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Original Article

The impact of static spatial stability on soldiers' functional readiness

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Abstract.
The objective of this study was to explore the correlation between static spatial stability and functional readiness of officer cadets (26 cadets; average age – 19.7 years). The variability of cadets' heart rhythm was analysed using the MPFI rhythmograph-1 system and EasyHRV software. Additionally, the Stabilis hardwaresoftware system was employed to assess the static spatial stability of cadets. The results were processed using non-parametric ANOVA statistical analysis. The main results obtained after balancing on 10 cm high stabilometric platform showed a statistically significant decrease of the median value of RRNN indicator ($p<0.001$), as well as a decrease in the Moda indicator ($p<0.001$), which indicates a decrease in the homogeneity of the heart rhythm. In addition, heart rate and parametric pulse rhythm amplitude increased ($p<0.05$), which indicates a regular functional response of the cardiovascular system to this physical activity. During the platform test, the statistically significant median differences were found in most indicators of static spatial stability of officer cadets ($p<0.05$). The platform test led to an increase in the length of the centre of pressure oscillation trajectory by 113.7%, the average speed of the centre of pressure movement by 112.5%, and the range of horizontal body movement by 63.3%. It is important to note that the balance function quality indicator decreased during balancing by 37.1%, indicating a significant deterioration of the cadets' stability during the platform tests. During the establishing of the relationship between static spatial stability and functional readiness, the obtained research results indicate that the heart rate results has an inverse medium correlation relationship with the balance function ($r=-0.485$). In addition, parameters of the average length of the RRNN indicator and Moda also have an inverse correlation with the balance function parameters ($r=-0.469÷-0.408$). On the other hand, parameters that indicate the activity of the sympathetic nervous system have a direct correlation with the balance function parameters ($r=0.444÷0.453$). This indicates the important influence of the heart rhythm and the activity of the sympathetic nervous system on the stability and the body's reaction to physical activity. Our results indicate the complex nature of the relationship between the functional state of the cardiovascular system and static spatial stability of officer cadets, emphasizing the importance of not only the regulation of heart rhythm, but also the activity of the sympathetic nervous system to ensure stability during military operations.
Key words: cadets, stability, heart rate variability, stabilizer muscles.

Introduction.

The relevance of this scientific work is that the static stability and functional readiness of military personnel are critical aspects of their basic physical training and successful performance of professional tasks.

Military professional activity is a complex dynamic system that is completely interconnected with soldiers and external factors that are very specific at each type of military profession. This requires the development of main professional and physical qualities of a military specialist.

Undoubtedly, an important factor in the formation of functional readiness of military personnel is a complex system of physical training. (Sirenko et al., 2023) The systematic analysis of the data of the specialized scientific and methodical literature indicates the search for ways to increase the efficiency of the modern system of physical training of military personnel. Researchers (Smith et al., 2022) on the basis of a meta-analysis of different physical training programs found tools that increase professional productivity and reduce the risk of injuries to the musculoskeletal system of military personnel. It has been noted that the physical training of military personnel requires greater variation in training stimuli to induce more effective training adaptations, especially when considering the development of maximal or explosive strength and maximal aerobic power (Kyröläinen et al., 2018). The authors (Szivak et al., 2015) emphasize the need for purposeful development of functional readiness and stability in the process of physical training of military personnel. Research conducted by a number of authors (Christopher et al., 2016; Helén et al., 2023) notes the need of implementation of functional training exercise into the training programs of military personnel. High intensity functional training programs improve the functional readiness of servicemen during operations in a changing combat environment

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(Christopher et al., 2016). The effectiveness of CrossFit and SEALFIT tools in improving the functional and physical fitness of military personnel has been proven (Petrachkov et al, 2021; Helén et al., 2023.), however, the need for additional research on the safety and risk of injury during high-intensity functional training is noted (Poston et al., 2016).

One of the most significant qualities of a military professional is coordination, which contribute to the combination of mental and physical capabilities (Tomczak et al., 2019). The conditions for performing professional duties for military personnel can be extremely diverse, requiring a high level of functional training and static stability. First of all, the difficulty of performing professional tasks for military personnel can be due to difficult terrain, sand dunes, ice, mountains etc. (Petrachkov et al., 2011, 2023). Carrying out combat missions in difficult-to-access areas requires a different set of skills and abilities, including maintaining static stability in unpredictable terrain. It is these specific requirements that emphasize the need for simultaneous training to maintain physical and functional fitness in various conditions of operation performance. Researchers (Nagai et al., 2016) emphasize the need to develop coordination skills in order to optimize functional and tactical readiness and reduce the risk of injuries. Understanding the relationship between static spatial stability and functional fitness, because of the specifics of the activity and constant stress exposure, is important for optimizing training programs and increasing physical fitness level of military personnel (Petrachkov et al., 2021, 2023).

According to Marchyk et al., (2019), static coordination depends on motor activity level. Also, it was mentioned that the development of a human cognitive abilities depends on physical exercises that increase the level of development of coordination movements and maintenance of static balance. Research findings (Nagai et al., 2017) highlighted the importance of developing anaerobic power/capacity and static balance. The authors emphasize that high-intensity training and exercises that develop static balance should be included in the physical training program of military personnel. Special balance training takes a small amount of time in physical training process, but it allows soldiers to improve much their balance parameters and combat technical skills (Osipov et al., 2023). Moreover, the impact of statokinetic stability on the development of other physical qualities has been proven (Chustrak, 2022).

Military educational institutions have their own peculiarities in the organization of physical training process, but a common feature is the high saturation of classes, which develops various aspects of functional readiness of military personnel and ensures their full readiness to perform professional tasks in various conditions (Yarmak & Chepurnyi, 2024).

In his research, Savchuk (2016) states that the main motor abilities of cadets that are necessary for accurate combat weapon shooting in a state of physical fatigue are coordination abilities (space-time orientation ability, kinaesthetic differentiation ability, agility, rhythm ability and balance ability) and special static strength endurance. Also, it is mentioned that control of postural and weapon stability is a distinctive feature in shooting sport (Zanevskyy et al., 2014).

In their scientific works, the authors Chander et al (2014) found factors such as muscle fatigue that can negatively affect the control of static stability of soldier's body during their performance of complex professional tasks, causing a violation of body coordination. According to Gribble et al (2004) and Eason et al (2016), such violations in static stability arise due to the loss of kinesthetic properties and the destruction of afferent feedback. The effect of body asymmetry on balance indicators has been proven (Bučinel et al., 2019). The need to monitor neuromuscular performance was set (Merrigan et al., 2020).

In the context of military activity, these aspects are important, as they affect the ability of military personnel to maintain stability and coordination of movements during physical exertion.

The relevance of this scientific work is that the static stability and functional readiness of military personnel are critical aspects of their basic physical fitness and successful performance of their professional tasks. The study of soldiers' coordination abilities gives us the possibility of thorough analysis of their physical conditions in order to improve their readiness to perform combat duties. In particular, the effective development of coordination skills contributes to increasing of mobility level and response to rapid changes in the combat environment. However, insufficient attention to this aspect of physical training can lead to a decrease efficiency level and an increase the risk of injury during performing official tasks. Considering the high degree of physical and mental stress to which servicemen are exposed in a conflict area, the importance of optimizing coordination abilities becomes obvious. Therefore, the scientific research on this topic could gives us a possibilities to develop an individual training programs aimed to increase soldiers' body static stability, their ability to accurately perform movements, visual motor coordination and maintaining balance.

Materials and methods.

Study participants. Taking into account the principles of biomedical ethics and on the basis of the obtained informed consent, a group was formed, which included 26 cadets studying at the Educational Scientific Institute of Physical Culture, Sports and Health Technologies of the National Defence University of Ukraine. The average age of the participants of the pedagogical experiment was 19.7 years. The main criterion for inclusion in the pedagogical experiment was the absence of chronic and infectious diseases, as well as the cadets' own decision. The pedagogical experiment was conducted in 2023 at the Sport base of the National Defence University of Ukraine.

Organization of the study. To achieve the aim of the research, we used a theoretical analysis, which included an analysis of scientific and methodological literature concerning our theme. A study of heart rate variability (HRV) is done that allowed us to assess the degree of tension or tone of the sympathetic and parasympathetic departments of the higher nervous system of cadets. Moreover the static spatial stability of cadets was checked. The pedagogical experiment involved the study of HRV in a state of relative rest and after balancing on 10 cm high stabilometric platform.

To analyse the state of HRV of cadets, we used a hardware and software complex, which consisted of a multifunctional device 'MPFI rhythmograph-1' and EasyHRV software. This software complex is intended for the study of the state of the cardiovascular and central nervous system by indicators of HRV and T-wave parameters of the PQRST complex. We chose the optimal duration of recording the electrocardiogram (ECG) - 5 minutes (300 seconds). ECG was recorded in a sitting position in front of a computer monitor, in accordance with the 'International Standard' [Task Force of the European of Cardiology, 1996].

The study was conducted from 9:00 to 12:00 a.m. in comfortable conditions at an air temperature + 22.0°C. During the first attempt, before the start of the study, the cadets were given an additional time of 7–10 minutes, necessary for adaptation to the environmental conditions. During the second attempt, the cadets had an ECG started immediately after balancing on the stabilometric platform and recorded for 5 minutes. Figure 1 shows the research protocol, which displays numerical and spectral indicators, and displays the results in a graphical interpretation.

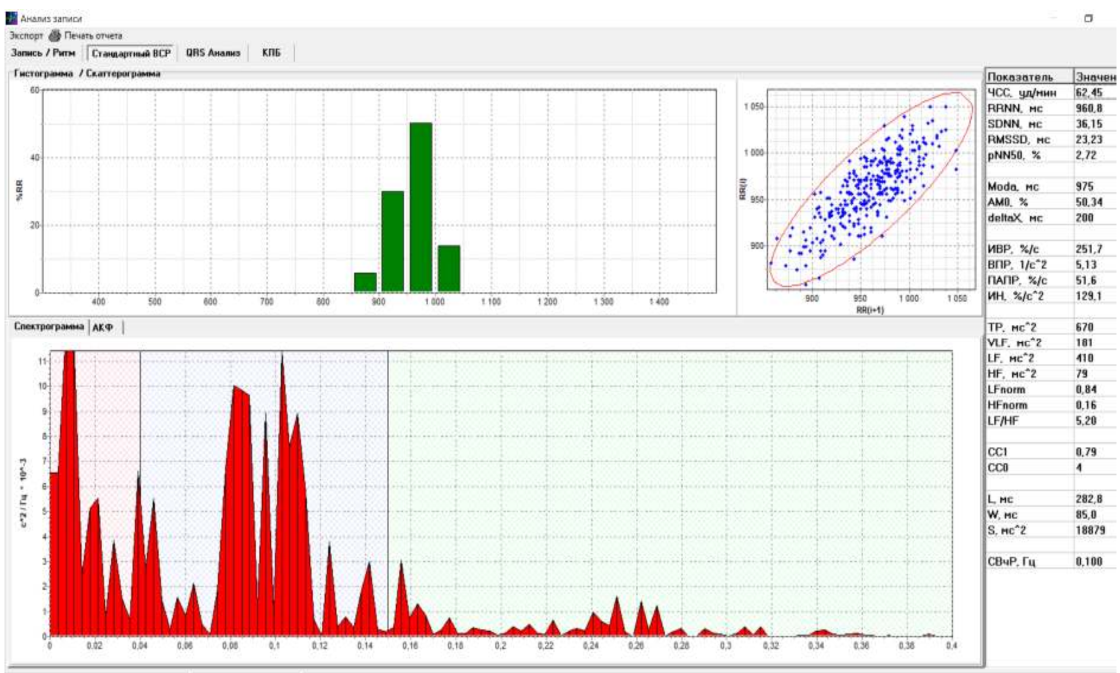


Figure 1. MPFI rythmograph-1 protocol in the study of HRV of cadets

To assess the static spatial stability of the cadets, the 'SPE Stabilis' software and hardware complex, produced by 'AYSTER-AITY' LLC, Kharkiv, Ukraine, was used (Kochyna, Kaminsky, 2012). This hardware and software complex simplifies the assessment of the function of the vestibular apparatus based on stabilogram indicators.

The program implements the following methods of processing the received data and calculates a number of indicators: correlation and spectral analysis, calculation of the balance quality indicator, analysis of the stabilogram in frontal and sagittal projections, construction of speed histogram of the centre of mass, etc. The Stabilis program includes a package for mathematical processing of the received data, which, according to the manual, were recorded in the computer archive and exported to an Excel file.

To conduct the study, it was assumed to perform two tests: the first test with open eyes in a vertical body position standing on both legs, the second test involved balancing with open eyes in a vertical position of the body with support on both legs on 10 cm high platform. The duration of each test was 2 minutes. Figures 2-3 show the research protocols of coordination abilities of the cadets.

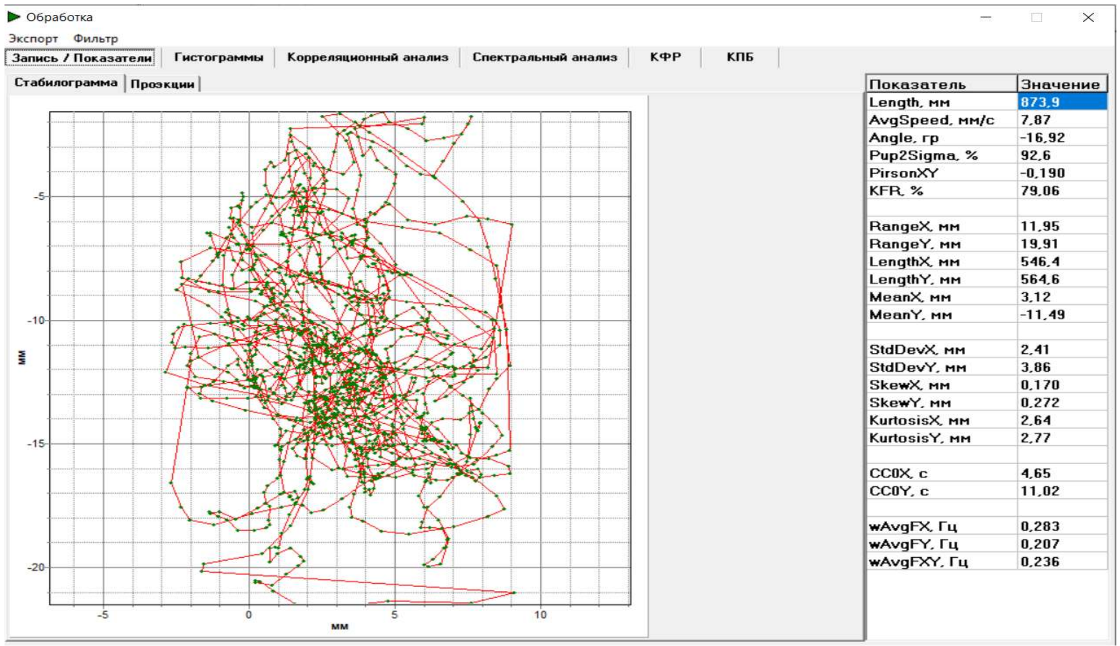


Fig. 2. Record protocol of the static spatial stability test (open eyes test) of cadets

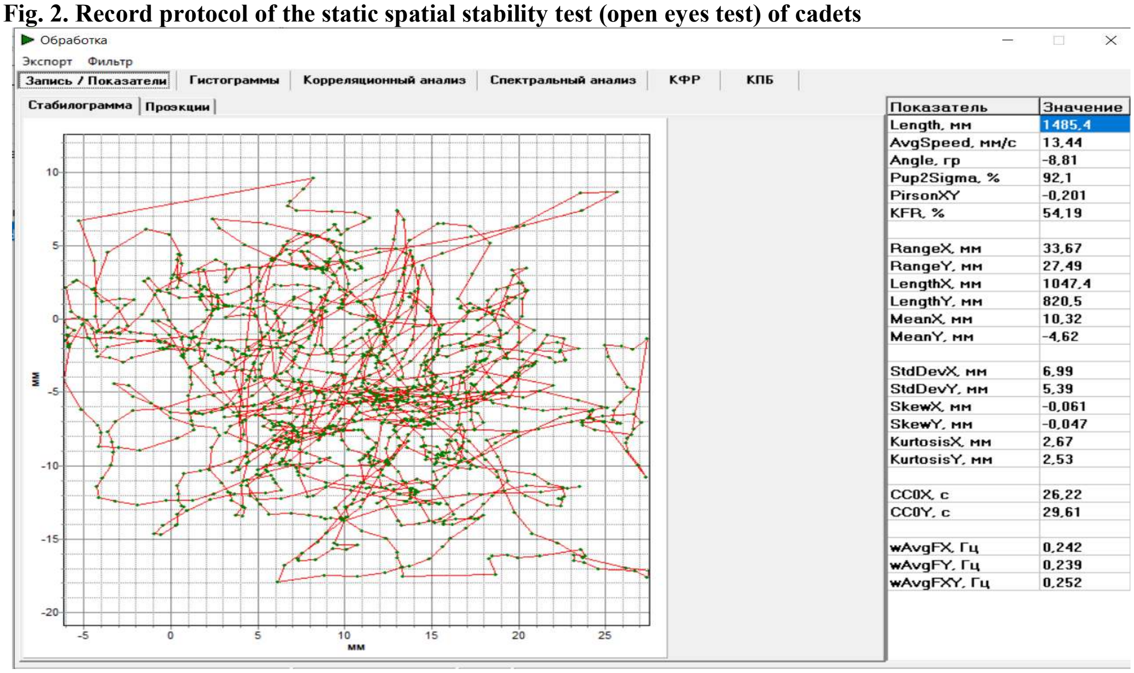


Fig. 3. Record protocol of the static spatial stability test of cadets on a balancing 10 cm high platform

The obtained research results are analysed using 'Statistics 10.0' software (StatSoft Inc., USA). First of all, we checked the sample of cadets for compliance with the law of normal distribution using the Shapiro-Wilk test. The sample of cadets showed differences from the normal distribution, so we used non-parametric methods of statistical analysis, specifically ANOVA, which are based on the comparison of the ranks of indicators, and not their specific numerical values. This allowed us to present data as median (Me), upper (25 %) and lower (75 %) percentiles. To assess a statistically significant difference between dependent samples of cadets, we used the non-parametric Wilcoxon test. The critical level of significance for this statistical analysis was determined at $\alpha = 0.05$. This means that in order to determine a statistically significant difference between dependent samples, it was decided to consider the results significant only if the probability of obtaining such a result by chance (p-value) was less than or equal to 0.05 (5 %). The non-parametric Spearman test was used to determine the correlation between HRV indicators and static spatial stability, the critical value for the sample (n = 26) at the significance level of 0.05 is r = 0.374. The use of non-parametric methods of mathematical statistics and the selection of appropriate criteria made it possible to ensure reliable statistical processing of the obtained data.

Results.

The obtained results of the study are aimed at considering the impact of static spatial stability on the functional readiness of cadets (see Table 1). The conducted comparative analysis indicates an increase in heart rate (HR) by 12.1 bpm^{-1} after balancing on 10 cm high stabilometric platform, ($p < 0.001$). Such HR changes indicate the activation of the sympathetic nervous system and the possibility of the body's reaction to physical exertion.

Table 1. Results of cadets' HRV analysis (n = 26)

Parameters	Results, Me(25 %;75 %)		p
	State of relative rest	Balancing on the platform	
HR, bpm	67.9(58.6;73.5)	80.0(72.9;89.8)**	0.001
RRNN, ms	883.8(815.8;1024.5)	750.3(668.1;823.0)**	0.001
SDNN, ms	50.3(35.4;78.2)	46.4(36.8;68.2)	0.53
RMSSD, ms	39.8(19.3;76.6)	35.1(27.8;48.4)	0.67
pNN50, %	18.9(1.5:48.9)	11.9(6.3;26.9)	0.21
Moda, ms	875.0(825.0;1025.0)	725.0(675.0;825.0)**	0.001
AM0, %	39.5(30.4;47.6)	45.6(32.7;52.6)	0.39
deltaX, ms	300.0(200.0;450.0)	300.0(250.0;400.0)	0.66
Autonomic response index, %	135.5(67.5;238.2)	143.7(109.1;210.5)	0.97
Variability of pulse rhythm, s^{-2}	3.8(1.9;5,7)	4.6(3.7;5.9)	0.27
PPRA, %	45.0(23.8(55.0)	60.6(42.2;75.9)*	0.02
Tension index, u.m.	81.9(26.5;137.6)	91.3(69.9;151.9)	0.36
Average deviation of rhythm frequency, Hz	0.107(0.09;0.141)	0.129(0.111;0.148)	0.07

Note. Significant differences according to the non-parametric Wilcoxon test for dependent samples of cadets between the results of time analysis of HRV indicators at rest and after balancing on a 10 cm high platform, *p < 0.05; **p < 0.001

A statistically significant decrease (133.5 ms) of the result of the median of parameter of intervals between heart beats (RRNN) was found ($p < 0.001$) after balancing on 10 cm high stabilometric platform in comparison with the resting state. The investigated RRNN indicator reflects the total effect of vegetative regulation of blood circulation, and its changes indicate the activation of the sympathetic nervous system and the possible reaction of the body to physical exertion due to balancing. Therefore, a decrease in the median result of the RRNN indicator can be an indicator of a change in the vegetative balance.

The following statistically significant changes, which we observe during the analysis of the results by the median, were found in the Moda indicator, which characterizes the level of functioning of the cardiovascular system. Comparing the data in a state of relative rest and after balancing on a 10 cm high platform, we found a statistically significant decrease of this parameter.

The specified change in the Moda parameter indicates a decrease in the homogeneity of the heart rhythm after exposure to static spatial stability. Such changes in the work of the cardiovascular system consist in the fact that the body reacts to balancing on the platform as an additional physical activity, and this can cause an adaptive reaction of the body. Our numerical data confirm this dynamic, showing a decrease in the Moda score at the median from 875.0 ms (at relative rest) to 725.0 ms (after balancing on the platform). It is important to note that this change is statistically significant at $p < 0.001$. The obtained results indicate that the effect of static spatial stability is reflected in the functioning of the cardiovascular system and may be related to the body's adaptive response.

The next indicator that underwent statistically significant changes was parametric pulse rhythm amplitude (PPRA), which reflects the magnitude HR amplitude fluctuations and indicates the degree of change in HR under the influence of various factors. In a state of relative rest, the median result of the PPRA index was 45.0%, which indicates moderate amplitude of HR fluctuations without physical exertion.

After balancing on a 10 cm high stabilometric platform, the median result of the PPRA indicator increased to 60.6%. This change is statistically significant ($p = 0.02$). The indicated response of the cardiovascular system, detected after balancing on the stabilometric platform, can be considered the norm in the context of the physiological adaptation of the cadets to physical exertion. An increase in the amplitude of HR fluctuations during certain types of physical activity can indicate the efficient operation of the heart and the adequate response of the body to external influences. An increase in the amplitude of the pulse rhythm in accordance with the conditions of the study indicates an adequate functional response of the cardiovascular system to physical exertion and can be considered as a normal response.

The next stage of our research was the analysis of the spectral indicators of HRV of the cadets under the influence of balancing on a stabilometric platform (Table 2).

Table 2. Results of spectral indicators of cadets' HRV in a state of relative rest and after balancing on a 10 cm high stabilometric platform, (n = 26)

Parameters	Results, Me(25 %;75 %)		Results
	State of relative rest	Balancing on the platform	
TP, ms^{-2}	1314.5(831.0;2434.0)	1257.0(829.0;1635.0)	0.54
VLF, ms^{-2}	344.0(277.0;790.0)	420.5(295.0;517.0)	0.66
LF, ms^{-2}	686.0(268.0;901.0)	576.5(425.0;759.0)	0.60
HF, ms^{-2}	344.5(96.0;877.0)	289.5(165.0;485.5)	0.47
LFnorm, y.o.	0.650(0.500;0.790)	0.660(0.540;0.760)	0.85
HFnorm, y.o.	0.350(0.210;0.500)	0.340(0.240;0.460)	0.86

Note. Significant differences according to the non-parametric Wilcoxon test for dependent samples of cadets between the results of spectral indicators of HRV at rest and after balancing on a 10 cm high platform.

The results of our study indicate no statistically significant changes in the spectral indicators of HRV of cadets after balancing test. Median results in TP (total power), VLF (low frequency), LF (medium frequency) and HF (high frequency) remained stable between relative rest and post-balancing, with no statistically significant differences in normalized indicators (LFnorm and HFnorm). This indicates that balancing on 10 cm high stabilometric platform did not cause changes in the functional state of the cardiovascular system of the cadets. The next stage of our scientific work was a comparative analysis of the indicators of static spatial stability of the cadets under different performance conditions (Table 3).

The obtained results indicate the importance of balancing conditions for the static spatial stability of cadets. When performing the test on a 10 cm high balancing platform with eyes open, a statistically significant ($p < 0.05$; $p < 0.001$) change in such parameters were found: the length of the trajectory of the centre of pressure oscillations (Length), the average speed of the centre of pressure movement (AvgSpeed), the range of fluctuations of the centre of pressure in the frontal (RangeX), the mean square deviation (StdDevX, StdDevY) and the quality indicator of the equilibrium function (KFR) that is based on the analysis of the length distribution function of the velocity vectors of the centre of pressure. These changes indicate that balancing conditions affect the level of stability during static tests. In particular, the values of the Length and AvgSpeed parameters indicate a difference in physical stability and speed of movement during balancing test in comparison with normal conditions. In addition, conditions with a balancing platform led to a median increase in Length by 113.7 % and a median increase in AvgSpeed by 112.5 %. Balancing on a 10 cm high platform led to an increase in the range of horizontal body movement (RangeX) by a median of 63.3 %. It is also worth noting that the value of the mean square deviation along the Y axis (StdDevY) increased by 30.8% on the median.

The KFR indicator shows statistically significant ($p < 0.001$) negative dynamics during the exercise on a 10 cm high platform. The median decrease in the KFR indicator is 37.1 %, negative dynamics are observed at the 25 % and 75% percentiles, where the value decreased by 33.7 % and 26.5%, which indicates a significant deterioration of the balance stability of the participants of the experiment during the performance of the task on the balancing platform. The obtained results of the study testify to the significant influence of various balancing conditions on the static spatial stability of cadets. The negative dynamics of the vast majority of the investigated indicators is caused primarily by the weak development of stabilizer muscles in cadets. It is the stabilizer muscles that play a critical role in ensuring the stability of the body, and in performing functions related to maintaining balance during physical exertion, as well as performing military-professional tasks. Stabilizer muscles provide stable support of the body in conditions of movement, even in unpredictable or extreme situations.

Table 3. Results of static spatial stability of cadets, (n=26)

Parameters	Open eyes test			Open eyes test on the platform			p
	Me	25 %	75 %	Me	25 %	75 %	
Length, mm	879.3	823.4	1053.2	1879.2**	1485.4	2104.1	0.001
AvgSpeed, $mm \cdot s^{-1}$	8.0	7.3	9.6	17.0**	13.4	19.5	0.001
Pup2Sigma, %	92.8	91.4	93.9	92.5	91.9	92.9	0.52
RangeX, mm	15.8	13.8	19.8	25.8**	23.8	29.9	0.001
RangeY, mm	21.8	16.8	27.6	25.9	23.4	29.7	0.15
StdDevX, mm	3.4	2.8	4.0	5.5**	4.7	6.1	0.001
StdDevY, mm	4.4	3.7	5.5	5.4*	4.8	6.8	0.03
CC0X, cs	18.5	11.5	30.5	12.7	6.9	22.3	0.14
CC0Y, s	17.2	10.6	20.7	22.8	13.4	36.5	0.11
wAvgFX, Hz	0.30	0.28	0.31	0.31	0.27	0.32	0.90
wAvgFY, Hz	0.22	0.20	0.26	0.29	0.26	0.34	0.96
wAvgFXY, Hz	0.25	0.24	0.28	0.29**	0.27	0.32	0.001
KFR, %	79.1	69.6	80.2	42.0**	35.4	53.7	0.001

Note. Significant differences according to the non-parametric Wilcoxon test for dependent samples between the results of tests with eyes open and on a 10 cm balancing platform. * $p < 0.05$; ** $p < 0.001$

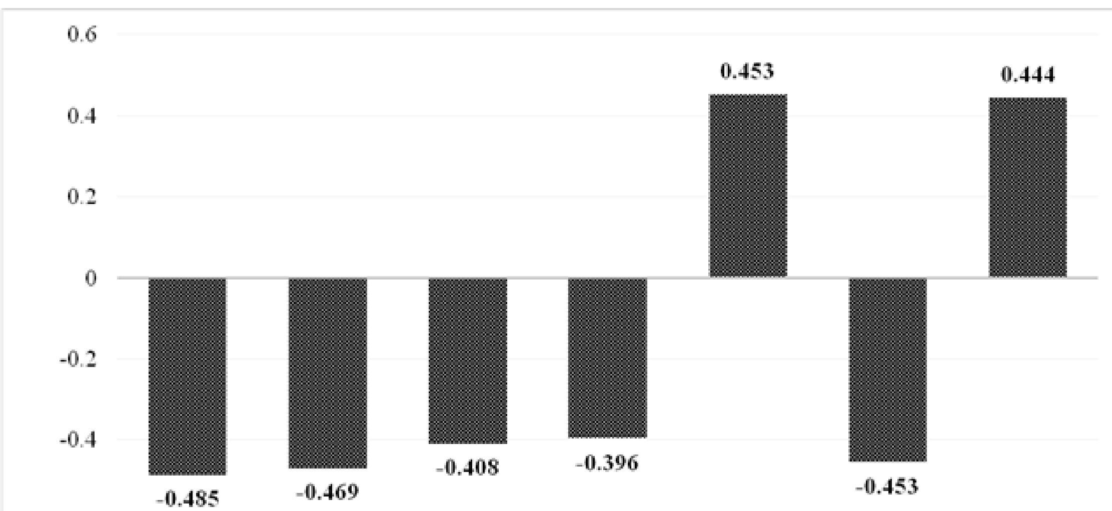
In accordance with the purpose of the study, we conducted a correlation analysis to establish the relationship between static spatial stability and functional readiness of cadets; the results are presented in Figure 4. We found that relationships between indicators of HRV exist with only one indicator of statistical spatial stability, which characterizes KFR.

The scientific substantiation of the results of the correlation analysis between the HRV parameters and the KFR indicator demonstrates the relationship between the indicators of cardiovascular regulation and the balance function. The HR indicator has an inverse correlation relationship with KFR indicator (r=-0.485). Our result indicates a possible deterioration of static stability with an increase of HR, which may be important in the context of ensuring physical stability during operations that require concentration and motor coordination. Additionally, measures related to heart rhythm, such as RRNN and Moda, also showed an inverse correlation with KFR (r=-0.469 and r=-0.408, respectively). Our results emphasize the importance of HRV and HR fashion changes for maintaining stability during exercise.

On the other hand, parameters that indicate the activity of the sympathetic nervous system, such as the normalized low-frequency component (LFnorm) and the ratio of the average values of the low- and high-frequency components (LF/HF), showed a direct correlation relationship with the KFR indicator (r=0.453 and r=0.444, respectively). In the context of balance, LF, HF and their ratio (LF/HF) can indicate the state of sympathetic and parasympathetic influence on the heart and regulatory system. These factors may affect balance function through their control over vascular tone and the heart's response to stress and exercise. For example, a decrease of HRV (LF and HF) can influence the deterioration of balance function due to changes in the heart's response to various situations.

The detection of correlation relationships between indicators of static spatial stability and functional readiness in the absence of a statistically significant difference in spectral indicators can be due to several factors. Indicators may interact with or be related to other aspects of physiology not detected through spectral analysis, such as muscle coordination, changes in neuromotor control, etc. Parameters of static spatial stability can be sensitive to changes that occur during balancing, compared to spectral indicators. Sometimes the relationships between parameters can be more complex than just direct changes in indicators, and they can only be detected during correlation analysis.

The obtained results testify to the complex nature of the correlation relationships between the indicators of the functioning of the cardiovascular system and static stability in the cadets, emphasizing the importance of not only the regulation of heart rhythm, but also the activity of the sympathetic nervous system to ensure static stability in the conditions of performance of military-professional tasks.



	HR	RRNN	Moda	IS	LFnorm	HFnorm	LF/HF
KFR	-0.485	-0.469	-0.408	-0.396	0.453	-0.453	0.444

Fig. 4 The structure of correlation relationships between KFR and HRV indicators

Also, the results demonstrating the relationship between the indicators of the cardiovascular system and static resistance emphasize the need for a comprehensive consideration of the process of military-professional physical training of cadets. Understanding the relationship between the cardiovascular regulation system and static stability can contribute to the improvement of physical training programs and the selection of new methods and means of training aimed at increasing functional fitness and static stability in conditions typical of military activity.

Discussion.

Our study was aimed at studying the impact of static spatial stability on the functional readiness of officer cadets. A comparative analysis of the obtained results indicates an increase of HR by 12.1 beats per minute after balancing on a 10 cm high stabilometric platform, which is a statistically significant at the $p < 0.001$ level. An increase of HR of cadets indicates the activation of the sympathetic nervous system and the possible reaction of human body to physical exertion. Comparing the results in a state of relative rest and after balancing on a 10 cm high platform, statistically significant changes in indicators of time analysis of HRV were found. Thus, the RRNN indicator, which reflects the total effect of autonomic regulation of blood circulation, showed a statistically significant decrease of 133.5 ms ($p < 0.001$) after balancing on the platform. Changes in the RRNN parameter indicate the activation of the sympathetic nervous system and the possible reaction of human body to physical exertion due to balancing. Also, statistically significant difference was found between HR mode results (Moda), which reflects the level of functioning of the cardiovascular system. Comparing the data in a state of relative rest and after balancing test, a statistically significant decrease in this indicator was found. The change in the Moda parameter indicates a decrease in the homogeneity of the heart rhythm after exposure in the form of balancing on 10 cm high platform. In addition, the PPRA indicator, which reflects the magnitude of HR amplitude fluctuations, increased statistically significantly after balancing on the platform. Such a change in this parameter may indicate an adequate response of the cardiovascular system to physical exertion.

Additionally, our study covers the analysis of spectral indicators of HRV and static spatial stability under the influence of balancing on the stabilometric platform. It is important to note that the effect of balancing on 10 cm high stabilometric platform did not cause statistically significant changes in the spectral indicators of HRV. These results indicate the stability of the functional state of the cardiovascular system during this type of exercise. In particular, the analysis of spectral indicators (TP, VLF, LF, HF, LFnorm, HFnorm) did not show statistically significant differences between the state of relative rest and after balancing test.

Also, our research includes a comparative analysis of the indicators of static spatial stability of officer cadets under different balancing conditions. We found that balancing on 10 cm high stabilometric platform significantly affects indicators such as the length of the trajectory of the pressure centre oscillations (Length), the average speed of the pressure centre movement (AvgSpeed), the range of pressure centre oscillations (RangeX), the mean square deviation (StdDevX, StdDevY), and the KFR.

We confirmed the results of previous studies that balancing conditions affect the level of stability during static tests (Lytvinenko, 2018; Merrigan et al., 2020). These changes indicate differences in physical stability and speed of movement during balance platform exercise compared to normal conditions.

The noted results indicate the importance of the development of stabilizer muscles of the cadets, as they play a critical role in ensuring body stability and balance during various types of physical exertion. These data can be useful for physical training process of officer cadets and there special operations performance. Our research results are consistent with the results of other studies (Savchuk, 2016; Vavrenyuk, 2018; Khabarov, Pohrebnyak, 2020; Osipov et al., 2023).

Our research expands the understanding of the relationship between functional fitness and static stability of officer cadets, especially in the context of changes in the cardiovascular system during exercise on the platform. And they also complement the already existing publications of scientists about factors affecting static stability and balance (Zanevskyy et al., 2012, 2014; Chander H. et al., 2014; Eason J.D. et al., 2016; Bučinel et al., 2019; Merrigan et al., 2020).

It is also worth pointing out that age and gender characteristics play an important role in the development of functional fitness and static stability. Research shows (Yarmak, et al., 2017; Blagii et al., 2018; Galan et al., 2018; Moseichuk et al., 2020) that children's, adolescents' and young adults' bodies can quickly respond to training, which improves functional readiness and coordination skills. Studies of the sexual aspect of coordination abilities (Moseychuk et al., 2018; Drozdovska et al., 2020) indicate the influence of modes of motor activity on the development of static stability.

An additional area for our further researches can be the study of the impact of the training program developed and proposed by us for cadets, which will be aimed at developing functional readiness to perform military duties in extreme conditions.

Conclusions.

The obtained results revealed a significant influence of static spatial stability on the functional readiness of servicemen. Cardiovascular parameters such as heart rate, heart rate variability, and sympathetic activity have been clearly demonstrated to interact with balance and stability in military task environments. These relationships emphasize the importance of maintaining and developing static spatial stability of military personnel. Understanding and controlling balance-related cardiovascular parameters can be critical to their successful functional training.

The obtained results provide important recommendations for the development of training programs aimed to improve the functioning of the cardiovascular system and increasing static stability of military personnel, even in extreme conditions. They emphasize that the improvement of the cardiovascular system and the development of stabilizer muscles can contribute to increasing the level of physical fitness, especially in situations where it is required to maintain the stability of the body during the performance of important tasks in a military environment and conditions of extreme stress.

The theoretical contribution of our research consists in expanding knowledge about the existence of correlation between soldiers' body static spatial stability and indicators of the cardiovascular system. Our results allow us to better understand the mechanisms that regulate the body's response to stressful situations in a military environment. Understanding these mechanisms is important for increasing the effectiveness of training programs and developing strategies for optimising the physical training of servicemen in military educational institutions.

The practical contribution of this article lies in the possibility of using the obtained results for developing effective training programs for military personnel. Also, the results obtained by us provide an opportunity to improve the physical training of servicemen for combat situations. Understanding the impact of static spatial stability on the functioning of the cardiovascular system can help in development of programs to improve the effectiveness of military training.

Conflict of Interest - The authors declare that there is no conflict of interest.

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