Read online

Research article

PROGNOSIS OF SUICIDAL RISK AMONG LAW ENFORCEMENT OFFICIALS INCLUDING MILITARY PERSONNEL

E.S. Shchelkanova, M.R. Nazarova, I.M. Gudimov, N.A. Galkin, E.A. Zhurbin

Military Innovative Technopolis "ERA", 41 Pionerskii Ave., Krasnodar Krai, Anapa, 353456, Russian Federation

Suicide is a major medical and social concern for law enforcement, a contemporary army included, not only in Russia but abroad as well. In recent years, frequency of suicides and suicidal attempts has been growing among law enforcement officials (LEOs), military personnel included. Therefore, it seems relevant to develop a model for predicting suicide risk.

In this study, our aim was to develop a model for predicting suicide risk in LEOs based on express testing results. Our research object was represented by LEOs (n = 591), their average age being 23.71 ± 1.12 years.

To assess suicide risk, we used a questionnaire for suicide risk assessment 'SSR-2', which is a part of DAP-2 methodology for deviant behavior research, and a clinical-psychopathological method. LEOs' personality characteristics and their current psychophysiological state were identified by using vibration imaging, a technology for recording and mathematically analyzing micro-vibrations of the head and face. It has certain advantages over its analogues.

We determined psychophysiological characteristics, basic abilities (types of Gardner's multiple intelligence) and moral qualities that differed in people with elevated suicide risk against the control. We identified a difference between unconscious reactions of the examined people to stimuli and declared (conscious) ones, which indicates that LEOs tend to hide any signs of suicidal behavior in them. A mathematical model was built for predicting suicide risk: we developed an integral suicide risk assessment and created a probabilistic nomogram that makes it possible to establish likelihood of suicidal behavior signs with accuracy above 98 % relying on results obtained by a 5-minute express test.

Use of this predictive model helps identify those people among personnel who should undergo a profound check-up by a psychological support team. Our research results can serve as a basis for creating an objective concept for diagnostics of suicide risk factors in LEOs

Keywords: suicide risk, suicide, law enforcement agencies, military personnel, prediction, vibration imaging, abilities, moral qualities.

Suicide is a major serious social and medical concern for law enforcement, both in Russian and abroad, according to the contemporary analysis of the issue and long-term expert observations [1–6].

In recent years, frequency of suicides and suicidal attempts has been growing among law enforcement officials (LEOs) [1, 7]. As opposed to civil population, this dynamics is largely associated with drawbacks of draft and selection systems and insufficient attention paid to psychological and mental state of law enforcement personnel rather than with difficulties typical for a period of socioeconomic reforms [8].

Suicide destroys personnel's morale, weakens battle readiness, does great moral and psychological damage to the civil society, stimulates negative attitudes towards service in law enforcement agencies and creates a negative image in public consciousness. Thus, for example, conscripted soldiers are a vulnerable group of military personnel as regards suicide risk [9].

Today, serious attention is paid to suicide risk prediction. There are many scales and

Elena S. Shchelkanova – Candidate of Biological Sciences, Senior Researcher at Research Department of Biomedical Research (e-mail: era_otd6@mil.ru; tel.: +7 (495) 693-30-99 (ext. 25-80); ORCID: https://orcid.org/0000-0003-0672-8820).

Marina R. Nazarova – Junior Researcher at Research Department of Biomedical Research (e-mail: era_otd6@mil.ru; tel.: +7 (495) 693-30-99 (ext. 25-84); ORCID: https://orcid.org/0009-0000-7368-9222).

Ivan M. Gudimov – scientific squadron operator (e-mail: era_otd6@mil.ru; tel.: +7 (495) 693-30-99 (ext. 25-80)).

Nikita A. Galkin – scientific squadron operator (e-mail: era_otd6@mil.ru; tel.: +7 (495) 693-30-99 (ext. 25-80)).

Evgeniy A. Zhurbin – Candidate of Medical Sciences, Head of Research Department of Biomedical Research (e-mail: era_otd6@mil.ru; tel.: +7 (495) 693-30-99 (ext. 21-87); ORCID: https://orcid.org/0000-0002-0867-3838).

questionnaires aimed to diagnose suicide. However, in our opinion, they have a lot of considerable drawbacks: estimates are subjective in their essence; it is time-consuming and costly to conduct them and analyze the results; keys of many questionnaires are available in open access in the Internet. This leads to much greater difficulties in identifying real suicidal ideations of LEOs, makes preventive measures less effective and increases relevance of searching for reliable suicide risk indicators [10, 11]. The proper diagnosis and immediate treatment plan for those individuals exhibiting severe depressive traits could prevent up to 70 % casualties of suicide. Therefore, it is relevant to build models eligible for predicting suicide risk based on objective indicators of the human body [12].

Vibration imaging is a promising method for assessing suicide risk among LEOs [13, 14]. It involves detection and mathematical analysis of microvibrations of the head and face. The method has been used successfully to solve a wide range of applied tasks within medical-psychological research. It has certain advantages over its analogues: it is time-saving; it provides objective and precise estimates of a person's mental state; it allows estimating more people per one hour than any contact examinations; a person does not experience any physical impacts during an examination and this excludes any likelihood of distortions in its results [15–17].

The aim of this study was to develop a model for predicting suicide risk in law enforcement officials, military personnel included, based on express testing results.

Materials and methods. Our research object was represented by LEOs ($n = 591$), their average age being 23.71 ± 1.12 years. Examinations took place between 2021 and 2023. The following inclusion criteria were applied: male sex; a written consent to participate in the study. The exclusions criteria were female sex; absence of a written consent to participate in the study; testing conducted incorrectly; apparent sickness (high temperature, fever, etc.)

Groups of LEOs per presence / absence of suicidal risk were created by using a questionnaire for suicide risk assessment 'SSR-2', which is a part of DAP-2 methodology for deviant behavior research. Clinical-psycho-pathological methods were applied to identify suicide risk.

Psychophysiological state, abilities and moral qualities were estimated with Profiler+ software package, version 10.2.3.167, based on vibration imaging [18]. Military personnel were examined in conformity with all requirements to work with the technology recommended by the system developers.

Authenticity of differences between the study groups was estimated with Student's t-test; critical significance was taken at 0.05. We used discriminant analysis, onward step-by-step with inclusion (at F-enter = 2.0, F-remove = 1.9 and $p < 0.05$), and multiple regression to build classifications and decision rules. Mathematical analysis of the research data was performed in STATISTICA v.10.0.

Results and discussion. Two groups of participants were made following the examinations: SR0 group was made of people without suicide risk ($n = 553$; 93.6 %); SR group included people with suicide risk ($n = 38$; 6.4 %).

Table 1 provides the results of assessing differences in psychophysiological parameters obtained by using vibration imaging in two analyzed groups.

Obviously, we established authentic differences between the groups SR0 and SR only for variability of the 'Inhibition' parameter (V_E9 (inhibition)). Some apparent trends were also established for variability of the 'Stress' (V_E2 (stress), and E6 (charisma), E8 (self-regulation) and E10 (neuroticism) parameters.

It is quite interesting to analyze differences in variability of vibration imaging parameters. Changes in the structure of a vibration spectrum are a well-known sign of growing strain of body regulatory mechanisms regardless of an examined function [19, 20]. Activation of the parasympathetic nervous system leads to acetyl choline release, which makes the R–R interval longer and heart rate

lower. On the contrary, the sympathetic nervous system increases catecholamine expression by synapses, which increases heart rate and smooth muscle contractility [21]. Since quite a close relation has been established between mechanical microvibrations of the head and body and rhythmic activity of the central nervous system[1] [22], we can assume that people with suicide risk have higher strain of the regulatory systems, which manifests itself through growing variability of the 'stress' and 'inhibition' parameters. Deviations in the regulatory systems are known to occur long before any energy, metabolic, or functional disorders of different organs and systems in the body, let alone an actual disease; they are early prognostic signs of a developing pathology and are far ahead of any changes measurable by clinical, laboratory or instrumental tests [21]. Therefore, practical use of prognostic express-methods makes it possible to diagnose prenosological changes in LEOs' adjustment disorders as a predecessor of suicidal behavior at early stages [23].

T a b l e 1

Assessment of differences between two groups of LEOs as per vibration imaging parameters

Parameter	SR0 group	SR group	p
	$M \pm \sigma$	$M \pm \sigma$	
Basic vibration imaging parameters			
E1 (aggression)	33.68 ± 7.43	33.33 ± 6.24	0.775
E2 (stress)	35.11 ± 4.36	34.76 ± 4.05	0.631
E3 (anxiety)	29.96 ± 7.77	29.94 ± 8.29	0.986
E4 (danger)	33.15 ± 3.14	32.91 ± 3.52	0.659
E5 (steadiness)	77.57 ± 4.50	77.77 ± 4.92	0.799
E6 (charisma)**	41.37 ± 16.26	36.56 ± 17.04	0.079
E7 (vitality)	16.15 ± 5.30	15.63 ± 4.33	0.553
E8 (self-regulation)**	59.26 ± 8.75	57.18 ± 9.39	0.160
E9 (inhibition)	20.93 ± 2.80	20.97 ± 3.05	0.933
E10 (neuroticism)**	47.15 ± 11.24	50.36 ± 14.39	0.096
E11 (depression)	33.42 ± 3.18	33.92 ± 3.08	0.355
E12 (happiness)	32.54 ± 6.68	31.64 ± 6.24	0.418
Variability of vibration imaging parameters			
V_E1 (aggression)	23.48 ± 5.45	23.91 ± 6.47	0.641
V_E2 (stress)**	18.26 ± 5.87	19.81 ± 8.11	0.126
V_E3 (anxiety)	34.90 ± 16.23	34.85 ± 17.01	0.986
V_E4 (danger)	13.56 ± 3.46	13.80 ± 3.40	0.681
V_E5 (steadiness)	12.26 ± 4.59	11.87 ± 5.40	0.615
V_E6 (charisma)	46.52 ± 33.18	51.91 ± 27.30	0.328
V_E7 (vitality)	35.81 ± 12.01	35.71 ± 11.62	0.960
V_E8 (self-regulation)	16.32 ± 5.67	16.71 ± 5.40	0.677
V_E9 (inhibition)*	22.59 ± 4.49	24.18 ± 6.40	0.042
V_E10 (neuroticism)	21.61 ± 1.60	21.84 ± 1.45	0.383
V_E11 (depression)	12.50 ± 3.25	12.41 ± 3.03	0.874
V_E12 (happiness)	18.92 ± 8.51	19.22 ± 8.58	0.831

N o t e: here and below in the text * points out indicators different with 95 % likelihood, and ** with 80 % likelihood as per Student's *t*-test. Names of vibration imaging parameters are given in brackets as they are interpreted by the technology developers.

---

[1] Rorakher G., Inanaga K. Microvibration: its biological function and significance for clinical diagnostics. Bern, Stuttgart, Wien, Hans Huber Publ., 1969, 160 p.

Table 2

Assessment of differences in abilities (as per multiple intelligence (MI) types) and moral qualities in different LEO groups

Characteristics	SR0	SR	p
Abilities (G. Gardner's MI types)			
Intrapersonal**	55.55 ± 30.52	62.90 ± 28.30	0.150
Philosophic-investigatory	52.51 ± 26.87	53.45 ± 29.04	0.835
Logical-mathematical	57.10 ± 29.79	52.83 ± 27.31	0.390
Business-selfish	23.97 ± 26.26	23.07 ± 24.05	0.838
Visual-spatial	57.02 ± 27.09	56.54 ± 28.02	0.916
Naturalistic	49.42 ± 29.22	53.49 ± 26.00	0.403
Locomotive	43.00 ± 27.48	42.86 ± 24.39	0.976
Musical-rhythmical*	34.49 ± 28.63	44.08 ± 28.84	0.046
Selfless	67.15 ± 24.79	62.43 ± 24.57	0.256
Verbal-linguistic	43.89 ± 30.05	49.55 ± 31.69	0.263
Creative	44.04 ± 29.69	38.00 ± 31.76	0.228
Interpersonal**	52.37 ± 29.93	43.10 ± 32.39	0.067
Moral qualities			
Wrath	25.29 ± 27.20	30.97 ± 29.61	0.216
Envy	24.43 ± 27.64	28.11 ± 22.86	0.424
Internet-addiction	19.45 ± 26.38	22.03 ± 23.71	0.557
Greed	32.01 ± 29.12	36.12 ± 27.19	0.398
Gluttony	40.03 ± 30.85	44.62 ± 36.56	0.381
Sloth*	23.53 ± 26.82	35.04 ± 30.18	0.011
Lust	21.37 ± 27.05	24.75 ± 23.61	0.453
Alcoholism, drug addition**	14.01 ± 21.50	19.45 ± 29.84	0.143
Egoism**	22.14 ± 27.47	29.78 ± 28.07	0.098
Suicide**	13.65 ± 20.95	19.75 ± 20.93	0.083
Theft, bribery*	14.86 ± 21.73	29.52 ± 22.47	0.000
Pride**	29.12 ± 27.24	35.42 ± 25.53	0.166

Direct differences in vibration imaging parameters manifest themselves in the symmetry of head and face micro-movements (parameter E6), in mean values of a sum of conditionally positive emotions (E8) and in the spread of measured values of inhibition over the measurement period (E10). Therefore, people with suicide risk have higher neuroticism and lower levels of positive emotions in general, which indicates that their psychophysiological state is unstable and their psychoemotional state has apparent sub-depression trends.

Data obtained during this study for different groups of LEOs that describe their key abilities (G. Gardner's multiple intelligence [24]) and moral qualities are of great interest.

Obviously, people with suicide risk tend to have the musical-rhythmical MI type more often as well as a more apparent intrapersonal type and less apparent interpersonal one. This indicates that LEOs with suicide risk are more often introverted, their psyche is turned inward, they focus on their internal world, do not have any need in communicating with others, and are more sensitive to sounds (their leading sensory organ is the hearing apparatus).

A significant advantage of vibration imaging is a provided possibility to estimate an unconscious response (IE) of a tested person to a presented stimulus (detection takes place at the moment when a stimulus has already appeared on the screen but a tested person has not yet given an answer by pressing 'yes/no' keys) and to compare it with an integral response (IE+YN). Mean values obtained for moral qualities by estimating unconscious responses are provided in Table 3.

Assessment of differences in unconscious responses to stimuli associated with moral qualities in two LEO groups

| Moral quality	SR0	SR	*p*
Wrath	33.75 ± 21.92	34.74 ± 21.89	0.787
Envy	33.48 ± 23.47	33.04 ± 23.18	0.911
Internet-addiction	34.93 ± 23.89	35.96 ± 16.39	0.794
Greed	34.33 ± 23.76	37.30 ± 20.17	0.453
Gluttony	35.25 ± 25.29	40.45 ± 22.25	0.218
Sloth	34.84 ± 22.99	38.15 ± 20.05	0.387
Lust	33.54 ± 24.40	30.10 ± 21.76	0.397
Alcoholism, drug addition	34.11 ± 23.58	36.99 ± 24.07	0.466
Egoism*	34.28 ± 25.32	45.29 ± 25.19	0.010
Suicide**	34.73 ± 22.69	40.89 ± 22.57	0.106
Theft, bribery	33.57 ± 21.67	34.40 ± 18.80	0.817
Pride**	33.57 ± 22.88	40.57 ± 21.90	0.068
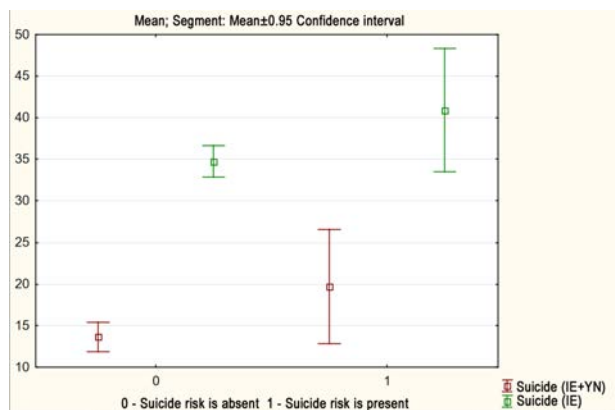
Figure 1. Differences between integral (IE+YN) and unconscious responses (IE) to stimuli associated with suicide in different LEO groups

Table 3 clearly shows that LEOs with suicide risks are more egoistic; put their interests above everything; have narcissism (not excluding auto-aggression). They also tend to have thoughts, concepts and feelings with suicidal ideation and readiness to realize them. Differences in unconscious and integral (Figure 1) responses to stimuli associated with identification of suicidal ideation indicate that people from the SR group tried to not declare their suicidal thoughts and ideations consciously.

A database was created to differentiate the analyzed LEO groups. It included 76 randomly selected observations (38 observations from the SR0 group and 38 observations from the SR group).

Discriminant analysis was applied to solve classification tasks. Assessment of informative value of characteristics revealed that 23 parameters were included into the model out of all vibration imaging parameters, their variability, abilities and moral qualities (integral and unconscious responses). They are provided in Table 4.

Informative value of personality characteristics within the linear discriminant function

Personality characteristics based on the Profiler+ program	Wilkes (Lambda)	Partial (Lambda)	F-excl. (1.52)	*p*	Tolerance	1-toler. (R-sq.)
Musical-rhythmical MI type	0.33	0.56	41.11	0.000	0.32	0.68
E10 (Neuroticism)	0.30	0.61	33.50	0.000	0.32	0.68
E9 (Inhibition)	0.28	0.65	28.32	0.000	0.28	0.72
Suicide (unconscious response)	0.28	0.65	27.98	0.000	0.18	0.82
Theft, bribery (integral response)	0.26	0.71	21.07	0.000	0.46	0.54
Egoism (IE)	0.25	0.72	20.21	0.000	0.38	0.62
E6 (Charisma)	0.25	0.72	20.17	0.000	0.00	1.00
V_E5 (Variability of the Steadiness parameter)	0.25	0.74	18.36	0.000	0.18	0.82
Lust (IE)	0.24	0.76	16.40	0.000	0.47	0.53

End of the Table 4

Personality characteristics based on the Profiler+ program	Wilkes (Lambda)	Partial (Lambda)	F-excl. (1.52)	p	Tolerance	1-toler. (R-sq.)
E8 (Self-regulation)	0.24	0.78	14.84	0.000	0.00	1.00
Internet-addiction (IE)	0.23	0.79	14.04	0.000	0.18	0.82
Intrapersonal MI type	0.23	0.79	13.61	0.001	0.56	0.44
Internet-addiction (IE+YN)	0.23	0.80	12.88	0.001	0.26	0.74
Locomotive MI type	0.23	0.80	12.61	0.001	0.55	0.45
Visual-spatial MI type	0.22	0.82	11.08	0.002	0.66	0.34
Sloth (IE)	0.22	0.84	9.57	0.003	0.15	0.85
Wrath (IE+YN)	0.21	0.85	8.97	0.004	0.45	0.55
Gluttony, bulimia (IE+YN)	0.21	0.86	8.44	0.005	0.39	0.61
E5 (Steadiness)	0.20	0.91	5.12	0.028	0.03	0.97
E11 (Depression)	0.20	0.92	4.49	0.039	0.28	0.72
E1 (Aggression)	0.20	0.92	4.29	0.043	0.23	0.77
VSR, % (virtues to moral qualities ratio)	0.20	0.93	4.02	0.050	0.55	0.45
Alcoholism, drug addiction (IE+YN)	0.19	0.95	2.74	0.104	0.42	0.58

Use of conventional discriminant analysis made it possible to develop an integral suicide risk indicator in LEOs (*IIsr*), which is given by an equation based on coefficients provided in Table 5.

Table 5

Values of coefficients for calculating *IIsr* for law enforcement officers, including military personnel

Indicator	Coefficient
Absolute tern	-100.73
Theft, bribery (IE+YN)	0.17
Suicide (IE+YN)	0.33
Intrapersonal MI type	0.10
Musical-rhythmical MI type	0.19
Internet-addiction (IE+YN)	-0.17
E10 (Neuroticism)	3.19
E9 (Inhibition)	0.85
E5 (Steadiness)	-1.54
Wrath (IE+YN)	-0.09
Locomotive MI type	-0.11
Lust (IE+YN)	-0.18
Gluttony, bulimia (IE+YN)	-0.09
V_E5 (Variability of the Steadiness parameter)	1.12
E6 (Charisma)	-3.00
E8 (Self-regulation)	5.39
Visual-spatial MI type	0.10
VSR, % (virtues to moral qualities ratio)	-0.39
E11 (Depression)	-0.72
Sloth (IE+YN)	-0.28
Internet-addiction (IE)	0.27
Egoism (IE+YN)	0.18
E1 (Aggression)	0.35
Alcoholism, drug addiction (IE+YN)	0.06

The said indicator was represented by a conventional discriminant function, which separated the groups with and without suicide risk.

Group membership was estimated with using linear discriminant functions Z_0, Z_1:

$$Z_0 = -46{,}06 + 2{,}21 \times IIsr \text{ T-scores} \quad (1)$$

$$Z_1 = -94{,}48 + 3{,}18 \times IIsr, \text{ T-scores}, \quad (2)$$

where the index 0 is attributable to LEOs without suicide risk; the index 1, LEOs with suicide risk.

An estimation of membership in a group is performed as follows: the integral suicide risk indicator is calculated for each specific law enforcement official as per the above formula and on the basis of coefficient values provided in Table 5. An obtained *IIsr* value is substituted into the formulas (1) and (2), which are used to calculate Z_0 and Z_1 values. An ultimate conclusion on membership / not membership in a group with elevated suicide risk is made per the maximum Z_i value.

Predictive ability of decision rules equaled 100 % for the group without suicide risk; 97.37 %, the group with suicide risk; 98.68 % for the whole sample.

A probabilistic nomogram (Figure 2) was built to facilitate use of decision rules. It allows quick and visualized identification of suicide risk likelihood (%) in a LEO based on his

IIsr value. For example, if *IIsr* = 49 scores, suicide risk likelihood equals 30 % and likelihood of its absence equals 70 % for a LEO with this score estimate. If *IIsr* = 53 scores, suicide risk likelihood is 95 %.
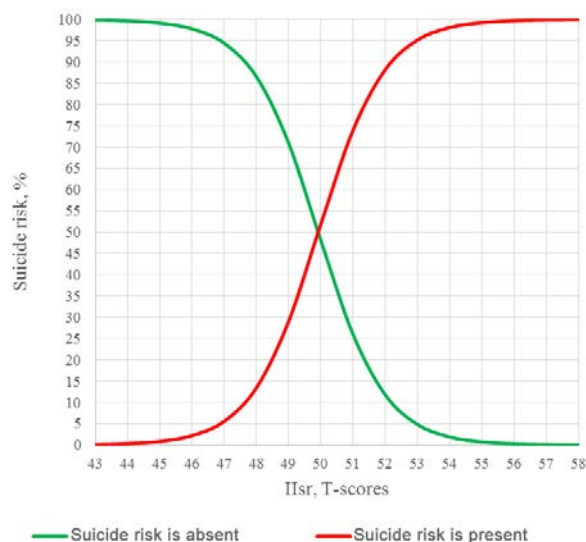

Figure 2. Probabilistic nomogram for suicide risk identification in law enforcement officers, including military personnel

The developed model can be implemented as an Excel macros; a result stating either presence or absence of suicide risk in a LEO can be received automatically upon completion of 5-minute testing. This is a considerable advantage for use within mass medical check-ups provided for law enforcement personnel.

Conclusion. Suicide risk prophylaxis in law enforcement officials, including military personnel, is accomplished not only to prevent accidents but also to protect personnel's physical and mental health. The developed model for suicide risk prediction makes it possible to obtain relevant data on likelihood of suicidal ideation, abilities and moral qualities of personnel after short-time testing. This allows developing personalized and optimized measures aimed at preventing suicidal behavior within medical and psychological support. A possibility to estimate both unconscious and integral responses given by examined LEOs to stimuli helps both a psychologist and commanders shape an opinion on as level of actual development of their moral qualities even if they would like to hide it. In our opinion, contactless express-methods, vibration imaging being among them, are quite promising in applied medical and psychological investigations conducted by various law enforcement agencies.

Competing interests. The authors declare no competing interests.

References

1. Harutyunyan S.O., Seregin D.A., Dnov K.V., Yusupov V.V., Yatmanov A.N. Mathematical model for prediction of suicidal behavior of military personnel. *Zhivaya psikhologiya*, 2023, vol. 10, no. 1 (41), pp. 29–38. DOI: 10.58551/24136522_2023_10_1_29 (in Russian).

2. Holliday R., Borges L.M., Stearns-Yoder K.A., Hoffberg A.S., Brenner L.A., Monteith L.L. Posttraumatic stress disorder, suicidal ideation, and suicidal self-directed violence among US military personnel and veterans: a systematic review of the literature from 2010 to 2018. *Front. Psychol.*, 2020, vol. 11, pp. 1998. DOI: 10.3389/fpsyg.2020.01998

3. Moradi Y., Dowran B., Sepandi M. The global prevalence of depression, suicide ideation, and attempts in the military forces: a systematic review and Meta-analysis of cross sectional studies. *BMC Psychiatry*, 2021, vol. 21, no. 1, pp. 510. DOI: 10.1186/s12888-021-03526-2

4. Shamrei V.K., Dnov K.V., Evdokimov V.I. Actual problems of prevention of suicide in the armed forces of the Russian Federation. *Mediko-biologicheskie i sotsial'no-psikhologicheskie problemy bezopasnosti v chrezvychainykh situatsiyakh*, 2019, no. 4, pp. 50–58. DOI: 10.25016/2541-7487-2019-0-4-50-58 (in Russian).

5. Willmund G.-D., Heß J., Helms C., Wertenauer F., Seiffert A., Nolte A., Wesemann U., Zimmermann P.L. Suicides between 2010 and 2014 in the German Armed Forces – Comparison of Suicide Registry Data and a German Armed Forces Survey. *Suicide Life Threat. Behav.*, 2019, vol. 49, no. 5, pp. 1497–1509. DOI: 10.1111/sltb.12534

6. Shelef L., Essami N., Birani A., Hartal M., Yavnai N. Personal and psychiatric characteristics among Druze soldiers attempting suicide during military service. *J. Affect. Disord.*, 2019, vol. 256, pp. 486–494. DOI: 10.1016/j.jad.2019.06.011

7. Aldarova D.A. Prognozirovanie suitsidal'nogo povedeniya [Prediction of suicidal behavior]. *Intellektual'nye sistemy v nauke i tekhnike. Iskusstvennyi intellekt v reshenii aktual'nykh sotsial'nykh i ekonomicheskikh problem XXI veka [Intelligent systems in science and technology. Artificial intelligence in solving urgent social and economic problems of the 21st century]: sbornik statei po materialam Mezhdunarodnoi konferentsii i Shestoi vserossiiskoi nauchno-prakticheskoi konferentsii.* In: L.N. Yasnitskii ed., 2020, pp. 536–542 (in Russian).

8. Bulygina V.G., Shport S.V., Dubinsky A.A., Pronicheva M.M. Occupational risk factors affecting mental health of professionals with dangerous jobs (a review of foreign studies). *Mediko-biologicheskie i sotsial'no-psikhologicheskie problemy bezopasnosti v chrezvychainykh situatsiyakh*, 2017, no. 3, pp. 93–100. DOI: 10.25016/2541- 7487-2017-0-3-93-100 (in Russian).

9. Prykhodko I., Matsegora Y., Kolesnichenko O., Pasichnik V., Kuruch O., Yurieva N., Kravchenko O. Psychological Markers of Suicides in Military Service During Wartime: A Contemporary Example. *International journal of psychology and psychological therapy*, 2021, vol. 21, no. 1, pp. 47–57.

10. Davidouski S.V., Ibragimova J.A., Goncharik A.V., Kartun L.V., Leonov N.N., Danilova L.I., Kuzhal V.V., Zalesskaya I.S. [et al.]. A classification method for predicting suicide risk. *Izvestiya Natsional'noi akademii nauk Belarusi. Seriya meditsinskikh nauk*, 2020, vol. 17, no. 2, pp. 248–256. DOI: 10.29235/1814-6023-2020-17-2-248-256 (in Russian).

11. Schuck A., Calati R., Barzilay S., Bloch-Elkouby S., Galynker I. Suicide Crisis Syndrome: A review of supporting evidence for a new suicide-specific diagnosis. *Behav. Sci. Law*, 2019, vol. 37, no. 3, pp. 223–239. DOI: 10.1002/bsl.2397

12. Hassan S.B., Hassan S.B., Zakia U. Recognizing suicidal intent in depressed population using NLP: a pilot study. *2020 11th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON).* Vancouver, BC, Canada, IEEE, 2020, pp. 0121–0128. DOI: 10.1109/IEMCON51383.2020.9284832

13. Minkin V.A. Vibroizobrazhenie, kibernetika i emotsii [Vibration imaging, cybernetics and emotions]. St. Petersburg, OOO «Renome» Publ., 2020, 164 p. DOI: 10.25696/ELSYS.B.RU.VCE.2020 (in Russian).

14. Minkin V.A., Nikolaenko N.N. Application of vibraimage technology and system for analysis of motor activity and study of functional state of the human body. *Biomed. Eng.*, 2008, vol. 42, no. 4, pp. 196–200. DOI: 10.1007/s10527-008-9045-9

15. Ivanovsky V.S., Shchelkanova E.S., Markin I.V. Psychophysiological express control of persons of hazardous occupations operating weapons systems. *Meditsina katastrof*, 2021, no. 1, pp. 45–50. DOI: 10.33266/2070-1004-2021-1-45-50 (in Russian).

16. Shchelkanova E.S., Zhurbin E.A., Markin I.V., Bitik O.V. Vibraimage technology application in the fields of medical and psychophysiological maintenance of military personnel. *Sovremennaya psikhofiziologiya. Tekhnologiya vibroizobrazheniya*, 2021, no. 1 (4), pp. 127–133. DOI: 10.25696/ELSYS.VC4.RU.11 (in Russian).

17. Shchelkanova E.S. Rapid noncontact diagnostics of psychophysiological state in workers of hazardous industries. *Mediko-biologicheskie i sotsial'no-psikhologicheskie problemy bezopasnosti v chrezvychainykh situatsiyakh*, 2019, no. 2, pp. 111–120. DOI: 10.25016/2541-7487-2019-0-2-111-120 (in Russian).

18. Minkin V.A., Akimov V.A., Lobanova E.G., Martynov O.E., Shchelkanova E.S., Kondratev V.A., Pishchugin M.V., Sturchak I.S. [et al.]. Blitz judgment concept update and testing statistics. *Sovremennaya psikhofiziologiya. Tekhnologiya vibroizobrazheniya*, 2023, no. 1 (6), pp. 47–69. DOI: 10.25696/ELSYS.VC6.RU.04 (in Russian).

19. Miroshnik E.V., Bobrov A.F. Prenosological express analysis of the factors of the "neurotic tetrad of danger" and the resources of the motivational personality profile in assessing the level of mental health of specialists in helping professions. *Sovremennaya psikhofiziologiya. Tekhnologiya vibroizobrazheniya [Modern Psychophysiology. The Vibraimage Technology]: The 6th International Open Science Conference*, St. Petersburg, 2023, pp. 209–216. DOI: 10.25696/Elsys_MPVT_06_ru19 (in Russian).

20. Baevskii R.M., Ivanov G.G., Gavrilushkin A.P., Dovgalevskii P.Ya., Kukushkin Yu.A., Mironova T.F., Prilutskii D.A., Semenov A.V. [et al.]. Analiz variabel'nosti serdechnogo ritma pri ispol'zovanii razlichnykh elektrokardiograficheskikh sistem (Chast' 1) [Analysis of heart rate variability using various electrocardiographic systems (part 1)]. *Vestnik aritmologii*, 2001, no. 24, pp. 65–86 (in Russian).

21. Novikov A.A., Smolensky A.V., Mikhailova A.V. Approaches to assessing heart rate variability (literature review). *Journal of new medical technologies, eEdition*, 2023, vol. 17, no. 3, pp. 85–94. DOI: 10.24412/2075-4094-2023-3-3-3 (in Russian).

22. Shabanov G.A., Rybchenko A.A., Lebedev Yu.A., Pripatinskaya E.A. Studying the relationship of human head microvibrations with rhythmic activity of the central nervous system induced by photostimulation. *Sovremennye problemy nauki i obrazovaniya*, 2020, no. 5, pp. 100. DOI: 10.17513/spno.30145 (in Russian).

23. Fegan J., Doherty A.M. Adjustment disorder and suicidal behaviors presenting in the general medical setting: a systematic review. *Int. J. Environ. Res. Public Health*, 2019, vol. 16, no. 16, pp. 2967. DOI: 10.3390/ijerph16162967

24. Gardner H. Frames of mind. The theory of multiple intelligence. In: translation from English. Moscow, «I.D. Vil'yams» Publ., 2007, 512 p. (in Russian).