.

Results of the research

The results of the study of psychophysiological characteristics of male and female athletes are presented in tables 1 and 2.

Table 1

Average values of individual-typological characteristics of male and female athletes of different qualifications

Male athletes				
Characteristics	Groups			
	I (n=22)		II (n=20)	
	Before training	After training	Before training	After training

	load	load	load	load
Functional mobility of nervous processes (ms)	230,8±53,4	195,1±19,8* Z=2,5;p=0,01	247 (234;282)	214 (182;251)
Strength of nervous processes (ms)	360,1±55,6	320,0±37,7* Z=3,5;p=0,0005	380 (353;424)	359 (292;372)
Dynamics of nervous processes (c.u)	0,002±0,001	0,0013±0,001	0,0021 (0,0001;0,003)	0,0019 (0,0001; 0,003)
Number of anticipated / delayed reactions	0,8(0,1;1,5)	0,7 (0,4;1,0)	1.2 (0.5;1.2)	1,6 (0,4;1,2)
Female athletes				
Characteristics	Groups			
	III (n=11)		IV (n=13)	
Functional mobility of nervous processes (ms)	246,7±57,9	212,6±44,7	262 (246;290)	258(216;287)
Strength of nervous processes (ms)	406,1±74,7	343,6±73,4	422 (387; 519)	405 (359; 496)
Dynamics of nervous processes (c.u)	0,0013±0,001	0,0011±0,001	0,0023 (0,0001;0,0026)	0,0021 (0,0012; 0,0026)
Number of anticipated / delayed reactions	0,18 (0,11;0,96)	0,67 (0,38;1,22)	0,67 (0,25;1,2)	0,43(0,33;1,0)

Note: * - differences in the values of the indicator before and after loading are significant according to the Wilcoxon test

Table 2

Average values of psychodynamic characteristics of male and female athletes of different qualifications

Male athletes				
Characteristics	Groups			
	I (n=22)		II(n=20)	
	Before training load	After training load	Before training load	After training load
Time of the simple visual-motor reaction (ms)	268±39,2	254±31	262±20	254±38,9
Time of the complex simple visual-motor reaction (ms)	378±30,6	344±40,8	397±55,6	351.5±60,2
Moving object	116 (104;154)	89 (76;112)*	88 (60; 113)	115 (93;147)*

reaction time (ms)		Z=2,6;p=0,009		Z=2,1;p=0,03
Time of space orientation (ms)	15907 (12003;20496)	13225 (10150; 14990)* Z=2,1;p=0,03	16864 (14238;22537)	19748 (14916;23749)
Speed of space orientation (1/ms)X10^{-3}	1,3(1,0;1,7)	1,5 (1,3;2,0)	1,0 (0,7;1,3)	1,2 (0,9;1,4)
Number of anticipated / delayed reactions	3,5 (1,3;9)	1,9 (0,9;4,8)	1,9 (0,7;1,3)	1,5 (0,5;3,5)
Female athletes				
Characteristics	Groups			
	III (n=11)		IV (n=13)	
Time of the simple visual-motor reaction (ms)	288±13,7	278±26,6	282±13,8	264±8,4* Z=2,4;p=0,02
Time of the complex simple visual-motor reaction (ms)	430±31,9	374±30,1	429±50,7	403±44,3* Z=2.4;p=0.02
Moving object reaction time (ms)	98±29,5	96 ±28,6	163±47,1[1] U=7,5;p=0,005	126±33,8* Z=2,4;p=0,02
Time of space orientation (ms)	17010 (13764;24970)	16684 (8000;20202)	20800 (11969; 2183)	17402* (10269;20001) Z=2,4;p=0,02
Speed of space orientation (1/ms)X10-3	1,2 (0,8;1,5)	1.2 (1,0;3,0)	0.9 (0.9;1.7)	1,1 (1,0;2,0)* Z=2,4;p=0,02
Number of anticipated / delayed reactions	5,8(2,3; 9)	9 (3;19)[3] U=44,5; p=0,03	3 (1;4)[1] U=0,0;p=0,0005	0.4 (0,3;1,0)*[2] Z=2,4;p=0,02 U=0.0;p=0,0005

Notes: * - differences in the values of indicators before and after training load in the corresponding group are significant according to Wilcoxon's test; 1 - differences in values of indicators before training load between groups are reliable according to Mann-Whitney test, 2 - differences in values of indicators after training load between groups are reliable according to Mann-Whitney test; 3- differences in the values of indicators after exercise between men and women are significant according to the Mann-Whitney test.

The results of the proofreading test done by male and female athletes are presented in table 3.

Table 3

Average values of proofreading indicators of male and female athletes of different qualifications

Male athletes				
Indicators	Groups			
	I (n=22)		II (n=20)	
	Before training load	After training load	Before training load	After training load
Time for test passing, s	332 (309;399)	281 (262;340)* Z=2,7; p=0,0061	341 (315;371)	312 (290; 325)
Number of mistakes	10 (7;14,5)	6 (3.5;7)	8 (7;10)	5.5 (4; 7)
Rate , s^{-1}	1.5 (1,3;1,7)	1,8 (1,5; 1,9)	1,5 (1,4;1,6)	1,6 (1,6;1,8)
Female athletes				
Indicators	Groups			
	III (n=11)		IV (n=13)	
Time for test passing, s	271(252; 342)	269 (247; 316)	319 (294; 329)	297 (287; 319)
Number of mistakes	8 (6; 12)	13 (7; 20)	18 (10; 23)	20 (14; 33)* Z=2,36;p=0,017
Rate , s^{-1}	1,7±0,3	1,9±0,3	1,7±0,2	1,7±0,1

Note: * - differences in the values of the indicator before and after training load are significant according to the Wilcoxon test

The results of the risk predisposition assessment in male and female athletes of the studied groups are presented in table 4.

Table 4

Distribution of athletes of the studied groups according to risk predisposition, (%)

Male athletes				
Risk predisposition	Groups			
	I (n=22)		II (n=20)	
	before	after	before	after
low (0-0.33)	8 (38±10,3)	3 (12.5±7,2) [1] F=0,000965 χ^2=12,7	4 (21±9,1)[1] F=0,054237 χ^2=5,25	6 (30±12,1)
moderate (0.34-0.66)	12 (56±10,6)	16 (75±9.2)	13 (64±10.7)	13 (65±10.7)
high (0.67-1)	2(6,0±5,0)[1] F=0,005922 χ^2=9,31	3 (12,5±7,2) [1] F=0,000965 χ^2=12,7	3 (15±8,0)[1] F=0,018306 χ^2 =7,34	1 (5,0±4,5)[1] F=0,004424 χ^2=9,96
Female athletes				
Risk predisposition	Goups			
	III (n=11)		IV (n=13)	
low	5 (45±15)	6 (55±15)	2 (15.5±10)	4 (31±13)

(0-0.33)				
moderate (0.34-0.66)	5 (45±15)	3 (27±13)	9 (69±13)	9 (69±13)* F=0,099532 χ^2=4,2
high (0.67-1)	1 (10±9,0)	2 (18±12)	2 (15,5±10)	0

Note: 1- is the difference in the frequency of exposure to moderate risk and other degrees are significant (p <0,05); : *- the difference in the frequency of exposure to moderate risk after exercise between groups is significant.

Conclusions / Discussion

According to table 1, it can be noted that the average values of individual-typological characteristics of male athletes of different levels of training before and after exercise did not differ significantly. Athletes of the first group significantly decreased the characteristics of functional mobility of nervous processes and the strength of nervous processes, which indicates the development of mobilization. We detected no significant changes in performance after exercise in the second group. Individual-typological characteristics are quite stable and reflect the innate abilities of the central nervous system, so they little change under the influence of external factors [11,13]. The lack of significant differences between the groups of trained athletes and beginners indicated a slight influence of the level of training on the features of the typological organization of the central nervous system. This also applies to female athletes as we noted no significant effect on the value of their fitness and training load.

The parameter ‘number of anticipated / delayed reactions’ characterizes the balance of excitation and inhibition processes in the central nervous system. Its values (table 1) indicated the predominance of inhibition processes both before and after training in the studied groups of athletes. The processes of inhibition predominated in the first group athletes, and processes of excitation prevailed in the central nervous system of the second group athletes.

Psychodynamic indicators of athletes of different qualification levels were more sensitive to training load (table 2). Thus, the reaction time to a moving object and orientation time in space significantly decreased in the first group after training, which confirms the development of the state of mobilization. The second group athletes developed the state of fatigue, which significantly increased the reaction time to the moving object. No significant differences were found between the groups before and after training.

There was a slightly different situation in groups of female athletes (table 2). We found no significant differences in the values of psychodynamic characteristics before and after training load in the group of trained athletes. In the fourth group, due to the load, all the studied indicators significantly decreased, except for the speed of orientation in space, which indicated the development of the state of mobilization. In the third group, the value of the ratio of the number of correct / incorrect answers indicates the intensification of excitation processes in the central nervous system. The fourth group showed the predominance of inhibition processes after training load. In addition, this parameter revealed significant differences between groups both before and after training load. The ratio 'the number of anticipated / delayed reactions' before training load indicated the predominance of excitation processes in the fourth group, although not such significant as in the third group, where there was an advantage of inhibition after training load. Simultaneous reduction of all studied indicators on the background of the inhibition process predominance may indicate the absence of a stable stereotype of the reaction to training load in athletes who have just been engaged in hand-to-hand combat. The training load offered to them caused the state of mobilization with the simultaneous development of the state of fatigue, which indicates the need to correct training.

Assessment of the level of attention and determination of the fatigue was performed using a proofreading test. Athletes of the first group significantly reduced the time of the test after training load on the background of maintaining its pace and quality, while the second group athletes did not experience significant changes in performance. Athletes of the fourth group significantly reduced the quality of the test, which is evidenced by the increase in the number of errors. This is another confirmation of the development of fatigue.

A professionally important quality of athletes who specialize in hand-to-hand combat is their predisposition for risky actions that provide an advantage over their opponents. The assessment of the risk predisposition (table 4) showed that most athletes had moderate predisposition, which was exacerbated by training load. Low and high risk predisposition are observed in significantly smaller percentage of cases. Most of the third group athletes revealed a tendency to low and moderate risk both before and after training load, while the fourth group athletes had mostly moderate risk ($\chi 2 = 3{,}85$; $F = 0{,}115238$) predisposition.

There is a considerable interest in comparing the values of the studied psychophysiological characteristics in trained athletes of both sexes (table 1 and 2). We did not find significant differences in the average values of individual-typological characteristics, but the dynamics of changes in indicators of male and female athletes differ (table 1). Thus, the parameter of functional mobility of nervous processes in men due to training load slightly decreased (by 6,9%) compared to baseline data. In women this parameter decreased by 25,5%, which shows a more pronounced reaction of mobilization. The strength of nervous processes also decreased in men much less than in women (11% and 24%, respectively). The indicator characterizing the dynamics of nervous processes increased in men by 54%, in women by 43% compared to baseline. Nervous processes, characterized by the ratio of the number of anticipated / delayed reactions, became more balanced in men (the ratio increased by 4,4 times) and did not change in women. For the most part, women underwent more noticeable changes under the influence of training load, which indicates their low resistance to training load.

When comparing psychodynamic characteristics, we found out that male and female athletes decreased the time of simple visual-motor reaction (male - by 7% and female - by 8,6%) due to training load (table 2). The time of complex visual-motor reaction in female athletes decreased by 8%; in male athletes it lowered by 12%. The decrease in the time of visual-motor reactions confirms the emergence of a state of mobilization in both men and women. Different direction of change is noteworthy in the characteristics ‘reaction time to a moving object’ and ‘orientation time in space’.

In male athletes, the reaction time to a moving object increased by 18% compared to the basaline data; in females this indicator decreased by 7%. On the other hand, the indicator of time orientation in space changed in the studied groups. It decreased by 6,5% in male athletes on the background of a significant ($Z = 2,1$; $p = 0,038$) increase in the number of errors when performing the test from (4,5 ± 2,1) to (7,1 ± 3,1), which indicates the development of fatigue together with mobilization. In female athletes, this indicator increased by 21% against a slight decrease in the number of errors from (4,3 ± 1,2) to (3,1 ± 0,9), which also indicates the development of fatigue. Significant differences between groups were revealed according to the number of correct / incorrect answers answers after training load. The dynamics of the parameter in male and female athletes is the same and indicates a decrease in excitation processes compared to the processes of inhibition. However, the severity of these changes is different. In males, the rate decreased due to training load by 40%, and in female athletes it lowered by 79%, which indicates more noticeable changes in the state of the central nervous system in females.

When comparing the distribution of athletes of both sexes according to the degree of risk predisposition (table 4), we can be see that before training load there were no significant differences between the groups. In both groups, the vast majority of athletes had low or moderate levels of risk predisposition. After training load, female athletes decreased the number of people with moderate risk predisposition and increased the number of people with low risk predisposition. In male athletes, on the contrary, there was a significant increase of people with moderate risk predisposition. Thus, the training load had different effect on the psychological state of athletes of both sexes.

The proofreading test results analysis (table 3) showed that there were no significant differences between groups of men and women. We can only note that the time of the test after training load did not change in female athletes, and significantly decreased by 15% in male athletes.

According to modern ideas, human psychophysiological characteristics are innate qualities and change slightly under the influence of training. Therefore, these indicators can serve a reliable source of information about the state of the athlete's body. For example, the reaction rate is inherited on average by 80%, the speed of elementary movements - by 65%, hand coordination - by 45%, and joint mobility - by 65% [18,31].

Shinkaruk O. A. (2017) emphasizes the great importance in the process of long-term improvement of athletes taking into account their gender psychophysiological characteristics, which include reactivity of the nervous system, mobility of nervous processes, psychological stability, volitional and personal qualities [26].

The same opinion is shared by other authors, who point to the need to take into account the psychological and psychophysiological characteristics of athletes of different sexes during the organization of the training and competition process [12]. But most studies do not have specific recommendations for taking into account the gender of athletes during their psychological support.

Hand-to-hand combat is a sport that requires athletes to have purely masculine qualities, such as courage, toughness, strength, aggression in interaction with the opponent, and so on. Women who are professionally engaged in hand-to-hand combat should be brave, prone to risk, active, i.e. have masculine personality traits [20].

Martial arts are usually assessed as very masculine or insufficiently feminine in terms of gender stereotypes in relation to other sports [10].

Our analysis showed that in the modern literature the issues of training of women in hand-to-hand combat are insufficiently researched. There are only some works describing psychophysiological characteristics of women, as well as their change in training dynamics depending on the level of training [22]. In most cases, the results of the study of psychophysiological characteristics, features of the construction of the training process, model characteristics of men of different qualifications who specialize in hand-to-hand combat [17].

Thus, the novelty of the study is in identifying features of changes in psychophysiological characteristics of women of different levels of training, who specialize in hand-to-hand combat with semi-contact with an opponent, and a comparative analysis of these changes in terms of gender.

Our research of psychophysiological reactions of male and female athletes with different levels of training allows drawing the following conclusions:

1. Comparison of individual-typological characteristics of trained athletes and beginners specializing in hand-to-hand combat did not reveal significant differences, indicating a slight effect of training on the typological organization of the central nervous system of men and women both before and after training load.

2. The inhibition processes dominated in athletes of different levels of training, while excitation processes prevailed in beginners which indicates different mechanisms of adaptation to training load.

3. The training load led to the development of mobilization in trained athletes, and fatigue – in beginners. We did not detect significant differences in the values of psychodynamic characteristics in the group of trained athletes before and after training load. The simultaneous decrease in all studied indicators in beginners on the background of the predominance of the inhibition process may indicate the absence of a stable stereotype of response to exercise, which caused a state of mobilization with the simultaneous development of fatigue.

4. The assessment of the risk predisposition of athletes showed that most of them had a moderate predisposition, which increased as a result of training load. Most trained athletes had a tendency to low and moderate risk both before and after training load but beginners had mostly moderate risk predisposition ($\chi 2 = 3.85$; $F = 0.115538$).

5. Comparison of individual-typological indicators of trained female and male athletes showed that as a result of training the indicator of functional mobility of nervous processes in men decreased by 7% compared to baseline data, and in women it decreased by 26%; the strength of nervous processes decreased in men by 11% , and in women it lowered by 24%; the ratio of the number of anticipated / delayed reactions increased by 4.4 times in male athletes and did not change in female

athletes. The obtained results indicated a more pronounced reaction to the training load in female athletes.

6. We did not reveal significant differences after training load in the number of anticipated / delayed reactions among trained athletes. The dynamics of the indicator in male and female athletes was the same and indicated a decrease in excitation processes compared to the processes of inhibition, but the degree of severity of these changes was different. The rate decreased due to the training load by 40% in male athletes, and by 79% in female athletes, which indicates more noticeable changes in the state of the central nervous system in women.

The prospect for further research is to identify gender characteristics of the response of functional systems of the body of athletes of different levels of training, specializing in hand-to-hand combat, training load and the development of individualized rehabilitation programs.

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