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EVALUATION OF COMPETITIVE ENDURANCE OF AIRBORNE TROOPS PARTICIPATING IN THE ALL-ARMY COMPETITION "AIRBORNE PLATOON" ACCORDING TO THE ANALYSIS OF HEART RATE VARIABILITY

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The article presents the results of a study of the competitive endurance of servicemen of the airborne troops performing at the 3rd stage of the military field training competition "Airborne Platoon". The relevance of the work lies in the fact that a timely assessment of the functional state of military athletes will make it possible to adjust training plans in time and perform more effectively at the competition. The aim of the study was to assess the competitive endurance of military athletes according to heart rate variability data with different military accounting specialties. Based on the data of heart rate variability, the analysis of the state of the regulatory processes of the body was carried out, the assessment of the competitive endurance of the airborne troops before and after performing special tasks in the "Airborne Platoon" military field training competition was carried out. With the help of an orthostatic test, the latent capabilities of the functional systems of the body were evaluated. The body of military personnel serving as driver mechanics is characterized by a pronounced tension of regulatory systems during the orthostatic test, in soldiers of other accounting specialties, the body reacts adequately. It is presented that the physical load during the period of the competition was at the limit of the capabilities of the body of military personnel and almost led to the breakdown of adaptation mechanisms.

Keywords: heart rate variability, military athletes, physical fitness, military field training competition "Airborne Platoon".

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Introduction. For 10 years, complex competitions on military field training of military personnel "Army Games" have been successfully held. One of the most difficult competitions is the "Airborne Platoon".

"Airborne Platoon " is a complex competition of parachute and amphibious assault units, including the performance of physical and combat exercises in a competitive form [4].

The competition consists of 4 stages, which include such disciplines as landing, driving, and using combat vehicles, overcoming obstacles, firing small arms and grenade launchers, terrain orientation, hand-to-hand combat, various marches. These disciplines are held in the form of competitions between teams, which creates, in addition to harmful factors caused by military service (from barometric pressure drop to vibration and motion sickness) [4, 6, 12], psycho-emotional stress affecting the functional state of military athletes [9].

From the above it becomes clear that

the preparation of military personnel for this competition. This is a complex dynamic process that requires the coaching staff to use all possible means to improve the physical capabilities of the body of military athletes [2, 3].

It is also necessary to separately highlight the presence of various harmful factors affecting military personnel. For shooters, the main harmful factors can be considered an increased load on the musculoskeletal system and cardiovascular system, for machine gunners and grenade throwers, this harmful factor is aggravated by the increased weight of equipment from 4 to 10 kg, and for mechanics-drivers and gunners-operators, all this is aggravated by carbon monoxide, fuel and lubricants vapors, repeatedly increased background noise caused by the action of the engine of military equipment and heavy weapons fire, increased vibration, confined space, long stay in one position, limited visibility [6].

The relevance of research. A timely assessment of the functional state of a serviceman using an express method based on HRV should help in the proper planning of the team's preparation for the performance at the "Airborne Platoon " competition, as well as timely identify negative changes in the state of health of soldiers and correct the training process in time [5].

With the development of computer technologies and software, there has recently been a new rise in interest in the study of heart rate variability both in clinical practice and in applied physiology [8, 10, 11, 14]. However, the number of works devoted to the study of heart rate variability in military personnel, despite the relevance of research, is insufficient and requires additional research in this area [14].

The purpose of the study is to evaluate the competitive endurance of military athletes participating in the "Amphibious Platoon" military field training competition using an express test based on heart rate variability, having different military accounting specialties (squad commander, senior shooter, shooter – active with light small arms; machine gunner, grenade launcher - active with heavy weapons; mechanic-driver, gunner-operator – operating in combat vehicles).

Tasks:

1. Assessment of the level of functional state of military athletes in a relative state of physiological rest and distribute them by types of heart rate regulation;
2. To investigate changes in the indicators of the analysis of the variability of the heart rate of military personnel after a competitive load.

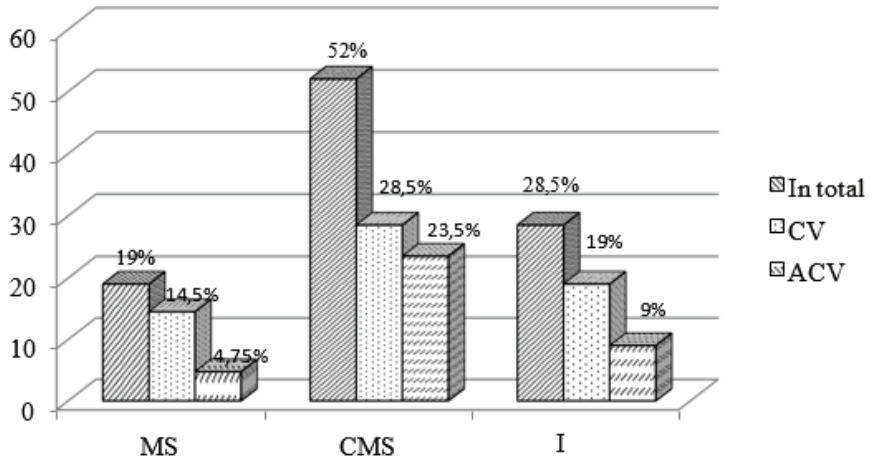

Diagram of the percentage distribution of military personnel by sports in accordance with sports ranks and categories. MS – Master of Sports of Russia; CMS – candidate for Master of Sports of Russia; I – first sports category. CV – cyclic sports; ACV – acyclic sports.

Materials and methods of research. 21 servicemen from the airborne assault unit took part in the study. The average age of the subjects was 24±3.1 years. The servicemen had from 1 sports category to the title of Master of Sports of Russia (Figure 1) in various sports.

Physical fitness of all military personnel participating in the study, it is at a very high level.

The study included 3 stages:

stage 1 – assessment of the functional state of military personnel before performing special tasks in the competition of military field training;

Stage 2 – assessment of the functional state of military personnel after performing special tasks in the "Landing Platoon" competition;

Stage 3 – included mathematical and statistical data processing, analysis of the results of the study, the formation of conclusions of the study/

To determine the level of functional state, an express method of assessing the functional state was used, and heart rate variability (HRV) indicators were analyzed. The analysis of heart rate variability was carried out in the morning. Before the examination, the servicemen were motionless for 15 minutes. The results obtained were recorded in an individual protocol. The cardiorhythmogram was recorded for 300 cardiocycles in a sitting position. The spectral parameters of HRV were evaluated. The frequency parameters of power were calculated in the high frequency range (HF, ms^2/Hz), in the low frequency (LF, ms^2/Hz) range, "very" low frequency (VLF, ms^2/Hz) range and ultra-low (ULF, ms^2/Hz) range, the total power of the spectrum (TP, ms^2/Hz) was analyzed, and also the stress index (SI) was evaluated. The type of regulation of the autonomic system was also determined in military personnel [1, 7].

The following types of heart rate regulation are distinguished in the scientific literature:

- with a moderate predominance of the central circuit of heart rate regulation – the first type of autonomic regulation;
- with a pronounced predominance of the central contour of heart rate regulation – the second type of autonomic regulation;
- with a moderate predominance of the heart rate regulation circuit – the third type of autonomic regulation;

Table 1

Distribution of types of vegetative regulation as a percentage in depending on the combat mission of the military personnel before the start of the performance in the competition of military field training

Military accounting specialties		Types of vegetative regulation			
		I	II	III	IV
with wearable weapons	n=9	4.75	-	33.4	4.75
who are part of the crew	n=6	4.75	14.3	4.75	4.75
with heavy weapons	n=6	14.3	4.75	4.75	4.75

Table 2

Changes in some average heart rate variability indicators before and after the competition

Functional tests	Military personnel with wearable weapons			Military personnel who are part of the crew			Military personnel with wearable weapons			The significance of differences between groups (p)	
	Md [Q_1; Q_2]										
	before	after	p	before	after	p	before	after	p	before	after
HF, ms²/Hz	914 [780.25;1179]	448 [323.5;707.5]	0.003	778.5 [620.5;1032.25]	288.5 [137;478.5]	0.002	1063.5 [1000;1193]	283 [252.75;339.5]	0.02	0.1	0.04
LF, ms²/Hz	1182.5 [967.25;1442.5]	1759.5 [1526.5;2020.5]	0.003	1093.5 [732.5;1436.5]	2169 [1824.25;2328.75]	0.002	657 [592;697.25]	1834 [1599.75;2240.75]	0.02	0.1	0.05
VLF, ms²/Hz	1094 [861.25;1438.25]	2559 [2279.25;2669.75]	0.003	1295 [938.5;1504]	3041 [2751;3268.75]	0.002	950 [646.75;1484.25]	3065 [2685.25;3505.5]	0.02	0.7	0.005
ULF, ms²/Hz	2019 [1635;2155]	1541.5 [1415.75;1824]	0.04	1963.5 [1812.25;2089]	1771.5 [1603.5;2046.25]	0.2	1514 [1404.25;1788]	1918.5 [1819.5;2103.75]	0.1	0.05	0.09
TP, ms²/Hz	5352 [4297;5770]	6322.5 [6142.25;6728]	0.004	5035.5 [4610.75;5325.5]	7242.5 [6998;7741]	0.02	4430 [4254.25;4649.25]	7320 [6730.75;7856]	0.02	0.1	0.04
SI, y.e	52 [44;60.5]	113.5 [90.25;167.5]	0.005	63.5 [37.5;69.5]	288.5 [232;323.5]	0.02	64 [61.75;68.5]	261.5 [216.5;300.5]	0.02	0.7	0.003

- with a pronounced predominance of the autonomous circuit of heart rate regulation – the fourth type of autonomic regulation [10, 11, 14].

The following mathematical and statistical methods were used in the work: Kolmogorov-Smirnov criterion (when checking the quantitative nature of a feature for the normality of the distribution); when comparing the results between groups, the Kruskal-Wallis criterion was used; Student's t-criterion for paired samples (comparison of quantitative features under the condition of their equality) – to compare the results within the team, in the case of comparing the results of qualitative characteristics, the Mcnimar criterion was additionally applied [13]. All mathematical and statistical processing of materials was carried out with the help of the STATISTICA 10 program.

Research results. The first task of the study was to assess the functional state of military athletes in a relative state of physiological rest.

After the end of the training process, the servicemen of the amphibious assault unit team were on vacation for three days. On the first day of the competition, in the morning, a few hours before the start of the first competitive task (landing as part of a platoon and a march for 10 km), an express functional state assessment test was conducted with military personnel using the analysis of heart rate variability (Table 1).

The presented data indicate that before the start of the competition, the military personnel participating in the competition were distributed approximately in a predominant ratio into favorable types (types I and III) - 66.7% (23.8% and 42.9%, respectively) and unfavorable types (types II and IV) of heart rate regulation - 33.3% (19.05% and 14.25% respectively). The presented results indicate that 66.7% of military personnel are functionally ready to perform special tasks of the competition and a rest of 3 days was sufficient for them. In 33.3% of the platoon members, dysregulatory manifestations of the functioning of the body were revealed. These data indicate insufficient rest for military athletes. Excessive physical exertion, together with the influence of harmful factors of military service, caused an overstrain of the nervous system of military personnel and led to overtraining. The largest number of servicemen with an unfavorable type of heart rate regulation was in the group of paratroopers operating in combat vehicles, 19%, which amounted to 66.6% of the entire group.

The presented data (Table 2) suggest that after completing the competitive tasks of the military field training competition "Landing Platoon", the reaction to orthostasis in the military personnel of the competitive platoon changes, hyporeactivity is recorded when the body position changes according to the TR index, hyperreactivity according to the stress index and a paradoxical reaction according to the spectral indicator "very low frequencies". A change in the presented indicators may indicate a decrease in the performance of paratroopers [1, 4, 7, 10, 11]. Considering the physiological characteristics of type I and IV regulation it occurs in 38% of athletes (19% of each type), type II is registered in 10% of military personnel and type III is registered in 52%.

It should be noted that type III regulation occurs in military personnel of all military accounting specialties; type IV is characteristic of military personnel operating with light weapons; type I manifested in two paratroopers operating in combat vehicles (both mechanics-drivers). After the end of the competition, there is an "alignment" by type, namely, the type of regulation changes to III. Summing up the results of the study, we can say that after the competition, in some military personnel, moderate centralization of heart rate control turns into moderate dominance of the autonomous regulation circuit, and in other military athletes, pronounced dominance of the autonomous mechanism turns into a moderate type of regulation. The transition from type II and IV to type III regulation, that is, the manifestation of the optimal type of vegetative regulation with a moderate predominance of autonomous regulation, confirms the well-known position that it is controlled self-regulation that allows achieving the optimum without overstressing the control system. The inclusion of the central circuit in the control process destabilizes the controlled system (organism), especially when the high activity of the central circuit is expressed, which completely suppresses the processes of self-regulation [5, 7]. It is also necessary to emphasize that, despite the belonging of some military personnel to the III types of regulation of the heart rate, depending on the military accounting specialty during the performance of competitive tasks of the competition, significant changes in individual indicators are possible up to the transition to another type of regulation.

It has been reliably established ($p \geq 0.02$) that in response to the competitive load, the reaction of regulatory systems depends on the type and degree of exposure to harmful factors on military personnel. According to the results of the study, military athletes who are part of the crew and participate in hand-to-hand combat have a significantly increased IN index compared to military personnel operating with small arms.

Conclusions. Assessment of the level of functional condition of military personnel before the start of the competition helped to distribute military athletes by types of regulation and identify soldiers who are in a state of overtraining. The introduction of functional state monitoring by analyzing heart rate variability in the process of preparing military athletes for competitions should help in adjusting training plans for soldiers and officers.

The solution of the second task of the study showed that the study and analysis of heart rate variability in military personnel of the airborne troops before and after participation in the military field training competition "Airborne Platoon" can help in obtaining objective information about the state of the mechanisms of regulation of cardiac activity of military athletes at different levels of neurohumoral regulation. The military personnel belonging to the group "operating with light small arms" have the best competitive endurance. According to the results of the study, it can be assumed that paratroopers competing in the positions of driver mechanics and gunner operators have a lower level of competitive endurance, but this is not due to a lack of physical fitness, but to the impact of more harmful factors of military service (fuel vapors, noise, vibration, confined space, etc. etc.), which leads to increased tension on the part of the regulatory mechanisms of the paratroopers' body, more often turning into maladaptation.

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