ЗДОРОВ'Я ЛЮДИНИ, ФІТНЕС І РЕКРЕАЦІЯ, ФІЗИЧНЕ ВИХОВАННЯ РІЗНИХ ГРУП НАСЕЛЕННЯ

DEPENDENCE OF PSYCHOLOGICAL AND PHYSICAL QUALITIES OF DRONE OPERATORS IN CONDITIONS CLOSE TO COMBAT

ЗАЛЕЖНІСТЬ ПСИХОЛОГІЧНИХ ТА ФІЗИЧНИХ ЯКОСТЕЙ ОПЕРАТОРІВ ДРОНІВ В УМОВАХ, НАБЛИЖЕНИХ ДО БОЙОВИХ

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Abstracts

The Ukrainian-Russian war has shown that physical fitness is closely related to the nature and method of conducting combat operations, which, in turn, are determined by the means available to military personnel and the conditions under which combat operations take place. Changes in combat methods, the use of advanced technologies, and the increase in means of long-range destruction have led to the introduction of a new military specialty in the Armed Forces of Ukraine – drone operator.

Specialists-operators of air, ground, and sea drones note that among the main qualities affecting task accuracy are psychological qualities, specifically: concentration and stability of attention, its switching and distribution, short-term and operational memory. Studies have shown that well-planned and organised physical training can improve and maintain psychological qualities at a level necessary for prolonged task performance under significant psychological stress and low physical activity.

Purpose – to determine the physical qualities that most effectively support the maintenance of psychological qualities of military drone operators in conditions close to combat.

Material and Methods. Subjects: 100 healthy cadets from a military educational institution. Four groups of cadets were formed, each consisting of 25 cadets. The first group included cadets with a high level of static endurance development (plank holding), the second with speed development, the third with general endurance, and the fourth with strength endurance. The age and duration of military service of cadets in both groups did not differ significantly ($p>0.05$). All participants in our study gave their informed consent to participate in the experiment. The studies were conducted and performed in accordance with the ethical standards of the Helsinki Declaration.

Results. Under the influence of vestibular irritation, the psychological qualities of cadets of all groups decrease. Indicators of CPQ of cadets of the first group deteriorate by 2.8 ($t=2.081$; $p<0.05$), of the second group – by 4.75 ($t=2.060$; $p<0.05$). In cadets of groups 3 and 4, these indicators also decrease by 1.2 and 0.7, respectively, but there is no significant difference with the resting values ($p>0.05$). The indicators of PSU of cadets of groups 3 and 4 decreased by 0.85 and 0.4, respectively, which does not allow us to speak about a significant difference compared to the initial data of this indicator ($p>0.05$).

The analysis of the influence of NEN on the psychological qualities of cadets revealed the following dynamics of changes in the indicators of CS: in cadets of group 1 – by 2.1 relative to the indicators at rest ($t=3.279$; $p<0.01$); in cadets of group 2 – by 2.9 ($t=2.112$; $p<0.05$); in cadets of group 3 – by 0.4 ($t=0.252$; $p>0.05$) and in the fourth group – by 0.7 ($t=0.417$; $p>0.05$).

Approach. The influence of the development of cadets' physical qualities on the development and maintenance of psychological qualities in a state of calm and under the influence of negative professional activity factors was studied.

Key words: psychological qualities, servicemen, operator, drones, physical training, combat activity.

Мета – визначити фізичні якості, які найбільш ефективно сприяють підтримці психологічних якостей військових – операторів безпілотників в умовах, наближених до бойових.

Матеріал і методи. Було сформовано чотири групи курсантів, кожна з яких складалася з 25 осіб. До першої групи увійшли курсанти з високим рівнем розвитку статичної витривалості (утримання планки), до другої – швидкісної, до третьої – загальної витривалості, до четвертої – силової витривалості. Вік і тривалість військової служби курсантів в обох групах достовірно не відрізнялися ($p>0,05$). Дослідження були проведені та виконані відповідно до етичних стандартів Гельсінської декларації.

Результати. Під впливом вестибулярного подразнення психологічні якості курсантів усіх груп знижуються. Показники КЗП курсантів першої групи погіршуються на 2,8 ($t=2,081$; $p<0,05$), другої групи – на 4,75 ($t=2,060$; $p<0,05$). У курсантів 3 та 4 груп визначені показники також знижуються на 1,2 та 0,7 відповідно, але достовірної різниці з показниками у спокої не визначено ($p>0,05$). Показники ПРУ курсантів 3 та 4 груп знизилися на 0,85 та 0,4 відповідно, що не дозволяє говорити про достовірну різницю порівняно з вихідними даними цього показника ($p>0,05$).

Аналіз впливу НЕН на психологічні якості курсантів дозволив виявити таку динаміку змін показників КСУ: у курсантів 1 групи зниження на 2,1 стосовно показників у спокої ($t=3,279$; $p<0,01$); у курсантів 2 групи – на 2,9 ($t=2,112$; $p<0,05$); у курсантів 3 групи – на 0,4 ($t=0,252$; $p>0,05$) та у четвертій групі – на 0,7 ($t=0,417$; $p>0,05$).

Висновки. Визначено, що під впливом вестибулярної стимуляції та НЕС курсанти з переважним розвитком загальної та силової витривалості демонструють достовірно вищі показники психологічної підготовленості порівняно з курсантами з переважним розвитком статичної витривалості та швидкості ($p<0,05$-$0,001$).

Ключові слова: психологічні якості, військовослужбовці, оператор, безпілотники, фізична підготовка, бойова діяльність.

Introduction. The Ukrainian-Russian war has shown that physical fitness is closely related to the nature and method of conducting combat operations, which, in turn, are determined by the means available to military personnel and the conditions under which combat operations take place. Changes in combat methods, the use of advanced technologies, and the increase in means of long-range destruction have led to the introduction of a new military specialty in the Armed Forces of Ukraine – drone operator [9].

The combat tasks of drone control units' personnel involve various tasks requiring physical effort, nervous tension, and precision of decisions, regardless of weather conditions, terrain, and time. They ensure constant interaction and fire support for combined arms units and subdivisions. The duration of a drone operator's task can range from several minutes to 24-hour device control. The task's success, accuracy, avoidance of enemy anti-drone measures, and, most importantly, the operator's life and health depend on the operator's confident actions [11; 16].

Despite the significant number of scientific works researching the development of physical qualities necessary for effective task performance by military personnel of various specialties, we have not found works dedicated to justifying the content of physical training sessions for drone operators [4; 25].

Specialists-operators of air, ground, and sea drones note that among the main qualities affecting task accuracy are psychological qualities, specifically: concentration and stability of attention, its switching and distribution, short-term and operational memory [1; 10].

Studies have shown [5; 17; 21] that well-planned and organised physical training can improve and maintain psychological qualities at a level necessary for prolonged task performance under significant psychological stress and low physical activity. To determine the physical qualities that most effectively ensure the psychological readiness of military drone operators, we conducted a comparative analysis of the indicators forming the basis of the professional activity of military personnel with different levels of physical quality development.

Materials and methods. *Subjects.* 100 healthy cadets of a military educational institution took part in testing. Four groups of cadets were formed. Each group consisted of 25 cadets. The first group included cadets with high static endurance (plank hold), the second group with speed development, the third group with general endurance, and the fourth group

with strength endurance. The age and duration of military service of the cadets in all groups did not significantly differ ($p>0.05$). All participants of our study gave their informed consent to participate in the experiment. Research was conducted and performed in accordance with the ethical standards of the Declaration of Helsinki.

Methods. Testing of the cadets' physical fitness level was carried out through exercises that characterise the development of static, speed, strength, and general endurance – plank hold, kettlebell snatch, 100-meter run, and 3000-meter run. Testing was conducted at the sports complex of the Hetman Petro Sahaidachnyi National Ground Forces Academy in May 2024 as control measures during physical training sessions in the morning. The uniform was military attire, and the footwear was boots.

Given the specifics of the work of military drone operators, our goal was to study changes in certain indicators of psychological qualities and mental performance under the influence of some adverse factors, besides the fatigue itself during mental activity. The cadets experienced vestibular stimulation on a combat installation model for 30 minutes. This duration was chosen because some authors indicate that symptoms of motion sickness appear after 30 minutes of stimulation. The body movement parameters of the subjects in the "sitting" position in the closed combat installation model corresponded to those experienced by drone operators during work and were as follows: vertical movement of the chair – 18 cm; upward movement time – 1.3 s; downward – 2.0 s; full cycle – 3.3 s; speed during upward movement – 14.3 m/min; downward – 9.3 m/min; total – 18.2 cycles/min. Immediately after this, the subjects again performed the same tasks as before the vestibular stimulation. After a 30-minute rest, when all the cadets' indicators returned to the baseline level, they were tested for nervous-emotional tension. This was created by reducing the thinking time, various noise effects, and distractions, including calculating the sum of numbers while performing the task.

The order of tasks, the content of instructions, working conditions during training, and direct research in each experiment were constant.

Psychological testing of the cadets was conducted by specialists from the psychological service of the National Ground Forces Academy using the blank method of research. Scores were calculated using nomograms. The tasks were as follows: actions with three-digit numbers, performing 10 actions; determining the reaction to a moving object; testing with Landolt rings; task "Switching and distributing attention"; task "Short-term memory"; task "Operational memory".

For processing the obtained research results, methods of mathematical statistics using Microsoft Office Excel and Statistika computer programs were used.

Results. According to the analysis of the works of leading scientists and the specifics of the professional activity of drone operators, it was determined that the most influential physical qualities on the effectiveness of operators' work are static, speed, general, and strength endurance.

Thus, the indicators of cadets in the group with a high level of strength endurance are significantly higher in the plank hold exercise compared to cadets from other groups ($p<0.05$-0.001). The results of cadets in the 2nd group are significantly higher than those of cadets in the 1st, 3rd, and 4th groups in the 100m run ($p<0.01$; $p<0.001$; $p<0.05$). The results of cadets in the 3rd group in the 3-km run are better than the results of cadets in the 1st group by 44.7s ($p<0.001$), the 2nd group by 37.6s ($p<0.001$), and the 4th group by 16.2s ($p<0.05$). Cadets in the 4th group have the best result in the kettlebell snatch exercise (24 kg) – 41.3 times, which is significantly higher than the indicators of cadets from the other three groups ($p<0.05$; $p<0.001$; $p<0.01$). The results of cadets with the most developed physical quality in each group exceed the indicators of cadets from the other groups.

The study of the psychological preparedness indicators of cadets in all groups at rest revealed that in groups 2 and 4, the results of short-term visual memory testing, concentration and stability of attention, switching and distribution of attention, and operational memory are higher compared to the corresponding indicators in cadets from groups 1 and 3, but there is no

significant difference between them (p>0.05) (Table 2).

The obtained results prove that the level of development of psychological qualities of cadets in all groups meets the requirements of the professional activities of drone operators and is assessed as average.

Under the influence of vestibular stimulation, the psychological qualities of cadets in all groups decline (Table 3).

Thus, the indicators of short-term visual memory (STVM) for cadets in the first group deteriorate by 2.8 points (t=2.081; p<0.05), and for the second group by 4.75 points (t=2.060; p<0.05). In the cadets of the 3rd and 4th groups, the identified indicators also decrease by 1.2 and 0.7 points respectively, but no significant difference from the indicators at rest was determined (p>0.05). The concentration and stability of attention of cadets deteriorate the most in groups 1 and 2 (0.9 and 2.3 respectively), indicating the absence of a positive impact of the development of strength and speed qualities on the psychological preparedness of the cadets (p<0.05). In groups 3 and 4, there is no significant difference between the indicators of concentration and stability of attention at rest and after the influence of vestibular stimulation (t=0.377; t=0.079; p>0.05).

The study of attention switching and distribution under vestibular stimulation conditions revealed a significant decline in indicators in group 1 and group 2 by 3.9 and 4.1 points, which is significantly worse than the indicators of attention switching and distribution at rest (p<0.05). The indicators of attention switching and distribution in cadets of groups 3 and 4 decreased by 0.85 and 0.4 points respectively, which does not allow for a significant difference compared to the baseline data of this indicator (p>0.05).

The indicators of operational memory decreased in all groups: in group 1 by 1.8 points (t=2.967; p<0.01), in group 2 by 3.1 points (t=2.192; p<0.05), in group 3 by 0.6 points (t=0.393; p>0.05), and in group 4 by 0.7 points (t=0.566; p>0.05).

The studies have shown that under the influence of vestibular stimulation, the psychological qualities of cadets in groups 1 and 2 decline to a greater extent than in cadets in groups 3 and 4. A significant difference in the indicators of cadets was found for all psychological qualities studied (p<0.05–0.01).

Stressful conditions significantly impacted the manifestation of the psychological qualities of the cadets.

Table 1

Physical Fitness Indicators of Cadets

Group od cadets	Plank holding, s		100-metre run, s		3-km run, s		24-kg kettlebell snatch, number	
	X	±m	X	±m	X	±m	X	±m
1 (n=25)	**126.3**	2.4	14.40	0.09	760.1	6.2	36.3	1.2
2 (n=25)	68.5	2.5	**14.10**	0.08	753.0	4.7	30.4	1.4
3 (n=25)	84.6	2.4	14.60	0.08	**715.4**	5.3	35.8	1.2
4 (n=25)	94.3	2.4	14.40	0.08	731.6	4.3	**41.3**	1.5

Table 2

Indicators of the development level of psychological qualities depending on the level of development of physical qualities of cadets (in points)

Indicators	1 group (n=25)	2 group (n=25)	3 group (n=25)	4 group (n=25)
	X±m	X± m	X±m	X±m
Short-term visual memory	6.0±1.0	7.5±1.5	7.0±1.0	7.0±1.0
Concentration and stability of attention	7.6±0.4	5.15±1.35	6.5±1.5	6.5±1.5
Switching and distribution of attention	5.5±1.5	7.5±1.0	7.0±1.0	7.5±1.5
Operational memory	7.4±0.5	6.0±1.0	7.0±1.0	8.0±0.5

The best short-term visual memory (STVM) was demonstrated by the servicemen in group 3 (6.5±0.5 points), which is 0.5 points lower than the STVM indicators at rest (p>0.05). No significant difference was found between the indicators of group 4 cadets (t=0.494; p>0.05). The most significant changes were observed in cadets of group 2 (5.1 points; p<0.05), and the STVM of cadets in group 1 decreased by 2.4 points (t=2.404; p<0.05). Moreover, the indicators of group 1 were significantly lower than those of cadets in groups 3 and 4 (p<0.01).

The indicators of concentration and stability of attention (CSA) under neuro-emotional stress (NES) were highest in group 3, which exceeded the indicators of groups 4, 1, and 2 by 0.3 (p>0.05), 0.6 (p>0.05), and 3.85 points (p<0.001), respectively. The CSA indicators of cadets in group 2 were significantly worse than those of cadets in the other groups (p<0.001) (Fig. 1).

Analysis of the impact of NES on the psychological qualities of cadets revealed the following dynamics of changes in CSA indicators:

– In cadets of group 1, a decrease by 2.1 points compared to indicators at rest (t=3.279; p<0.01);

– In cadets of group 2, a decrease by 2.9 points (t=2.112; p<0.05);

– In cadets of group 3, a decrease by 0.4 points (t=0.252; p>0.05);

– In cadets of group 4, a decrease by 0.7 points (t=0.417; p>0.05).

Table 3

Indicators of the development level of psychological qualities of cadets under the influence of vestibular stimulation

Indicators	1 group (n=25)	2 group (n=25)	3 group (n=25)	4 group (n=25)
	X±m	X± m	X±m	X±m
Short-term visual memory	3.2±0.9	2.75±1.75	5.8±1.0	6.3±1.0
Concentration and stability of attention	6.7±0.2	2.85±1.35	5.85±0.85	6.35±1.15
Switching and distribution of attention	1.6±1.1	3.4+1.4	6.15±1.15	7.1±1.3
Operational memory	5.6±0.4	2.9±1.0	6.4±1.15	7.3±1.3

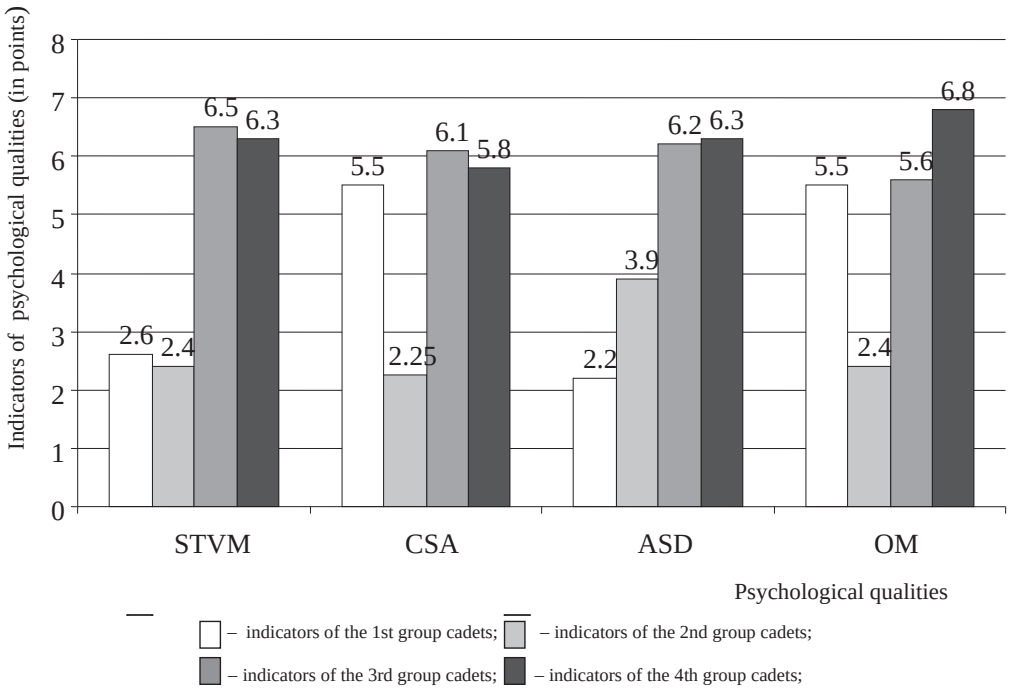

Fig. 1. Indicators of the development level of psychological qualities of cadets under the influence of neuro-emotional stress (NES), (in points)

Similar dynamics were observed in the indicators of attention switching and distribution (ASD) in all groups of cadets. Under the influence of NES, the indicators of cadets in groups 1 and 2 showed a significant difference compared to the baseline data ($t=2.087$; $t=2.092$; $p<0.05$), while the indicators of cadets in groups 3 and 4 did not show a significant difference compared to the indicators at rest ($p>0.05$).

Between the groups, there was no significant difference in the indicators of cadets ($p>0.05$), except for the indicators of cadets in group 1, which were lower than those of cadets in groups 3 and 4 by 4.0 and 4.1 points, respectively ($t=3.578$; $p<0.01$; $t=2.944$; $p<0.01$).

The study of operational memory (OM) indicators also confirmed the superiority of servicemen in groups 3 and 4 and the worst indicators in cadets of group 2. The test results after the influence of NES in cadets of group 2 were lower than those of group 1 by 3.1 points ($t=3.286$; $p<0.001$), lower than those of group 3 by 3.2 points ($t=3.010$; $p<0.001$), and lower than those of group 4 by 4.4 points ($t=4.400$; $p<0.001$).

Regarding the OM indicators of cadets at rest under the influence of NES, the operational memory indicators of cadets changed as follows:

– In cadets of group 1, decreased by 1.9 points ($t=2.828$; $p<0.01$);

– In cadets of group 2, decreased by 3.6 points ($t=2.811$; $p<0.01$);

– In cadets of group 3, decreased by 1.4 points ($t=1.146$; $p>0.05$);

– In cadets of group 4, decreased by 0.5 points ($t=1.536$; $p>0.05$).

The studies prove that under the influence of neuro-emotional stress and vestibular stimulation, the indicators of the psychological qualities of cadets decrease in all groups, but the impact is felt to a lesser extent in groups with well-developed general and strength endurance.

Discussion. Scientists argue that during task execution, the operator must detect, recognise targets, track them, and guide the drone. The operator needs to evaluate numerous factors in a short time and find a rational solution. Due to this, the operator experiences significant emotional and psychological stress, which disorganises his psyche and activities [7; 18; 24].

The quality of task performance under conditions of obstacles and time constraints is determined not only by the technical characteristics of the equipment but also by the level of readiness of the operator, psychological characteristics, and professional efficiency. In this sense, a qualified operator is, if one may say so, an effective "means" of protection. The decision made by the operator influences the final outcome of the battle. At the modern stage of training military specialists, it is necessary not only to comprehensively study various qualities of the operator, required for successful task completion but also to determine the means and methods necessary for their development [2; 6; 20].

Researchers have proven that the development of physical qualities in military personnel mainly occurs during their studies at higher military educational institutions. In subsequent service, officers need to maintain a level of physical fitness necessary for effective performance.

The military-professional training system at higher military educational institutions, along with other factors, contributes to achieving a high level of combat readiness among military personnel. The implementation of the main principles of training in a military institution creates numerous acute problems, the resolution of which ensures a level of mastery of the military specialty that meets the requirements of training-combat activities [3; 12; 19].

Analysis of the obtained results shows that the psychological qualities of cadets in all groups change under the influence of vestibular stimulation and neuro-emotional stress (NES). The least number of changes in psychological quality indicators were recorded in servicemen of groups 3 and 4, while the most changes were observed in group 2 [8; 15; 22]. It is evident that a high level of endurance development in military personnel implies the presence of more balanced nervous processes, and speed implies the balancing of nervous processes. This assertion is confirmed by changes in functional state indicators after the influence of adverse factors.

Examination of cadets for vestibular tolerance did not show significant differences between groups, although within the groups, servicemen with different levels of vestibular tolerance were identified. Evidently, as some authors claim, vestibular tolerance is determined not so much by the level of development of physical qualities but rather by the existing type of nervous system. However, as our studies have shown, the level of development of physical qualities also has some influence.

Explaining the obtained data, it is appropriate to assume that the vestibular stimulus, due to its monotonous influence on the serviceman's body, causes an inhibitory process in the cerebral cortex. Based on I.P. Pavlov's assertion about the beyond-limits inhibition, the physiological mechanism of vestibular stimulus influence becomes entirely understandable. Therefore, it was expected to observe a decrease in the level of psychological qualities, functional state indicators, psychomotor skills, and mental performance.

Under conditions of NES, the most significant indicators are general and strength endurance. It is apparent that the stability of mental performance is ensured by genetically determined systems (physical development indicators) and functional systems whose activity is enhanced through physical training. The state of NES arises due to a lack of information for the body to respond correctly to external stimuli. Due to insufficient information, the body reacts excessively, enhancing the activity of functional systems more than necessary. This leads to rapid fatigue [13; 14; 23].

Thus, the obtained results indicate that adverse factors reduce the professional efficiency of drone operators. The leading adverse factor can be termed as NES. On the other hand, conclusions were drawn about the positive impact of general and strength endurance on the activity of psychological systems in military personnel.

Conclusions. The positive impact of the development of specific physical qualities on the professional efficiency of military drone operators has been proven. It was determined that under the influence of vestibular stimulation and NES, cadets with predominant development of general and strength endurance show significantly higher psychological preparedness indicators compared to cadets with predominant development of static endurance and speed ($p<0.05–0.001$).

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