American Journal of Biomedical Science & Research

www.biomedgrid.com
ISSN: 2642-1747

Mini Review

Express Assessment of the Physical Condition of Operators of Unmanned Aircraft Systems

Kalnysh VV[1*], Trinka IS[1], Pashkovskyi SM[2], Koval NV[3], Bohush HL[4] and Tymchushyn TP[5]

[1]*Department of Aviation, Ukrainian Military Medical Academy, Ukraine*

[2]*Military Medical Clinical Center of the Central Region, Ukraine*

[3]*Department of the psychophysiology and psychology, Military Medical Clinical Center of the Central Region, Ukraine*

[4]*Head of the Minimally Invasive Surgery, Clinic of the Military Medical Clinical Center of the Central Region, Ukraine*

[5]*Department of the Gastroenterology, Military Medical Clinical Center of the Central Region (Vinnytsia), Ukraine*

***Corresponding author:** Valentyn Kalnysh, Professor of the Department of Aviation, Maritime Medicine and Psychophysiology of the Ukrainian Military Medical Academy (Kyiv), Doctor of Biological Sciences, Ukraine.

To Cite This Article: *Kalnysh VV*, Trinka IS, Pashkovskyi SM, Koval NV, Bohush HL and Tymchushyn TP, Express Assessment of the Physical Condition of Operators of Unmanned Aircraft Systems. Am J Biomed Sci & Res. 2024 22(1) AJBSR.MS.ID.002930,* DOI: 10.34297/AJBSR.2024.21.002930

Received: : March 11, 2024; **Published:** April 18, 2024

Introduction

In the conditions of war, the problem of maintaining a high level of physical state of military personnel who perform complex combat tasks becomes even more urgent. Stress, which is formed by a complex of harmful factors acting on servicemen, has a synergistic nature and accumulates in the body of servicemen over short periods of time. Therefore, it is important to diagnose the physical condition of military personnel before performing difficult and responsible tasks.

One of the contingents, whose representatives perform combat tasks, are operators of unmanned aircraft systems, which are now united in Ukraine into a new type of military - the Forces of Unmanned Systems. These operators have a number of functions: tracking the dynamically changing situation at the front, extermination defense centers and neutralizing enemy offensive actions, destroying distant military targets, participation in the evacuation of wounded, injured and sick servicemen etc. [1]. Along with the intense mental load, the operators of unmanned aircraft systems are affected by a complex of external harmful factors: weather, workplace factors, constant movement in space to avoid the enemy's fire response, and psychological ones related to personal danger, responsibility for the loss of equipment and poor performance of the task [2,3]. The emotional and physical stress caused by these factors can significantly shift the psycho-emotional state and working capacity of military personnel in a negative direction [4]. Therefore, for this contingent of servicemen, the assessment of their physical condition is extremely important.

Case Presentation

Taking into account the nature of the professional activity and location of the operators of unmanned aircraft systems, it is necessary to develop such a mechanism for assessing their physical state, the use of which would be acceptable in field conditions and in the absence of high-quality specialists such as psychophysiologists. Under these conditions, the following requirements should be applued for the physical condition assessment method:

a) The used device must be compact, light in weight and easy to move in space;

b) The device must have autonomous power supply;

c) Assessment of the physical state should be quick and have a graded scale of the quality of this condition for the commander to make decisions as soon as possible;

d) It is necessary to ensure the absence of overlap of any electrodes;

e) Assessment of physical condition should be non-specific to manifestations of various health disorders, severe fatigue or stress-associated diseases [5];

f) Assessment should be individual, and its interpretation should depend only on changes in the physical condition of the tested person.

The analysis of the above group of requirements for testing methods led to the opinion that the testing method can be stabilometry. This method of estimating the degree of displacement of the center of pressure of the serviceman's body, regulated by the vestibular apparatus and the cerebellum, i.e., it is sensitive to integral centralized changes in the operator's physical condition and state of health [6,5]. It takes into account all the formulated requirements for the methodology of assessing the physical condition of a serviceman. In addition, it should be noted that individualization of the assessment is necessary to take into account the age of the operator and the physiological characteristics of his body.

For the practical use of the discussed approach to the assessment of the physical condition of the operator, a special stabilographic platform developed in Ukraine, which is controlled by a computer, was used [7]. The active medical product "Device for research of vestibular functions "STABILIS" TU U 26.6 37366104-002:2020" with software package "StabiliS" version v2.00 intended for the study of the function of equilibrium and balance of the human body during procedures for assessing the physical condition of the human vestibular system, monitoring professionally important psychophysiological qualities, conducting various types of control of a person's condition, for example, before shifts or before performing complex tasks. The device is intended for operation in the range of ambient operating temperatures from 10 to 35°C and relative humidity up to 80% at a temperature of 25°C. The device consists of a horizontally placed rectangular metal plate, to which four strain gauges are attached on the lower side along the diagonals. From above, the plate is covered with two layers of non-conductive material and forms the upper resistance surface. Each sensor is rigidly connected to the plate at one end with the help of screws, and at the other end of each sensor, the resistance legs are fixed in such a way that their axis forms an angle of 90° with the plane of the plate.

During research, the device is installed horizontally with the legs on the floor. It should be noted that the device must stand on a flat surface and approximately the same load must be applied to each of its legs. The test subject is placed on the upper support surface of the device in a vertical position. Since the position of a person's center of gravity is physically related to the center of pressure of his feet on the supporting surface, the analysis of the record obtained in this way makes it possible to evaluate the equilibrium and balance functions of the human body in statics and dynamics in combination with various functional tests.

It is known that the balance function is provided by the combined action of a number of systems: vestibular, visual, somato-sensory. But it is generally accepted that the vestibular contribution to the implementation of the balance function is the most significant. Under the conditions of exclusion or leveling of systems alternative to the vestibular analyzer, the function of balance is practically realized at the expense of the vestibular analyzer and the cerebellum [8]. Research were performed in the position with closed eyes. The examinee is asked to weigh himself before conducting the study for the possibility of calibrating the device, if the difference in body weight on the scales and on the platform is more than 200 grams. After that, the examinee stands on the platform in the position "heels together - toes apart" with an angle of 30°. For convenience, landmarks are marked on the platform in order to take the correct position. Then the examinee stands in a vertical position, hands are lowered along the body and closes the eyes. After that, the recording is turned on and the process of "zeroing" begins in order to level out excess movements to obtain better quality information. The research time in each is 2,5 minutes (30 seconds - zeroing and 120 seconds of the actual research).

Classical stabilometric parameters, as well as parameters characterizing the frequency spectrum of pressure center fluctuations in the frontal and sagittal planes, were used for the analysis. According to our previous studies in the position with closed eyes [6] 4 indicators, which were later used in the construction of solving rules, turned out to be the most informative.

Solving rules are used to obtain the test result, which allow determining the degree of suitability to control unmanned aircraft systems according to the following scale: fully meet the requirements of the operator's profession and can be recognized as suitable without restrictions (1), generally meet the requirements of the operator's profession and can be recognized suitable (2), conditionally meet the requirements of the operator's profession and can be recognized as suitable for a period of 6 months, followed by an extra-ordinary psychophysiological examination (3):

"1"=-2705,36+48,62×KFR+185,25×AvgSpeed+0,18×LengthX;

"2"=-2576,32+47,25×KFR+181,59×AvgSpeed+0,19×LengthX;

"3"=-2685,71+47,94×KFR+185,93×AvgSpeed+0,20×LengthX;

Where:

KFR: Indicator of the quality of the equilibrium functions;

AvgSpeed: The average velocity of the center of pressure;

LengthX: The length of the trajectory of pressure center oscillations in the frontal plane.

Based on the obtained parameters, you need to make calculations on all three equations. The assessment of physical condition is determined by the equation that gives the greatest result.

It should be noted that the given equations are not calculated based on individual data of the operator, but based on parameters obtained during testing of a group of operators (50, under 40 years of age). In this case, 54% of operators were assigned to group "1" using cluster analysis, 34% to group "2", and 12% to group "3". Solving rules were obtained using a step-by-step discriminant analysis (reliability of discrimination 98%) and their results were verified during the practical application of the proposed method. In addition, it turned out that the representatives of group "3" suffered from corresponding, mainly stress-associated diseases [6,5].

The proposed method of using the stabilographic platform gives a quick and high-quality result, and its analysis will allow its

use not only for the express assessment of professionally important psychophysiological qualities, and conducting various types of control of the operator's condition, but also as a training of psychophysiological functions or for the purpose of determining the effectiveness of preventive and rehabilitation measures.

Discussion

In addition to the proposed method of express assessment of the physical condition of military personnel, other methods of recording human reactions can be used, for example, heart rate variability analysis, etc [9]. Such equipment is quite compact, and also has its advantages and disadvantages when assessing physical condition. For example, multiple (necessary to obtain a reliable result) testing of human reactions by several methods takes a lot of time and requires a separate room.

Registration of the rhythmogram should be carried out for a sufficiently long time while the operator is at rest. The proposed stabilographic technique excludes these defects and satisfies all the presented requirements for conducting an express analysis of the physical state of the operator. This technique must be applied in conditions close to field conditions for a quick and sufficiently accurate determination of the physical condition of the operator, on the basis of which a decision will be made regarding the determination of the degree of suitability for controlling unmanned aircraft systems.

Conclusion

Therefore, the stabilometry method allows for a quick and high-quality assessment of the physical condition of operators in the field without the involvement of narrow specialists (psychophysiologists). The used indicators of the stabilographic platform and the obtained solvers can be useful for other authors as well, because a complex of informative indicators was used to improve the result. In the perspective of further research, the proposed method of express assessment of physical condition will be used as psychophysiological stress resistance training of military personnel, as well as for the purpose of determining the effectiveness of preventive and rehabilitation measures.

References

1. Kuo PJ, Lee CL, Wang JH, Hsieh SY, Huang SC, et al. (2017) Inhalation of volatile anaesthetics via a laryngeal mask is associated with lower incidence of intraoperative awareness in non-critically ill patients. PLoS One 12(10): e0186337.
2. Philips A, Sherwood D, Greenberg N, Jones N (2019) Occupation stress in Remotely Pilotes Aircraft System operators. Occup Med 69(4): 244-250.
3. Kalnysh VV, Shvets AV, Pashkovskyi SM, Maltsev OV, Koval NV, et al. (2023) Features labour intensity formation among operators of unmanned aviation complexes. Current Aspects of Military Medicine 30(1): 20-37.
4. Chappelle WL, McDonald KD, Prince L, Goodman T, Ray Sannerud BN, et al. (2014) Symptoms of Psychological Distress and Post-Traumatic Stress Disorder in United States Air Force "Drone" Operators. Mil Med 179(8 Suppl): 63-70.
5. Kalnysh VV, Pashkovskyi SM, Koval NV, Pashkovska OV (2023) Indicators of changes in the level of functional reserves of the organism of operators body in the development of age changes, fatigue and stress-associated diseases. Fiziol Zh 69(4): 19-28.
6. Pashkovskyi SM, Koval NV, Angelska VYu, Kalnysh VV, Klunko ES (2023) Peculiarities of the influence of diseases, which are to varying degrees associated with stress, on the psychophysiological state of operators of unmanned aircraft complexes. In: Tabachnikov S (Edn.), Proceedings of the 1st International Scientific and Practical Online Conference. Actual problems of education and science in the war conditions Kyiv. Kyiv: Subsidiary enterprise, pp. 213-224.
7. Kochyna ML, Kaminsky AA (2012) Hardware and software complex for the study of the static dynamic stability of a person. Appl Rradio electron 11(1): 120-124.
8. Kompaniyets OA (2022) Static balance: clinical aspects and professional selection of servicemen [monograph]. Kamyanets-Podilskyi: Ruta Printing house LLC, pp. 288.
9. Jasper P, Siblay C, Coyne J (2016) Using Heart Rate Variability to Assess Operator Mental Workload in a Command and Control Simulation of Multiple Unmanned Aerial Vehicles. Proc Hum Factors Ergon Soc Annu Meet 60(1): 1125-1129.