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SPECIAL EFFECTS OF CERTAIN TYPES OF WEAPONS ON MILITARY PERSONNEL IN COMBAT ZONES

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Based on the complex of sensations resulting from combat stress factors associated with the use of different types of weapons, three age groups were identified among the military personnel (Group 1: ≈30 years; Groups 2 and 3: ≈41 years). The study demonstrated that age has a significant effect on the nature of sensations caused by combat stress factors: younger respondents exhibited higher sensitivity to most of these factors. The most stress-inducing factors were identified as shelling involving unmanned aerial vehicles, guided aerial bombs, and attacks from tanks and artillery. Military personnel of older age groups tended to exhibit lower levels of sensitivity, which may be explained by accumulated combat experience, habituation to danger, or a decrease in the body's functional reserves. The findings also highlight the physiological and psychological effects associated with exposure to specific types of weapons.

Key words: combat stress, physical factors, age-related characteristics, military personnel, types of weapons, sensitivity, impact.

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ОСОБЛИВОСТІ ВПЛИВУ ОКРЕМИХ ВИДІВ ЗБРОЇ НА ВІЙСЬКОВОСЛУЖБОВЦІВ, ЯКІ ПЕРЕБУВАЛИ В ЗОНІ БОЙОВИХ ДІЙ

За комплексом відчуттів від дії факторів бойового стресу, сформованих при застосуванні зброї різного типу, серед військовослужбовців виділено 3 вікові групи (група 1: ≈30 років; групи 2 і 3: ≈41 рік). Показано, що вік достовірно впливає на характер відчуттів від дії факторів бойового стресу: молодші респонденти демонструють вищу чутливість до більшості факторів. Найбільш стресогенними факторами виявилися: обстріли за допомогою безпілотних авіаційних комплексів, керовані авіаційні бомби, обстріли з танків та артилерії. Військовослужбовці старших вікових груп частіше виявляли нижчі рівні чутливості, що може бути зумовлено набутим досвідом, звичкою до небезпеки або зниженням функціональних резервів організму. Перелічені фізіологічні та психічні наслідки дії окремих видів зброї.

Ключові слова: бойовий стрес, фізичні фактори, вікові особливості, військовослужбовці, види зброї, чутливість, вплив.

The study is a fragment of the research project "Peculiarities of the impact of stress-associated diseases on the psychophysiological state of the body of servicemen of the Armed Forces of Ukraine and a comprehensive assessment of the effectiveness of providing rehabilitation assistance", state registration No. 0124U000652.

Modern armed conflicts are characterized by excessive physical and psycho-emotional strain [5], among which the combat-related factors associated with the use of advanced warfare technologies are of particular significance. Exposure to these factors may lead to functional impairments in military personnel, manifested through sleep disturbances, decreased work capacity, irritability, symptoms of fatigue, and altered perception of external stimuli [1]. The rapid advancement of modern warfare technologies has resulted in a certain lag in the analysis of combat-related factors and their specific effects. Consequently, there is a significant lack of studies presenting data on the influence of various factors of contemporary combat operations. Extremely high levels of physical and psycho-emotional strain [6], as well as conditions such as hypoxia and heat exposure, contribute to the development of overfatigue and chronic fatigue [4]. Several authors have focused their research on issues of psychological rehabilitation related to combat stress, aggravated by noise, vibration, sleep deprivation, and overall physical exhaustion [9]. The effects of physical factors as triggers of adverse physiological changes in military personnel leading to the development of post-traumatic stress disorder (PTSD) have been examined by a number of foreign researchers [3]. Xue C. and colleagues identified the role of chronic physical stress in increasing the risk of PTSD among active-duty service members and veterans [10].

Given the limited amount of scientific research in this field and the emergence of new types of weaponry, there is a growing need to investigate their effects on the human body. Therefore, examining the specific perceptions and impacts of different types of weapons among military personnel who have served in combat zones is of high relevance both theoretically and practically. Moreover, this line of research has interdisciplinary significance for military medicine, mental health, and the study of professional environmental conditions.

The purpose of the study was to identify age-related differences in the effects of certain types of weapons on military personnel who had served in combat zones.

Materials and methods. The study was conducted at the Military Medical Clinical Centre of the Central Region (MMCC CR) and involved 136 male military personnel aged 21 to 50 years who were undergoing inpatient treatment. The research was conducted in 2024–2025. The inclusion criteria were the gender and age of the servicemen.

Data were collected using a specially developed modified anonymous questionnaire consisting of seven questions aimed at assessing the influence of key combat environment factors. The specified methodology is an author's development that was previously tested on a sample of military personnel, representative in terms of age [2]. The anonymity of the survey ensured the acquisition of more objective and accurate data regarding the effects of certain types of weapons on the individual. Sensitivity to combat-related factors was self-assessed by the respondents on a 10-point scale. The scale was an unmarked line 10 cm long, where 1 indicated the lowest level of sensitivity and 10 indicated the highest.

It should be noted that the analysis of the obtained results revealed considerable heterogeneity, with both very high and relatively low ratings of the sensations reported. Therefore, cluster analysis was applied to achieve more homogeneous groupings of the data. Naturally, the simplest approach to data segmentation involves dividing the analyzed dataset into two groups. However, considering the wide age range and the sufficient number of military personnel examined, dividing the sample into three groups was deemed more appropriate. Moreover, the application of cluster analysis to the set of sensations associated with specific types of weapons revealed distinct impact profiles that were statistically differentiated from one another across several parameters.

The distribution of the examined military personnel across the obtained groups was as follows: Group 1 – 72 participants, Group 2 – 32 participants, and Group 3 – 32 participants. This classification showed that Group 1 was the most numerous (mean age 30.1±0.7 years). Groups 2 and 3 had the same number of participants, with mean ages of 41.3±1.5 and 40.3±1.3 years, respectively. These findings suggest that individuals of similar age may differ in how they perceive the effects of various types of weapons, and that such perceptions may become more differentiated with increasing age. This observation also indicates the predominant participation in combat operations of middle-aged personnel (30-40 years), who possess a certain level of life experience and remain sufficiently active to perform complex combat tasks.

It is well established [2] that age introduces significant differences in individuals' perception of harmful environmental factors. Therefore, a one-way analysis of variance (ANOVA) was conducted to assess the effect of age on the perception profiles of military personnel in response to the combined factors of the combat environment. These profiles were constructed for the identified groups (1, 2, and 3) after performing cluster analysis. The results revealed that the influence of the age factor was statistically significant ($p<0.001$). However, the perceptions of physical factors were similar among participants of Groups 2 and 3 ($p>0.05$).

Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (protocol No. 5 from 16.04.2025) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations, and laws of Ukraine.

Statistical data analysis was performed using methods of parametric statistics, one-way analysis of variance (ANOVA), and cluster analysis with the STATISTICA 13.3 software package (license AXA905I924220FAACDN).

Results of the study and their discussion. The working hypothesis assumed that the effects of certain types of modern weapons on the physiological state of military personnel are influenced by combat environment factors associated with age and functional reserves. The level of these reserves is determined by the degree of exposure to stress factors, the possibility of recovery during periods of leave, and the duration of continuous exposure to these factors.

Next, the impact of individual combat environment factors on military personnel who directly experienced their effects was analyzed (Fig. 1).

The obtained results demonstrate that the influence of the factor "shelling by unmanned aerial vehicles UAVs" (Fig. 1a) was statistically significant ($p<0.001$). However, this effect differed markedly among the groups of military personnel. For participants in Group 1, the mean impact score of this factor approached 8 points, indicating a very high level of influence. In contrast, for the older age groups (Groups 2 and 3), the impact was considerably lower, ranging from 2 to 3 points. These findings may suggest a

substantially higher sensitivity among younger military personnel, as well as a relative lack of combat experience that could help mitigate exposure to this threat. Another factor, "shelling by guided aerial bombs (GABs)," shows a somewhat different pattern of responses among the groups of military personnel (Fig. 1b). In this case, the influence of the "GAB shelling" factor was also statistically significant ($p<0.001$). A distinctive feature of this factor is the statistically significant variation in its effect across all identified groups. The highest impact was observed in Group 2, where the mean perception score reached 7 points. The next most sensitive was Group 1, with an average score approaching 5 points. The least sensitive were the participants in Group 3, whose perception score was below 3 points.

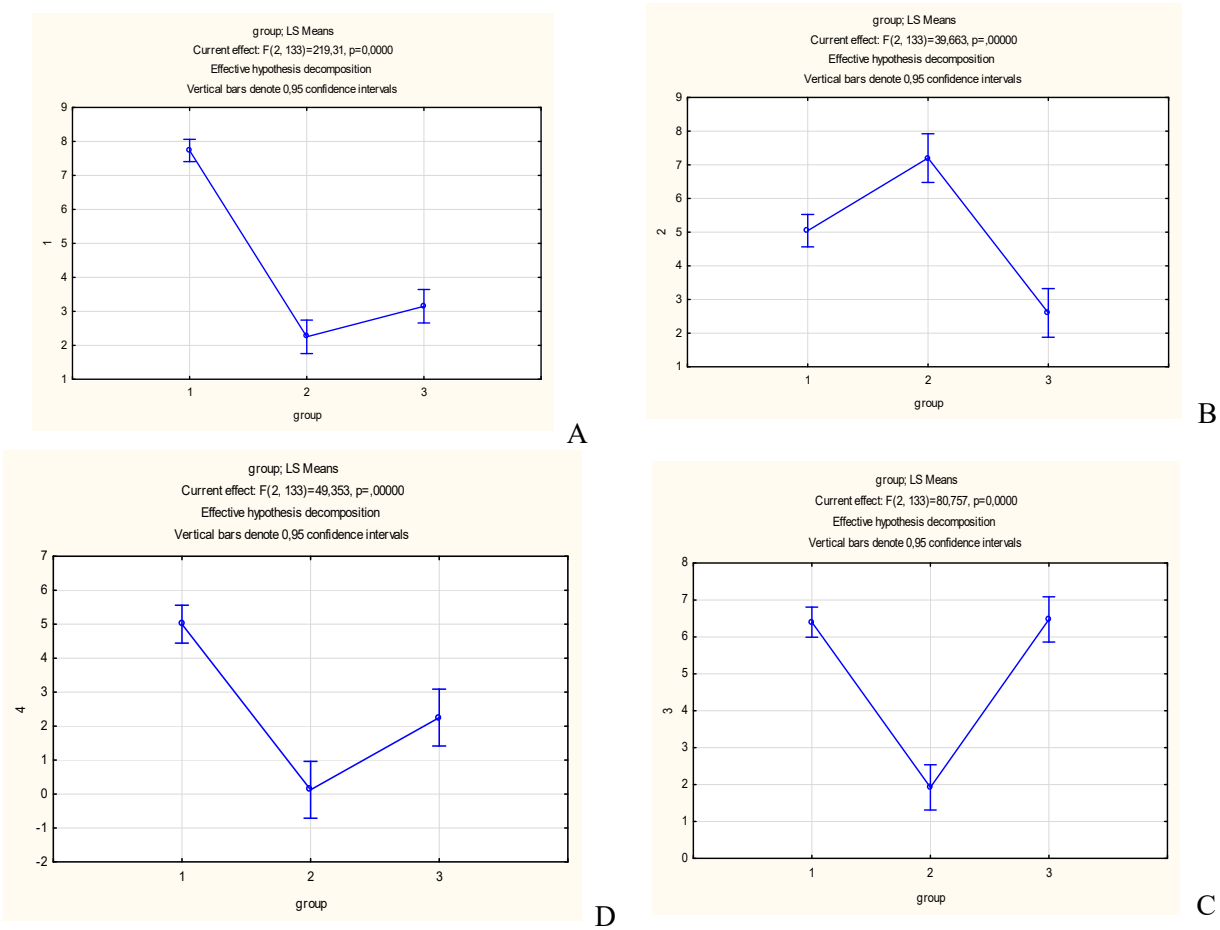
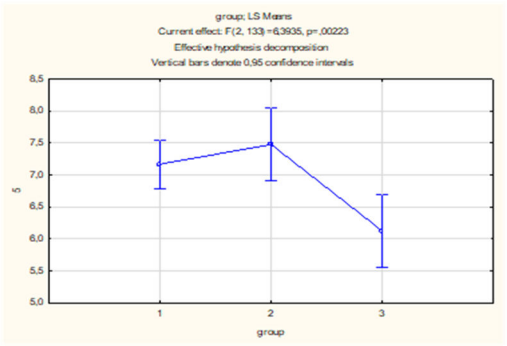


Fig. 1. Effects of factors associated with the use of different types of weapons on military personnel in Groups 1, 2, and 3. a – structure of the factor "shelling by unmanned aerial vehicles" (1); b – structure of the factor "shelling by guided aerial bombs" (2); c – structure of the factor "mortar fire" (3); d – structure of the factor "flamethrower fire" (4). Impact of factors expressed in conventional units.

The next factor reflects the sensations of military personnel in response to "mortar fire" (Fig. 1c). The influence of the "mortar fire" factor was also statistically significant ($p<0.001$). In this case, the distribution pattern of perceptions is unique. Notably, the perception scores among participants of Groups 1 and 3 were high and did not differ significantly, ranging between 6 and 7 points. This phenomenon may indicate that age and experience have only a minor effect on the perception of this factor. However, the significantly lower impact scores observed in Group 2, whose participants are nearly the same age as those in Group 3, require additional explanation.

The factor "flamethrower fire" (Fig. 1d) occurs less frequently in combat zones compared with other types of weapon attacks; however, its impact demonstrates distinct characteristics. The influence of the "flamethrower fire" factor was also found to be statistically significant ($p<0.001$). Analysis of the distribution pattern of sensations suggests that flamethrower attacks have the strongest psychological effect on participants in the younger Group 1, although even in this group the mean impact score does not exceed 5 points. The lowest impact values were reported by participants in Group 2 (slightly above 0 points), whereas Group 3 demonstrated intermediate sensitivity, with scores slightly above 2 points. The relatively low level of fear associated with this powerful factor is likely explained by the infrequent use of this type of weapon in combat operations.

Another set of combat environment factors is presented in Fig. 2.



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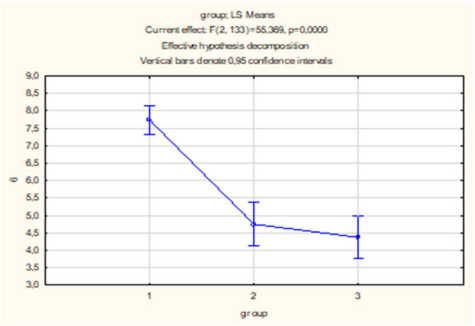

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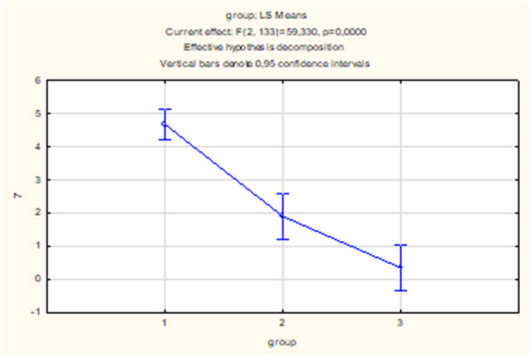

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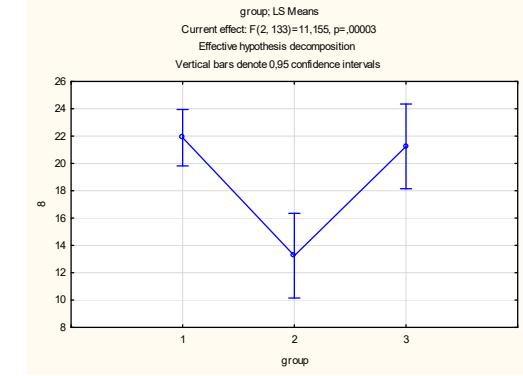
Fig. 2. Effects of factors associated with the use of different types of weapons on military personnel in Groups 1, 2, and 3. a – structure of the factor "tank fire" (5); b – structure of the factor "artillery fire" (6); c – structure of the factor "sniper activity" (7). Impact of factors expressed in conventional units.

The sensations associated with tank fire (Fig. 2a) were rated above 6 points across all three analyzed groups. The relatively small variation in perception levels slightly reduces the statistical significance of this factor compared with the previous ones ($p<0.01$).

Another detrimental factor is associated with artillery fire, which also exhibits specific characteristics illustrated in Figure 2b. The effect of this factor was found to be highly significant ($p<0.001$). A notable feature of its perception is the high sensitivity observed among participants in Group 1, with mean scores exceeding 7.5 points. In contrast, the sensitivity of participants in Groups 2 and 3 was nearly identical, significantly lower, and ranged between 4 and 5 points. These findings suggest that age has a considerable influence on the perception of this factor, which is likely related to the greater combat experience accumulated by members of the older groups during prolonged service in the combat zone.



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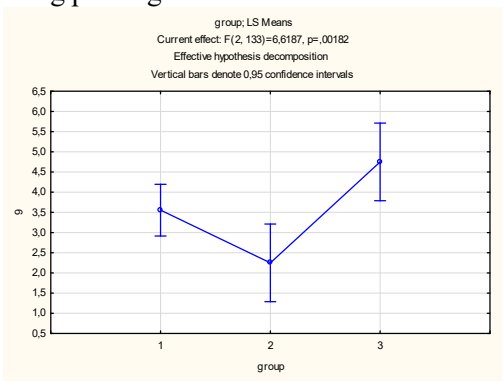

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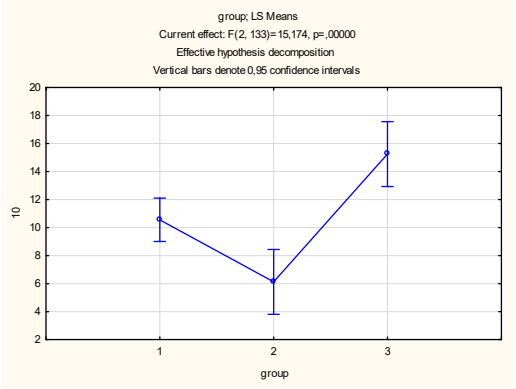

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Fig. 3. Characteristics of the influence of temporal indicators on military personnel. a – structure of the indicator "total duration of stay in the combat zone" (8); b – structure of the indicator "duration of stay in the combat zone after returning from leave" (9); c – structure of the indicator "duration of stay in the combat zone during direct contact with the enemy" (10). Temporal indicators are expressed in months.

A distinctive feature of the "sniper activity" factor (Fig. 2c) is that its detrimental effects can often be avoided through caution and tactical awareness under combat conditions. The highest sensitivity to this factor was observed in Group 1 (nearly 5 points), whereas Group 3 demonstrated the lowest sensitivity (slightly above 0 points). Group 2 showed intermediate sensitivity, with an average score of about 2 points. Thus, combat experience appears to play a decisive role in mitigating the psychological impact of this factor. This observation is further supported by the results of the one-way analysis of variance, which confirmed the statistical significance of this factor ($p<0.001$).

Considering the above, it is appropriate to discuss certain aspects of military service among the personnel whose data were included in this study. The characteristics of temporal indicators related to the

duration of stay in the combat zone – taking into account the time elapsed since returning from leave and the conditions of direct contact with the enemy – are presented in Fig. 3.

When analyzing the indicator "total duration of stay in the combat zone" (Fig. 3a), it should be noted that this variable has a statistically significant effect on the distribution of the studied contingent into groups ($p<0.001$). A distinctive feature of the analyzed distribution is the considerably lower exposure to combat stress observed among the servicemen of Group 2 (approximately 14 months). In contrast, participants in Groups 1 and 3 remained in the combat zone for 20-22 months. Consequently, the shorter combat experience of Group 2 personnel is reflected in their higher sensitivity to certain harmful factors, as a shorter period of stay under high-risk conditions is associated with less pronounced manifestations of fatigue.

Another indicator is related to the duration of stay in the combat zone after returning from leave. This parameter approximately reflects the level of fatigue among military personnel, since after returning from leave, its symptoms may not appear immediately or may be less pronounced. However, a one-way analysis of variance demonstrates a statistically significant effect of the analyzed parameter ($p<0.01$). The distribution pattern of this factor across the studied groups is shown in Figure 3b. In particular, the analysis of the studied indicator shows that members of Group 2 had the shortest post-leave exposure to the combat zone (2.0–2.5 months). This finding may indicate the lowest depletion of the functional reserves of the body, which could be reflected in a reduced perception of certain stressors of the combat environment. Conversely, younger military personnel remained in the combat zone after returning from leave for approximately 3.5 months. Given their age, it can be assumed that the functional reserves of the respondents in Group 1 were also not significantly affected by combat load. The longest post-leave period was observed among older military personnel (Group 3). This period exceeded 4.5 months, which, considering their age, provides evidence of the greatest reduction in functional reserves within this group. The described phenomenon is also reflected in the Given their age, it can be assumed that the functional reserves of the respondents in Group 1 were also not significantly affected by combat load. The longest post-leave period was observed among older military personnel (Group 3). This period exceeded 4.5 months, which, considering their age, provides evidence of the greatest reduction in functional reserves within this group. The described phenomenon is also reflected in the influence of combat environment factors on the military personnel of Group 3. influence of combat environment factors on the military personnel of Group 3. A roughly similar distribution pattern of the studied contingent of military personnel can be observed with respect to the indicator "duration of stay in the combat zone under direct contact with the enemy." The distribution of the levels of this indicator across the groups is presented in Figure 3c. The one-way analysis of variance revealed a highly significant effect of this indicator ($p<0.001$). In this case, the lowest duration of continuous stay in the combat zone was recorded in Group 2 (approximately 6 months). This may explain the corresponding alteration in the perception of combat environment factors, as during this period, members of Group 2 acquire sufficient operational experience. Younger military personnel (Group 1) are exposed to adverse conditions for approximately 10 months and also gain relevant experience. However, age-related characteristics contribute to differences in the perceived danger of harmful combat-related factors. The highest exposure to the indicator "duration of stay in the combat zone under direct contact with the enemy" was recorded among servicemen of Group 3. They remained continuously in the combat zone for approximately 14-16 months and acquired considerable combat experience. However, age-related changes, including slower reaction times and reduced functional reserves of the body, contribute to an increased sensitivity to the adverse effects of combat environment factors.

Thus, the impact of various types of modern weapons on the physical and psychological state of military personnel [7] is complex and multifaceted. Each type of weapon exerts its own specific effects [8], which depend on the intensity and duration of exposure, the nature of the damage, and the conditions of the combat environment [5]. These factors are difficult to assess using questionnaire-based methods.

Summarizing the obtained results, it should be emphasized that the perceptions and responses of military personnel are shaped by the combined influence of multiple factors – primarily age, combat experience, and the specific effects associated with different types of weapon exposure. The combined influence of these factors forms a nonlinear pattern of the impact of physical stimuli on the psychophysiological state of military personnel, which should be taken into account when planning their combat activities and recovery periods.

It should be noted that such studies always have certain methodological limitations related to the impossibility of fully controlling all variables in real combat conditions and the subjectivity of participants' self-assessment. Such nonlinearity is present in many questionnaires regarding impressions from the action of any external factors, which is compensated by the organism at the expense of the integral value of the

impressions received. This approach requires careful interpretation of the results and their future supplementation with objective physiological indicators.

Conclusions

1. The working hypothesis was confirmed regarding the complex mechanism underlying the formation of perceptions of the effects of various types of modern weapons. These effects are determined by age-related changes in the physiological capabilities and functional reserves of military personnel, which in turn depend on the total duration of stay in the combat zone, the duration of stay in direct contact with the enemy, and the duration of stay in the combat zone after returning from leave.

2. Age influences the formation of sensory perceptions resulting from exposure to various physical factors caused by the use of modern weapons. In general, the greatest cumulative impact is observed among military personnel aged 30.1±0.7 years, whereas the lowest impact is recorded in older age groups (40.3±1.3 and 41.3±1.5 years). This finding suggests that older service members may exhibit markedly different sensory response profiles to the effects of specific types of weapons, indicating that the quality of such perceptions tends to diversify with age.

3. The factors exerting the greatest impact on military personnel across different age groups include exposure to attacks involving unmanned aerial vehicles, guided aerial bombs, tank fire, and artillery strikes. These stressors predominantly affect younger service members (Group 1).

4. The nonlinear nature of the impact of specific types of weapons on the psychophysiological responses of military personnel of different ages depends on the organization of their direct involvement in armed conflicts and the adequacy of rest periods for restoring functional reserves. This dependence is closely related to such indicators as the total duration of stay in the combat zone, the duration of stay after returning from leave, and the duration of stay in direct contact with the enemy.

References

1. Verbyn NB, Vysochina NL, Kostiv SF. Vytryvalist viiskovosluzhbovtsiv ta metodyka yii rozvytku: navch.-metod. posib. Nats. un-t oborony Ukrainy im. I. Cherniakhovskoho. Kyiv : NUOU, 2020. [in Ukrainian].

2. Zhyhailo NI, Mateiuk OA. Psykholohichnyi suprovid viiskovosluzhbovtsiv u zoni vedennia boiovykh dii. Visnyk Lvivskoho universytetu. Seriia psykholohichni nauky. 2022;13:64-70. doi: 10.30970/PS.2022.13.8. [in Ukrainian].

3. Kalnysh VV, Shvets AV, Maltsev OV. Kharakterystyky umov profesiinoho seredovyshcha, yaki spryiaiut formuvanniu napruzhenosti pratsi zovnishnikh pilotiv bezpilotnykh aviatsiinykh kompleksiv. Ukrainskyi zhurnal viiskovoi medytsyny. 2022;3(4):109-20. doi: 10.46847/ujmm.2022.4(3)-109. [in Ukrainian].

4. Puzyrov YeV, Izviekov VV. Boiovyi stres ta yoho naslidky dlia viiskovosluzhbovtsiv. Naukovi zapysky Tavriiskoho natsionalnoho universytetu imeni V. I. Vernadskoho, seriia Psykholohiia. 2023;1:203-9. doi: 10.32782/2709-3093/2023.1/33 [in Ukrainian].

5. Savychenko OM, Horbachova OV, Shunevych YeM. Dynamika psykhichnoho zdorovia viiskovosluzhbovtsiv u period viiny. Psykholohichnyi zhurnal. 2024;13:97-106. doi: 10.31499/2617-2100.13.2024.315043. [in Ukrainian]

6. Surhund NA, Verba HV. Osoblyvosti psykholohichnoi reabilitatsii viiskovosluzhbovtsiv na etapi vidnovlennia. Psychology Travelogs. 2024;3:47-56. doi: 10.31891/PT-2024-3-5. [in Ukrainian]

7. Chaban OS, Khaustova OO, Omelianovych VIu. Psykhichni rozlady voiennoho chasu. K.: Vydavnychyi dim Medknyha, 2023. [in Ukrainian].

8. Brewin CR, Atwoli L, Bisson JI, Galea S, Koenen K, Lewis-Fernández R. Post-Traumatic Stress Disorder: Evolving Conceptualization and Evidence, and Future Research Directions. World Psychiatry. 2025;24:52-80. doi: 10.1002/wps.21269.

9. Kienzler H. Debating War-Trauma and Post-Traumatic Stress Disorder (PTSD) in an Interdisciplinary Arena. Social Science & Medicine. 2008;67(2):218-27. doi: 10.1016/j.socscimed.2008.03.030.

10. Xue C, Ge Y, Tang B, Liu Y, Kang P, Wang M, Zhang L. A meta-analysis of risk factors for combat-related PTSD among military personnel and veterans. PloS one. 2015 Mar;10(3):e0120270. doi: 10.1371/journal.pone.0120270.

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