ORIGINAL ARTICLE

CONTENTS

Peculiarities of psycho-emotional and neurovegetative state in Ukrainian women who have experienced war-related stress and ways of its non-medicinal correction

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ABSTRACT

Aim: To investigate the peculiarities of psycho-emotional and neurovegetative disorders in women exposed to war-related stress and to assess the possibilities of their correction by cognitive behavioural therapy (CBT) and Transcendental Meditation (TM).

Materials and Methods: The study involved 72 women, 35 of whom had experienced high-intensity stress and 37 of whom were in the control group. The psychoemotional state was assessed by the DASS-21 test and a screening test for post-traumatic stress disorder. The neurovegetative state was assessed by mathematical analysis of heart rate variability (HRV). The main group was divided into subgroups that received correction using CBT or TM.

Results: In the main group exposed to the stressors of war, a higher level of anxiety, depression, PTSD score, and neurovegetative imbalance (decreased total adaptation reserve [SDNN], decreased parasympathetic regulation activity [RMSSD], increased vegetative balance index [LF/HF], indicating a shift towards sympathicotonia) was found. After the correction, both subgroups (CBT and TM) showed a decrease in anxiety, depression and stress. TM showed a more pronounced corrective effect on neurovegetative regulation and some indicators of psycho-emotional state (anxiety) compared to CBT.

Conclusions: A war significantly affects the psycho-emotional and neurovegetative state of women. Both of the applied non-medicated methods (CBT and TM) showed a significant corrective effect. The results of the study confirm the positive effects of TM and indicate the feasibility of its use for psychological support of persons exposed to the stress factors of war.

KEY WORDS: women, post-traumatic stress disorder, autonomic dysfunction

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INTRODUCTION

The war in Ukraine, which was started by Russia in 2014 and escalated into a full-scale war in 2022, has had a significant impact on the lives and health of civilians, including women. The hostilities and the consequences of the socio-humanitarian crisis are causing numerous physical, psychological and social problems among women living in the conflict zone or who have been forced to flee their homes. Studies show that the effects of war include a significant increase in stress, anxiety, depression and post-traumatic stress disorder (PTSD) among women [1-3].

From February to May 2024, the State Institution of Science «Center of innovative healthcare technologies» State Administrative Department (Kyiv, Ukraine), in partnership with the Ukrainian public organisation Impact Force, UN Women and information support from the Ministry of Digital Transformation of Ukraine and «Diia. Education», the ReSTART Mindset educational and health programme was developed and implemented for women veterans and women family members of veterans. The programme included an assessment of women's health by conducting a survey and examining ECG readings with mathematical analysis of heart rate variability (HRV) [4-8]. To correct the condition, both the well-known and recommended by international protocols method of cognitive behavioural therapy (CBT) [9-12], and the method that has shown its effectiveness in PTSD and other stress disorders, but requires further research, – Transcendental Meditation (TM) [13-15], – were used.

AIM

The aim of the study was to investigate the peculiarities of psycho-emotional and neurovegetative disorders in women exposed to war-related stress and to assess the potential for their correction through psychotherapy and meditation.

MATERIALS AND METHODS

The main group consisted of 35 women who had experienced high-intensity severe war-related stress, with an average age of (mean [M] ± standard error of the mean [m]) 40,7 ± 1,4 years. The main group included women in a state of stress-associated uncertainty, such as internally displaced women who fled their homes because of the hostilities and wives of military personnel who are experiencing a difficult emotional state due to anxiety about their loved ones; women veterans who have returned to civilian life after service or people who are adapting to society after military service; women who worked in difficult conditions, including those who were under occupation, in the shelling zone or near the contact line, as well as those who participated in the evacuation of civilians, demining, etc. The control group consisted of 37 women, whose average age was 40,1 ± 1,7 years, who did not participate in hostilities, were not under occupation, did not have deceased military relatives, i.e. did not experience the effects of extremely intense stress factors associated with the war.

Standardised questionnaires were used to study the psycho-emotional state: DASS-21 (anxiety, depression, stress) [16] and the PTSD screening test recommended by the Ministry of Health of Ukraine [17]. The neurovegetative state was assessed using the functional parameters of the Autonomous Nervous System (ANS). To assess the functional state of the ANS, the method of mathematical analysis of HRV was used, which was carried out on the basis of an ECG recorded in a sitting position, at rest, for three minutes, using an ECG recorder DiaCard 06000.1 (Solvaig, Kyiv) and the "Harmony" software and hardware complex [5] with the "Oracle" computing core [6].

HRV was studied according to international clinical standards of 1996 [7, 8]. Additionally, the Roman Baevsky stress index (SI) was used [8, 18-21]. The following HRV parameters were evaluated: heart rate (HR), the standard deviation of normal-to-normal intervals (SDNN), the root mean square of successive differences (RMSSD), SI and the ratio of low-frequency to high-frequency power (LF/HF).

At the first stage of the study, the psychoemotional and neurovegetative state of women in the main and control groups was compared. The second stage of the study examined the effect of two types of corrective measures – CBT and TM – on women in the main group. For this purpose, in accordance with the type of correction used, the main group of women was divided into two groups, TM (15 women, average age 41,7 ± 2,1 years) and CBT (20 women, average age 40,1 ± 2,0 years).

Statistical analysis was performed using IBM SPSS Statistics 26 (USA). Quantitative data were presented as M ± m and median (Me) with interquartile range (first [Q1] and third [Q3] quartiles). The study used parametric and non-parametric methods of statistical evaluation: Student's T-test for independent (T unpaired) and paired (T paired) samples; non-parametric criteria: Wilcoxon test for paired samples (W), Mann-Whitney test for independent samples (U). Differences between group means and medians were considered significant at a significance level of $p < 0,05$; and at the trend level – at $0,05 < p < 0,1$.

ETHICS

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Scientific and Practical Centre for Preventive and Clinical Medicine of the State Administration of Affairs (Protocol No.1 dated January 15, 2024). Written informed consent was obtained from all participants, and their personal data were anonymized to ensure confidentiality.

RESULTS

Women in the ReSTART Mindset task force reported complaints related to high levels of stress, emotional exhaustion, and difficulties in adapting to war-affected living conditions. The most frequent psycho-emotional complaints included persistent feelings of anxiety, fear, and depression; emotional instability and irritability; reduced motivation; apathy; and a sense of helplessness. Women in the main group also reported difficulties with concentration and decision-making.

Common somatic complaints included pain syndromes in the cervical and lumbar spine, headaches, muscle tension, and sleep disturbances such as difficulty falling asleep, light or fragmented sleep, and frequent awakenings. In addition, women in the main group experienced vegetative symptoms, including palpitations, blood pressure fluctuations, a sensation of a lump in the throat, shortness of breath, gastrointestinal disturbances, excessive sweating, and dizziness.

Among the social complaints, feelings of isolation and being misunderstood by others were prominent, as were difficulties in forming or maintaining social contacts, and conflicts within the family or workplace caused by a worsened emotional state.

Complaints related to stress adaptation were also notable, including a perceived inability to cope with current circumstances, increased emotional vulnerability even to minor events, fear of the future, and feelings of uncertainty.

The women in the main group often experienced post-traumatic symptoms, such as flashbacks or re-

Table 1. Comparison of the primary group at baseline with the control group

Indicator	Groups	M ± m	Me	Q1	Q3	p
Sum of DASS-21 test, scores	control	27,46 ± 1,50	29	26	34	p (T) > 0,1 p (U) > 0,1
	main	29,71 ± 2,01	29	20	38	
Depression level, points	control	10,08 ± 0,61	11	8,5	12	p (T) > 0,1 p (U) > 0,1
	main	10,43 ± 0,88	10	6	13	
Anxiety level, points	control	5,65 ± 0,49	6	2,5	8,5	p (T) = 0,047 p (U) = 0,061
	main	7,37 ± 0,69	7	4	11	
Level of subjectively experienced stress, points	control	11,73 ± 0,69	13	10	14	p (T) > 0,1 p(U) > 0,1
	main	11,91 ± 0,73	13	8	15	
Level of PTSD severity, points	control	2,97 ± 0,15	3	2	4	p (T) = 0,001 p(U) = 0,001
	main	4,09 ± 0,29	4	3	5	
HR, bpm	control	76,16 ± 1,41	75,00	71,00	82,50	p (T) = 0,05 p(U) = 0,05
	main	80,49 ± 1,66	79,00	74,00	88,00	
SDNN, ms	control	42,81 ± 2,04	41,00	32,50	51,00	p (T) < 0,001 p(U) < 0,001
	main	32,20 ± 1,56	30,00	26,00	40,00	
RMSSD, ms	control	29,32 ± 1,58	29,00	20,50	38,00	p (T) < 0,001 p(U) < 0,001
	main	20,89 ± 1,59	19,00	15,00	28,00	
SI, units	control	194 ± 18	174	115	242	p (T) = 0,001 p(U) < 0,001
	main	342 ± 36	272	212	435	
Vegetative balance (LF/HF)	control	1,97 ± 0,30	1,56	0,79	2,07	p (T) = 0,033 p(U) = 0,022
	main	3,12 ± 0,44	2,46	1,11	4,12	

Note: p(T) – the significance of the difference in mean values (paired t-test); p(U) – the significance of the difference in medians (Mann-Whitney U test)

peated memories of traumatic events, nightmares, hyper-arousal, difficulty relaxing and a sense of constant alertness.

At the first stage of the study, the main group was compared with the control group at baseline. The following was found (Table 1). In the main group, compared to the control group, there was an increased level of anxiety, a higher degree of PTSD severity, a higher level of cardiovascular functioning (as indicated by HR), a lower overall adaptive potential of neurohumoral regulation (as indicated by SDNN), lower activity of parasympathetic modulation (by the RMSSD index), a higher level of tension of regulatory systems (by SI), and a more pronounced shift of autonomic balance towards sympathicotonia (by LF/HF index).

At the second stage of the study, changes in the psychoemotional state and HRV in the dynamics were investigated in each of the groups (CBT and TM), and the reliability of changes in their mean group values (by Student's T-test for paired samples) and medians (by the nonparametric Wilcoxon signed rank test) was assessed.

The following was found when analysing the indicators of psycho-emotional state assessment (Table 2). After correction, in both groups, CBT and TM, there was a significant decrease in the total score on the DASS-21 test (in the TM group p = 0,001; in the CBT group p = 0,004). At the same time, in the TM group, the median of this score decreased significantly (p = 0,003) from 24 to 11 points, and in the CBT group, it decreased significantly (p = 0,006) from 34 to 14 points.

The median score of depression in the CBT group corresponded to severe depression, according to the DASS-21 test. And in the TM group, the median depression score corresponded to moderate depression. After correction, in both groups, CBT and TM, there was a significant decrease in both the mean group scores of depression (p = 0,001 and p = 0,006, respectively) and median scores (p = 0,002 and p = 0,004, respectively). In the TM group, the median depression score decreased from 9 to 3, which is normal. And in the CBT group - from 12 to 5, which also corresponds to the norm.

The median anxiety score in the TM group (7 points) corresponded to «moderate anxiety», and in the CBT group (9 points) – to «severe anxiety». After correction, a significant decrease in the mean group anxiety level was observed in the TM group (p = 0,002), and in the CBT group – its decrease at the level of the trend (p = 0,076). The median anxiety score in the TM group significantly (p = 0,004) decreased from 7 to 2, which corresponds to the norm, and in the CBT group it had a strong downward trend (p = 0,066), from 9 to 6 points, which corresponds to «mild anxiety».

Table 2. Indicators of psycho-emotional state in the dynamics after correction

Indicator	Group	State	M ± m	Me	Q1	Q3	p
Sum of points DASS-21	CBT	initial	32,7 ± 2,6	34,0	20,8	39,8	$p_{(T)} < 0,01$ $p_{(W)} < 0,01$
		after correction	19,6 ± 3,4	14,0	9,0	32,5	
	TM	initial	25,8 ± 2,9	24,0	15,0	31,0	$p_{(T)} < 0,01$ $p_{(W)} < 0,01$
		after correction	11,3 ± 2,5	11,0	4,0	16,0	
Depression, points	CBT	initial	11,9 ± 1,1	12,0	6,8	15,5	$p_{(T)} < 0,01$ $p_{(W)} < 0,01$
		after correction	6,8 ± 1,3	5,0	2,0	11,5	
	TM	initial	8,5 ± 1,3	9,0	5,0	12,0	$p_{(T)} < 0,01$ $p_{(W)} < 0,01$
		after correction	3,6 ± 0,8	3,0	1,0	5,0	
Anxiety, points	CBT	initial	8,1 ± 1,0	9,0	4,0	12,5	$0,05< p_{(T)}<0,1$ $0,05< p_{(W)}<0,1$
		after correction	6,0 ± 1,2	6,0	2,0	8,5	
	TM	initial	6,4 ± 0,8	7,0	3,0	9,0	$p_{(T)} < 0,01$ $p_{(W)} < 0,01$
		after correction	2,5 ± 0,9	2,0	0,0	2,0	
Stress, points	CBT	initial	12,7 ± 0,9	13,0	10,0	15,8	$p_{(T)} < 0,01$ $p_{(W)} < 0,01$
		after correction	6,8 ± 1,1	5,5	3,0	10,5	
	TM	initial	10,9 ± 1,1	12,0	7,0	14,0	$p_{(T)} < 0,01$ $p_{(W)} < 0,01$
		after correction	5,1 ± 1,0	5,0	1,0	8,0	
PTSD, points	CBT	initial	4,5 ± 0,4	4,5	3,0	6,0	$p_{(T)} < 0,01$ $p_{(W)} < 0,01$
		after correction	2,7 ± 0,5	2,0	1,0	5,0	
	TM	initial	3,5 ± 0,3	3,0	3,0	4,0	$p_{(T)} < 0,001$ $p_{(W)} < 0,01$
		after correction	1,3 ± 0,5	1,0	0,0	2,0	

Note: p(T) – the significance of the difference in mean values when using Student's T-test for paired samples; p(W) – the significance of the difference in medians when using the Wilcoxon signed rank test

The median stress scores in the TM group (12 points) and the CBT group (13 points) corresponded to «moderate stress», according to the DASS-21 test. After correction, in both groups, CBT and TM, there was a significant decrease in the mean group values of stress (p = 0,001 for both groups) and medians (p = 0,003 in the TM group; p = 0,004 in the CBT group). In the TM group, the median stress score decreased from 12 to 5 points, and in the CBT group – from 13 to 5,5 points, which corresponds to the norm.

The median value of the PTSD score at baseline in the TM group (3 points) corresponds to the norm, i.e., the absence of PTSD. In the CBT group, the median PTSD score at baseline, before correction, was 4,5 points, which corresponds to the probable presence of PTSD. After correction, in both groups, CBT and TM, there was a significant decrease in the mean group values of PTSD severity (p <0,001 and p = 0,006, respectively). In the TM group, the median PTSD score significantly (p = 0,003) decreased from 3 to 1 point, and in the CBT group, it significantly (p = 0,010) decreased from 4,5 to 2 points, which corresponds to the norm (absence of PTSD).

The analysis of HRV indicators revealed the following (Table 3). The HR in the TM group after the course of correction tended to decrease, according to the average group value (p = 0,088). In the CBT group, there was no significant change in HR after the course of correction.

After the course of correction, the mean group value of SDNN in the TM group increased significantly (p = 0,011); the median also increased significantly (p = 0,021), by 11 ms. While in the CBT group, after correction, an increase in the average group SDNN value was noted at the level of the trend (p = 0,08); the median significantly (p = 0,046) increased by 2,5 ms.

After the course of correction, the average group indices of RMSSD, SI, LF/HF autonomic balance and their medians in the CBT and TM groups did not change significantly.

DISCUSSION

According to the World Health Organization, nearly 10 million Ukrainians may suffer from mental health disorders such as depression or anxiety, of which nearly 4 million may have moderate or severe cases [3]. Women who are homeless, sanguine, with mild depression and mild/medium anxiety are more likely to develop PTSD [1].

Describing the peculiarities of the psychoemotional and neurovegetative state of Ukrainian women, it is worth noting that the control group of women, according to the average group values, was characterised by severe depression and a moderately pronounced level of stress, which is subjectively experienced by the individual. This may be due to the fact that

Table 3. HRV indicators in the dynamics after correction

Indicator	Group	State	M ± m	Me	Q1	Q3	p
HR, bpm	CBT	initial	82,15 ± 2,40	81,50	75,50	88,75	$p_{(T)} > 0,1$ $p_{(W)} > 0,1$
		after correction	80,65 ± 2,19	79,00	74,00	81,75	
	TM	initial	78,27 ± 2,15	77,00	72,00	86,00	$0,05< p_{(T)}<0,1$ $0,05< p_{(W)}<0,1$
		after correction	74,67 ± 1,49	74,00	70,00	77,00	
SDNN, ms	CBT	initial	31,95 ± 2,15	30,50	26,00	39,50	$0,05< p_{(T)}<0,1$ $p_{(W)} < 0,05$
		after correction	36,90 ± 2,67	33,00	28,25	47,00	
	TM	initial	32,53 ± 2,32	30,00	26,00	40,00	$p_{(T)} < 0,05$ $p_{(W)} < 0,05$
		after correction	41,13 ± 4,22	41,00	34,00	51,00	
RMSSD, ms	CBT	initial	20,45 ± 2,06	18,00	15,25	26,50	$p_{(T)} > 0,1$ $p_{(W)} > 0,1$
		after correction	22,70 ± 2,61	19,50	16,25	30,50	
	TM	initial	21,47 ± 2,56	20,00	14,00	29,00	$p_{(T)} > 0,1$ $p_{(W)} > 0,1$
		after correction	24,73 ± 2,98	26,00	16,00	29,00	
SI, units	CBT	initial	382 ± 55	375	226	457	$p_{(T)} > 0,1$ $p_{(W)} > 0,1$
		after correction	283 ± 40	218	144	353	
	TM	initial	287 ± 39	261	205	408	$p_{(T)} > 0,1$ $p_{(W)} > 0,1$
		after correction	289 ± 83	158	122	275	
Vegetative balance (LF/HF)	CBT	initial	3,38 ± 0,64	2,77	1,05	5,36	$p_{(T)} > 0,1$ $p_{(W)} > 0,1$
		after correction	3,35 ± 0,70	2,07	1,18	3,95	
	TM	initial	2,77 ± 0,59	2,46	1,42	3,19	$p_{(T)} > 0,1$ $p_{(W)} > 0,1$
		after correction	3,41 ± 0,62	2,46	1,44	6,17	

Note: p (T) – the significance of difference in mean values using Student's T-test for paired samples; p (W) – the significance of difference in medians when using the Wilcoxon signed rank test

they experience less intense, chronic stress, a constant sense of danger to themselves and their families when living in a country at war. These results provide grounds for the expediency of taking corrective measures and implementing corrective actions for this category of the Ukrainian population as well.

Assessing the differences between the main group of women exposed to severe high-intensity war-related stress and women in the control group, the following features can be noted: higher indicators of anxiety level, severity of PTSD, energy level of cardiovascular system functioning; lower indicators of the general adaptive reserve of neurohumoral regulation (according to the SDNN index), lower activity of parasympathetic modulation (according to the RMSSD index), higher level of tension of regulatory systems (according to SI), a more pronounced shift in the autonomic balance towards sympathicotonia (by the LF/HF autonomic balance index).

Given the experience of the American researchers [22], it would be ideal to investigate the initial state of autonomous nervous regulation of civilian and military Ukrainian women before the start of the war, to take into account the influence of the initial functional state of autonomic regulation on the likelihood of developing PTSD after exposure to a stressful factor.

The main effects of the correction were as follows: in both groups, TM and CBT, the overall adaptive potential of neurohumoral regulation increased; in both groups, the integral indicator of psycho-emotional state assessment improved (the total score of the DASS-21 test decreased), the level of depression decreased, the severity of subjective stress decreased (according to the «stress» indicator of the DASS-21 test), and the severity of PTSD decreased; the level of anxiety in the TM group decreased significantly, and in the CBT group decreased at the level of a trend. At the same time, after the course of correction in both groups, CBT and TM, there were no significant shifts in the activity of parasympathetic modulation (RMSSD), the level of tension of regulatory systems (SI), and no significant changes in the LF/HF autonomic balance.

Thus, the results of this study give grounds to recommend the methods of correction (CBT and TM) used by us for the implementation of psychological support programmes aimed at reducing psychoemotional stress and normalising ANS among the population affected by war.

PERSPECTIVES FOR FUTURE WORKS

Further research could be aimed at expanding the sample to increase the reliability of the results, analysing gender differences in the effects of meditation and CBT, and studying the long-term effects of these methods on psychoemotional and neurovegetative state. Of particular relevance is the study of the mechanisms of action of meditation using

neuroimaging and the comparison of its effectiveness with other therapeutic approaches. Of particular interest is the development of adapted support programmes, their economic feasibility and assessment of cultural acceptability for Ukrainian society. Research among military personnel in the combat zone and evaluation of changes in the quality of life of participants are commercial aspects for further study and implementation of the methods.

CONCLUSIONS

1. Our study showed that Ukrainian women have abnormalities in both indicators of psychoemotional state and neurovegetative regulation. These abnormalities were more pronounced in the group of women who had experienced stressful events of high significance, which caused them to have a pronounced subjective feeling of nervous and emotional stress and a generally mobilising sympathicotonic autonomic response, which led to the depletion of adaptive reserves.
2. The correctional measures, CBT and Transcendental Meditation, had a generally positive effect, which consisted of an increase in the overall adaptive potential of autonomic regulation and improvement of the psycho-emotional state.
3. A comparative evaluation of the effects of CBT and TM showed that TM has a more pronounced corrective effect on the functional state of the autonomic nervous system (increases the overall adaptive potential of neurohumoral regulation), improves the psychoemotional state, with a particularly good reduction in anxiety, and more effectively reduces the manifestations of PTSD. Based on our data, we can recommend a combination of CBT and TM techniques, with the expectation of potentiating their corrective and therapeutic effects.
4. Further, larger-scale research is needed to reveal the mechanisms of influence of the correctional tools (CBT and TM) used in our study.

REFERENCES

1. Oros MM. Vplyv viyny na lyudynu. Zminy psykhiky ta kharakteru v umovakh voyennoho stanu [The impact of war on a person. Psyche and character changes in martial law]. Ukrayins'kyy medychnyy zhurnal. 2023;2(154)III-IV:3-7. doi: 10.32471/umj.1680-3051.154.241952. (Ukrainian) DOI
2. Golovakha Ye, Makeiev S et al. Ukrayinske suspilstvo v umovakh viyny. 2022: Kolektyvna monohrafiya [Ukrainian society in wartime. 2022: Collective monograph]. Kyiv: Institute of Sociology of the National Academy of Sciences of Ukraine. 2022. https://i-soc.com.ua/assets/files/monitoring/maket-vijna...2022dlya-tipografiivse.pdf [Accessed 19 February 2025] (Ukrainian)
3. Gottbrath LW. The silent toll of war: Ukraine's growing mental health crisis. Axios. https://www.axios.com/2023/02/24/ukraine-war-mental-health-russia-invasion-children [Accessed 24 February 2025]
4. Matsyshyn VS, Kravchenko AM, Chaikovsky IA et al. Heart rate variability as an objective criterion for the psycho-emotional state of combatants. Wiad Lek. 2023;76(10):2212-2218. doi: 10.36740/WLek202310113. DOI
5. Sharypanov AV, Vyshnevskyy VV, Kalmykov VG, Kizub LA. Svidotstvo pro reyestratsiyu avtorskoho prava No. 98944. Komp'yuterna prohrama «Avtomatyzovana tekhnolohiya upravlinnya dykhannyam «Harmony» [Certificate of copyright registration No. 98944. Computer program «Automated breathing control technology «Harmony»]. https://sis.nipo.gov.ua/uk/search/detail/1758287/ [Accessed 11 February 2025] (Ukrainian)
6. Chaikovskyy IA, Frolov YuO, Vasylyev VE, Dordiyenko MO. Svidotstvo pro reyestratsiyu avtorskoho prava No. 47857. Komp'yuterna prohrama «Reyestratsiya ta analiz malokanal'nykh EKG syhnaliv» [Certificate of copyright registration No. 47857. Computer program «Registration and analysis of low-channel ECG signals»]. https://sis.nipo.gov.ua/uk/search/detail/1527245/ [Accessed 11 February 2025] (Ukrainian)
7. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability: standards of measurement, physiological interpretation, and clinical use. Circulation. 1996;93(5):1043–1065. doi: 10.1161/01.CIR.93.5.1043. DOI
8. Yabluchanskiy NI, Martynenko AV, Isayeva AS. Osnovy prakticheskogo primeneniya neinvazivnoy tekhnologii issledovaniya regulyatornykh sistem cheloveka [Fundamentals of practical application of non-invasive technology for studying human regulatory systems]. Kharkiv: Osnova; 2000. (Russian)
9. Bandelow B, Allgulander C, Baldwin DS et al. World Federation of Societies of Biological Psychiatry (WFSBP) guidelines for treatment of anxiety, obsessive-compulsive and posttraumatic stress disorders – Version 3. Part II: OCD and PTSD. World J Biol Psychiatry. 2023;24(2):118–134. doi: 10.1080/15622975.2022.2086296. DOI
10. Karatzias T, Murphy P, Cloitre M et al. Psychological interventions for ICD-11 complex PTSD symptoms: systematic review and meta-analysis. Psychol Med. 2019;49(11):1761-1775. doi: 10.1017/S0033291719000436. DOI
11. Hoppen TH, Morina N. Psychological treatments for post-traumatic stress disorder in adults: a network meta-analysis. Psychol Med. 2021;51(8):1260–1270. doi: 10.1017/S0033291720000070. DOI
12. Lewis C, Roberts NP, Andrew M et al. Psychological therapies for post-traumatic stress disorder in adults: systematic review and meta-analysis. Eur J Psychotraumatol. 2020;11(1):1729633. doi: 10.1080/20008198.2020.1729633. DOI

13. Nidich SI, Mills PJ, Rainforth M et al. Non-trauma-focused meditation versus exposure therapy in veterans with post-traumatic stress disorder: a randomized controlled trial. Lancet Psychiatry. 2018;5(12):975–986. doi: 10.1016/S2215-0366(18)30384-5. DOI
14. Bellehsen M, Stoycheva V, Cohen BH, Nidich S. A pilot randomized controlled trial of Transcendental Meditation as treatment for posttraumatic stress disorder in veterans. J Trauma Stress. 2022;35(1):22–31. doi: 10.1002/jts.22665. DOI
15. VA/DOD Clinical Practice Guidelines. Management of Posttraumatic Stress Disorder and Acute Stress Disorder 2023. https://www.healthquality.va.gov/guidelines/mh/ptsd/ [Accessed 11 February 2025]
16. Lovibond SH, Lovibond PF. Manual for the Depression Anxiety Stress Scales. 2nd Ed. Sydney: Psychology Foundation. 1995.
17. Nakaz Ministerstva okhorony zdorov'ya Ukrayiny 23.02.2016 121. Unifikovanyi klinichnyi protokol pervynnoi, vtorynnoi (spetsializovanoi) ta tretynnoi (vysokospetsializovanoi) medychnoyi dopomohy "Reaktsiya na vazhkyi stres ta rozlady adaptatsiyi. Posttravmatychnyi stresovyi rozlad". [Order of the Ministry of Health of Ukraine No. 121 dated February 23, 2016. Unified Clinical Protocol for Primary, Secondary (Specialized), and Tertiary (Highly Specialized) Medical Care "Response to Severe Stress and Adjustment Disorders. Post-Traumatic Stress Disorder."]. https://www.dec.gov.ua/wp-content/uploads/2019/11/2016_121_ykpmd_ptsr.pdf [Accessed 10 March 2024] (Ukrainian)
18. Baevsky RM, Bennett BS, Bungo MW et al. Adaptive responses of the cardiovascular system to prolonged spaceflight conditions: assessment with Holter monitoring. J Cardiovasc Diagn Proced. 1997;14(2):53-57.
19. Quendler E, Trieb K, Nimmerichter A. Validation of automated detection of physical and mental stress during work in a Hühnermobil 225. Ann Agric Environ Med. 2017;24(2):329–331. doi: 10.5604/12321966.1235183. DOI
20. Huizinga JD, Chen JH, Hussain A et al. Determining autonomic sympathetic tone and reactivity using Baevsky's stress index. Am J Physiol Regul Integr Comp Physiol. 2025;328(5):R562–577. doi: 10.1152/ajpregu.00243.2024. DOI
21. Khan MSI, Prasad R, Rabeh N et al. Baevsky's Stress Index as a Sensitive Indicator for Biofeedback Efficacy in Medical Students: a Pilot Study. Annu Int Conf IEEE Eng Med Biol Soc. 2024;2024:1–4. doi: 10.1109/EMBC53108.2024.10782708. DOI
22. Minassian A, Maihofer AX, Baker DG et al. Association of predeployment heart rate variability with risk of postdeployment posttraumatic stress disorder in active-duty Marines. JAMA Psychiatry. 2015;72(10):979–986. doi: 10.1001/jamapsychiatry.2015.0922. DOI

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CONFLICT OF INTEREST
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