

Chronic pain and psychological well-being in soldiers wounded during Russo-Ukrainian war: a retrospective study

Kronična bol i psihološka dobrobit u vojnika ranjenih tijekom rusko-ukrajinskog rata: retrospektivna studija

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Summary

Background: Chronic pain is highly prevalent among Ukrainian soldiers with gunshot and mine-explosive injuries. Our study examines the impact of acute stress reaction (ASR) and post-traumatic stress disorder (PTSD) on chronic pain development and its effect on soldiers' quality of life post-treatment.

Methods: In this retrospective study, we analyzed data from 1,166 wounded soldiers diagnosed with PTSD following ASR. We assessed pain intensity, anxiety/depression, quality of life, and PTSD presence at hospital discharge, one and three months later.

Results: We identified significant predictors of chronic pain in wounded soldiers, emphasizing the role of psychological factors and the quality of life. High levels of anxiety and depression, PTSD symptoms, and low quality of life scores were strongly associated with chronic pain, even after adjusting for injury type and initial pain intensity. The presence of an ASR, high Hospital Anxiety and Depression Scale scores (HADS), and low scores on the Chaban Quality of Life Questionnaire (CQLS) were identified as predictors of chronic pain, with a notably high risk (95.6%) for patients meeting these criteria. Our findings suggest a significant association between the risk of chronic pain and ASR, with quality of life scores at discharge, one month, and three months post-treatment, indicating a high predictive accuracy. Moreover, ineffective pain treatment correlated with ineffective PTSD treatment.

Conclusion: Soldiers' diminished psychological well-being post-gunshot and mine-explosive injuries significantly increase chronic pain risk. Addressing anxiety, depression, and PTSD symptoms, alongside improving quality of life, could reduce the likelihood of chronic pain and other negative health outcomes in soldiers with combat injuries.

Keywords: Ukraine; War-Related Injuries; Chronic Pain; Acute Stress Reaction; Post-Traumatic Stress Disorder

Sažetak

Pozadina: Kronična bol vrlo je česta među ukrajinskim vojnicima s prostrijelnim i minsko-eksplozivnim ozljedama. Naša studija ispituje utjecaj akutne stresne reakcije (ASR) i posttraumatskog stresnog poremećaja (PTSP) na razvoj kronične boli i njezin utjecaj na kvalitetu

života vojnika nakon liječenja.

Metode: U ovoj retrospektivnoj studiji analizirali smo podatke 1.166 ranjenih vojnika kojima je dijagnosticiran PTSP nakon ASR-a. Procijenili smo intenzitet boli, anksioznost/depresiju, kvalitetu života i prisutnost PTSP-a pri otpustu iz bolnice, te mjesec i tri mjeseca kasnije.

Rezultati: Identificirali smo značajne prediktore kronične boli u ranjenih vojnika, naglašavajući ulogu psiholoških čimbenika i kvalitete života. Visoke razine anksioznosti i depresije, simptomi PTSP-a i niske ocjene kvalitete života bili su snažno povezani s kroničnom boli, čak i nakon prilagodbe za tip ozljede i početni intenzitet boli. Prisutnost ASR-a, visoke ocjene na Bolničkoj ljestvici anksioznosti i depresije (HADS) i niske ocjene na Chabanovom upitniku kvalitete života (CQLS) identificirani su kao prediktori kronične boli, s posebno visokim rizikom (95,6%) za bolesnike koji zadovoljavaju ove kriterije. Naši rezultati ukazuju na značajnu povezanost između rizika od kronične boli i ASR-a, s ocjenama kvalitete života pri otpustu, mjesec i tri mjeseca nakon liječenja, što potvrđuje visoku prediktivnu točnost. Štoviše, neučinkovito liječenje boli korelira s neučinkovitim liječenjem PTSP-a.

Zaključak: Smanjena psihološka dobrobit vojnika nakon prostrijelnih i minsko-eksplozivnih ozljeda značajno povećava rizik od kronične boli. Rješavanje problema anksioznosti, depresije i simptoma PTSP-a, uz poboljšanje kvalitete života, moglo bi smanjiti vjerojatnost kronične boli i drugih negativnih zdravstvenih ishoda u vojnika s ratnim ozljedama.

Ključne riječi: Ukrajina; ratne ozljede; kronična bol; akutna stresna reakcija; posttraumatski stresni poremećaj

Background

Pain management on the battlefield has changed markedly in recent times and has become an essential component of treatment for the wounded in combat.^{1,2} Most soldiers wounded on the battlefield experience pain, and more of them require analgesics for pain management than life-saving interventions.³ Kuchyn et al. demonstrated that 70% of patients experience chronic pain following gunshot wounds, which impairs functionality and diminishes the quality of life.⁴

Mills et al. revealed the bidirectional relationship between chronic pain and negative emotional states, such as depression and anxiety, suggesting that chronic pain can both cause and result from poor mental health.⁵ Furthermore, anxiety and fear related to pain are associated with a higher likelihood of developing chronic pain and experiencing poorer recovery outcomes.⁵ Fear-avoidance behaviors and a lack of movement are also identified as independent risk factors for developing chronic pain.⁵

Recently, Kuchyn et al. demonstrated that acute stress reactions (ASR) increase the risk of developing chronic pain.⁴ ASR is characterized by a prompt and diverse array of psychological and physiological symptoms in response to severe stress. The impact of this reaction varies in terms of the functional capabilities of individuals exposed to high-stress situations. While a person might recover swiftly, for professions demanding high performance under pressure, even a brief disruptions in functionality can heighten risks for the individual, their colleagues, and

the overall mission.⁶ After gunshot wounds, civilian patients are diagnosed with ASR in 75% of cases.⁷ Additionally, evidence indicates that 56% of children are diagnosed with ASR following gunshot wounds.⁷ Adler et al. reported that during combat-related events, ASR was observed in 51.7% of cases.⁸

Considering that ASR can disrupt the operations of a military unit, posing a risk to the combat team,⁹ the investigation of ASR among soldiers during the war in Ukraine holds significant importance for the future treatment of such conditions. This issue may evolve into a broader concern with national implications over time. Furthermore, symptoms of ASR were strongly associated with a positive screening result for post-traumatic stress disorder (PTSD) in long-term treatment.⁸

Our studies on soldiers wounded during the war in Ukraine show that high postoperative pain intensity is associated with a higher risk of PTSD treatment failure among patients with gunshot wounds.¹⁰ Among soldiers who sustained gunshot injuries during combat, 82.1% of PTSD treatment cases are complicated by chronic pain and treatment resistance.¹⁰ Early pain treatment improves post-injury outcomes, whereas inadequate treatment contributes to higher rates of PTSD.¹¹ This link is also evident from data on the civilian population, where 82.5% of patients who endured a traumatic event were diagnosed with PTSD.¹² This proves that prompt and effective pain management enhances post-injury recovery, whereas inadequate pain treatment leads to elevated PTSD incidence.¹¹

Our study aimed to analyze whether anxiety and

depression symptoms, PTSD, and quality of life affect the risk of chronic pain in soldiers with gunshot and mine explosive injuries sustained during combat tasks in the war in Ukraine. We hypothesized that severe anxiety, depression, PTSD, and poor quality of life would predict chronic pain in these injured military personnel.

Methods

The setting and the participants

This retrospective study was conducted at the National Military Medical Clinical Center "Main Military Clinical Hospital" in Kyiv, Ukraine. It analyzed medical records of soldiers wounded during the Anti-Terrorist Operation/Operation of the United Forces (ATO/OJF) in Eastern Ukraine from 2014 to 2021 (n=550) and the defense of Kyiv from February 24 to May 24, 2022, amid the full-scale Russian invasion (n=616).

Inclusion criteria were soldiers with gunshot or mine-explosive injuries, diagnosed with PTSD one month post-discharge, which was preceded by a diagnosis of ASR. Exclusion criteria were individuals with an ASR diagnosis without subsequent PTSD, those showing isolated symptoms of ASR/PTSD, those with a history of craniocerebral trauma before or during hostilities, and those enrolled in another study.

Ethics

The study was approved by the Bioethical Expertise and Ethics of Scientific Research Committee of the O. Bogomolets National Medical University (protocol #158 of May 23, 2022).

Procedures

After sustaining battlefield injuries, wounded soldiers were initially evacuated to a field medical team, which included at least one anaesthesiologist, one surgeon, one nurse anesthetist, and one operating room nurse strategically positioned near the front lines. The team's responsibility was to stabilize the patients' general condition before evacuating them to a military mobile hospital and, subsequently, to a military medical clinical center, a larger facility with advanced treatment and diagnostic capabilities. During the defense of Kyiv, all wounded soldiers were evacuated to the National Military Medical Clinical Center "Main Military Clinical Hospital" for treatment. In contrast, only a portion of the wounded soldiers from the Anti-Terrorist Operation/Operation

of the United Forces (ATO/OJF) received treatment at this hospital. Following treatment completion, injured soldiers underwent rehabilitation (Figure 1). Anesthetic support for surgical operations was provided through either general anesthesia or regional anesthesia, with some patients receiving sedation during regional anesthesia via a continuous infusion of 1% propofol at a rate of 1-4 mg/kg/h. Fentanyl solution (0.005%) was used for analgesia, with dosages varying during induction and maintenance. Regional anesthesia was conducted under ultrasound guidance, injecting 20-30 ml of 0.5% bupivacaine near the nerve roots. Postoperative analgesia included paracetamol, nonsteroidal anti-inflammatory drugs, opioids, and, if necessary, repeated peripheral blockades or catheterization for prolonged regional anesthesia using 0.25% bupivacaine solution (20-30 ml). Patients were evaluated by a psychiatrist at admission, discharge, and 1 and 3 months post-admission.

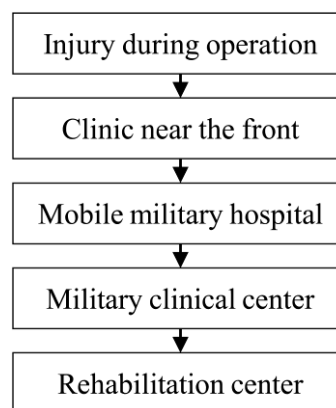


Figure 1 Roadmap of wounded Ukrainian military soldiers' treatment

Slika 1. Shema protokola liječenja ranjenih ukrajinskih vojnika

Data collection

All study data were derived from the patients' medical histories stored at the National Military Medical Clinical Center "Main Military Clinical Hospital" in Kyiv, Ukraine. The study's outcomes were pain intensity, anxiety and depression scores, and the quality of life of soldiers through psychometric assessments conducted at four different times, as depicted in Figure 2.

Prior to surgery, the anaesthetic risk was assessed in all soldiers according to the American Society of Anaesthesiologists (ASA) scale during admission to all stages of treatment.

A Numerical Rating Scale (NRS) was utilized upon admission and at 1 and 3 months post-discharge

to assess pain intensity. Pain intensity categories on a scale of 0 to 10 are 0 for no pain, 1-3 for mild pain, 4-6 for moderate pain, and 7-10 for severe pain.¹³

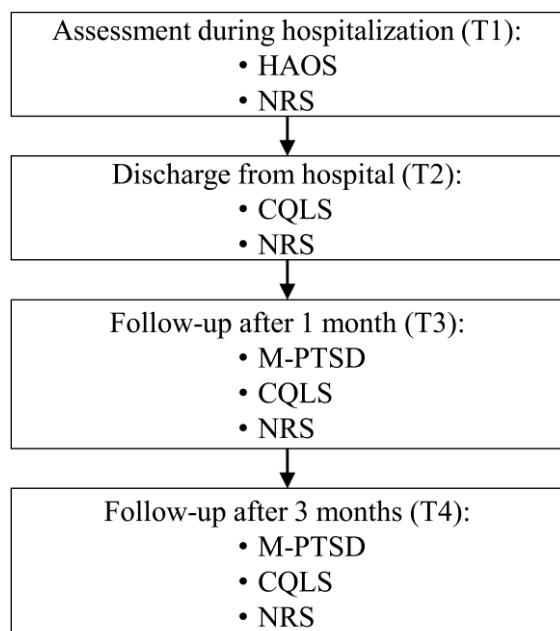


Figure 2 Assessment points. Abbreviations: HADS - Hospital Anxiety and Depression Scale; NRS - Numerical Rating Scale; M-PTSD - Mississippi Scale for Combat-Related Post-traumatic Stress Disorder; CQLS - Chaban Quality of Life Questionnaire

Slika 2. Vremenske točke mjerenja. Kratice: HADS - Bolnička skala anksioznosti i depresije; NRS - Numerička ocjenska skala; M-PTSD - Mississippiska skala za posttraumatski stresni poremećaj povezan s borbenim djelovanjima; CQLS - Chaban upitnik kvalitete života

A psychiatrist made the diagnosis of Acute Stress Reaction (ASR) upon the admission of wounded soldiers to a military mobile hospital, based on clinical symptoms.

The Hospital Anxiety and Depression Scale (HADS) was used to quantify anxiety and depression, key components of the psycho-emotional state during an ASR.¹⁴ The HADS, a validated instrument ($\alpha=0.94$), comprises of 14 items divided into two subscales for anxiety (odd-numbered items) and depression (even-numbered items), with each item scored from 0 to 3. Scores range from 0 to 21 for each subscale, where higher scores indicate more severe symptoms.¹⁵

Post-Traumatic Stress Disorder (PTSD) was diagnosed by a psychiatrist one month following release from hospital and confirmed after 3 and 6 months, following standard procedures. To

objectively assess PTSD severity, the Mississippi Scale for Combat-Related Post-traumatic Stress Disorder (M-PTSD), a 35-item screening tool for combat-related PTSD, was used.^{10,16} M-PTSD demonstrates high internal consistency ($\alpha = .92$), and its sensitivity (68% to 81%) and specificity (61% to 70%) render it a valuable screening tool for combat-related PTSD.¹⁷ Scores range from 58-94, indicating good adaptability; 95-112, suggesting the presence of mental disorders; and 113-148, indicating PTSD.

The Chaban Quality of Life Questionnaire (CQLS)¹⁸ was used to assess soldiers' quality of life at hospital discharge and 1 and 3 months post-discharge. This self-administered questionnaire consisted of 10 items, each rated on an 11-point scale from 0 (not at all satisfied) to 10 (extremely satisfied), leading to a total score range from 0 to 100 points. The scoring criteria range from very low to very high quality of life, with the questionnaire demonstrating high internal consistency, reliability, and validity.¹⁸

Statistical analysis

The sample size calculation was performed using G*Power v.3.1.9.6 (19), while subsequent analyses were conducted using the EZR v.1.35 package, which is based on R statistical software version 3.4.3 (R Foundation for Statistical Computing, Vienna, Austria) (20). The distribution of data was assessed for normality using the Kolmogorov-Smirnov tests. Group comparisons were made using the Mann-Whitney U test. To explore the association between the risk of chronic pain (NRS > 0 after 3 months) and observed outcomes, both univariate and multivariate logistic regression models were utilized. These models were also applied to examine the relationship between the risk of not achieving the desired treatment effect and factor characteristics. The quality of these models was evaluated by the area under the ROC curve (AUC), and the 95% confidence interval (CI) for this measure was calculated.²¹ The odds ratio (OR) and its 95% CI were determined using a direct selection method at an alpha level of 5% to quantify the impact of factor characteristics. The significance level was set at 0.05.

Results

A total of 2,000 medical records were initially pre-screened for compliance with the study's inclusion criteria. Of these, 1,166 records met the inclusion criteria. The remaining 834 records were excluded during the pre-screening process due to failure to meet the inclusion criteria or the presence of exclusion criteria, as illustrated in Figure 3.

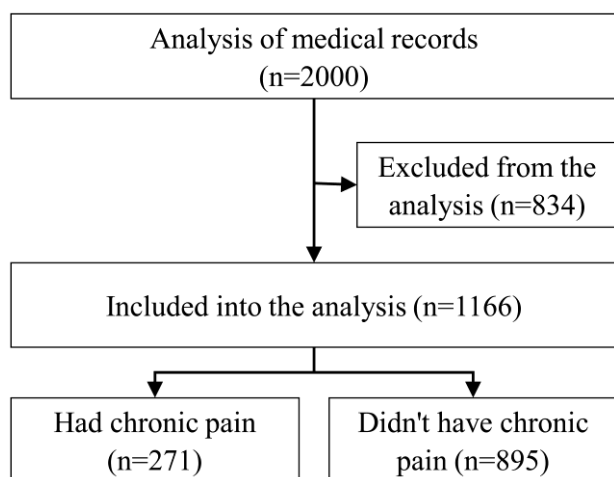


Figure 3 Flow diagram of medical records' selection
Slika 3. Dijagram tijeka odabira povijesti bolesti

All participants were males, with an average age of 32 years (range 25-39 years), an average height of 178 cm (range 176-182 cm), and an average weight of 78 kg (range 75-84 kg). Each underwent surgical procedures, with an average of 5 (range 4-7) procedures. The average number of wounds per soldier was 2 (range 1-3) across different anatomical body parts. The mean anesthetic risk, as assessed by the ASA score, was 3. The average duration of the surgical procedures was 115 minutes (range 105-130 minutes), and the average anesthesia duration was 125 minutes (range 110-150 minutes). Soldiers from both groups, i.e., those with or without chronic pain, showed no significant differences in socio-demographic characteristics or the diagnosis and treatment received (Table 1).

Table 1 General characteristics of patients with gunshot and mine-explosive injuries; median (Me), and interquartile range (QI-QIII) are presented.

Tablica 1. Opće karakteristike ranjenika s prostrijelnim i minsko-eksplozivnim ozljedama; prikazani su medijan (Me) i interkvartilni raspon (QI-QIII).

Variables / Varijable	Soldiers with gunshot wounds (n=786) Vojnici s prostrijelnim ranama	Soldiers with mine blast wounds (n=380) Vojnici s ranama od eksplozije mina	P value P vrijednost
Age (years)/starost (godine)	32 (25-39)	32 (26-39)	0.791
Height (cm) / visina	178 (176-182)	178.5 (176-182)	0.29
Weight (kg) / težina	78 (75-84)	79.5 (75-84)	0.148
No. of surgical operations Broj operativnih zahvata	5 (5-7)	5 (4-7)	0.349
No. of injuries /broj ozljeda	2 (2-2)	2 (1-3)	0.767
ASA	3 (3-3)	3 (3-3)	0.563
Duration of anesthesia (min.) Trajanje anestezije (min)	125 (110-145)	125 (110-150)	0.786
Duration of surgical operations (min.) Trajanje operativnih zahvata (min)	115 (105-130)	115 (105-130)	0.369
NRS score upon admission NRS uspjeh kod prijema	7 (7-7)	7 (7-7)	0.106

Abbreviations: ASA - American Society of Anesthesiologists Classification; NRS - Numerical Rating Scale
Skraćenice: ASA - Američko društvo klasifikacije anesteziologa; NRS - Numerička skala ocjenjivanja

When the NRS score was above 0 after three months, it indicated that a positive effect had not been achieved (n=271 cases). Conversely, if the NRS score was 0 after three months, this denoted that a positive effect was achieved (n=895 cases).

The risk of chronic pain was reported as 23.2%, with a 95% confidence interval of 20.8%-25.8%. For factorial analysis, we utilized HADS scores from patients diagnosed with ASR by a psychiatrist upon admission to a military mobile hospital. Additionally, we included M-PTSD scores at 1 and 3 months post-

discharge, as well as CQLS data at discharge and at 1 and 3 months after treatment.

Due to the significant correlation between the subscales of the HADS indicating a high probability of multicollinearity in the regression analysis, the scores of both HADS subscales were aggregated to form a single HADS variable for use in the regression analysis. No other variables were transformed. The outcomes of this analytical approach are presented in Table 2.

The analysis of univariate logistic regression

models for predicting the risk of chronic pain in wounded soldiers revealed several significant predictors. The HADS coefficient (the change in the log odds of the outcome for a one-unit increase in the predictor variable) was 1.69 ± 0.34 , indicating a strong association with chronic pain, with a significance level of <0.001 and an odds ratio (OR) of 5.41 (95% CI: 2.77-10.6). The M-PTSD showed a significant association at 3 months post-injury (0.085 ± 0.013 , significance: $p < 0.001$, OR: 1.09, 95% CI: 1.06-1.12), but not at 1 month. The CQLS at discharge and 1 and

3 months post-injury were strongly inversely associated with chronic pain, showing coefficients of -2.45 ± 0.28 , -1.63 ± 0.11 , and -1.64 ± 0.11 respectively, all with significance levels of <0.001 . These results suggest that higher levels of anxiety, depression, and PTSD symptoms, along with lower quality of life, are significant predictors of chronic pain in this population. Figure 4 illustrates the receiver operating characteristic (ROC) curve for predicting chronic pain risk based on M-PTSD data 3 months after treatment.

Table 2 Coefficients of univariate logistic regression models for predicting the risk of pain chronicity in soldiers with gunshot and mine-explosive injuries.

Tablica 2. Koeficijenti univarijatnih logističkih regresijskih modela za predviđanje rizika od kroničnosti boli u vojnika s prostrijelnim i minsko-eksplozivnim ozljedama.

Factor variable <i>Faktorska varijabla</i>	Coefficient, $b \pm m$ <i>koeficijent</i>	Significance level <i>Razina značaja</i>	OR (95% CI)	AUC (95% CI)
HADS	1.69 ± 0.34	<0.001	5.41 (2.77-10.6)	0.98 (0.97-0.99)
M-PTSD after 1 month <i>Nakon 1 mjeseca</i>	0.006 ± 0.011	0.579	–	–
M-PTSD after 3 months <i>Nakon 3 mjeseci</i>	0.085 ± 0.013	<0.001	1.09 (1.06-1.12)	0.65 (0.62-0.68)
CQLS at discharge <i>Kod otpusta</i>	-2.45 ± 0.28	<0.001	0.09 (0.05-0.15)	0.98 (0.97-0.99)
CQLS after 1 month <i>Nakon 1 mjeseca</i>	-1.63 ± 0.11	<0.001	0.20 (0.16-0.25)	0.98 (0.97-0.99)
CQLS after 3 months <i>Nakon 3 mjeseci</i>	-1.64 ± 0.11	<0.001	0.19 (0.16-0.24)	0.98 (0.97-0.99)

Abbreviations: HADS - Hospital Anxiety and Depression Scale; M-PTSD - Mississippi Scale for Combat-Related Post-traumatic Stress Disorder; CQLS - Chaban Quality of Life scale; OR – Odds Ratio; AUC – area under curve.

Skraćenice: HADS – skala bolničke napetosti i depresije; M-PTSD – Mississippi skala za Posttraumatski stresni poremećaj povezan s borbom; CQLS – Chaban skala kvalitete života; OR – Odds Ratio; AUC – područje ispod krivulje.

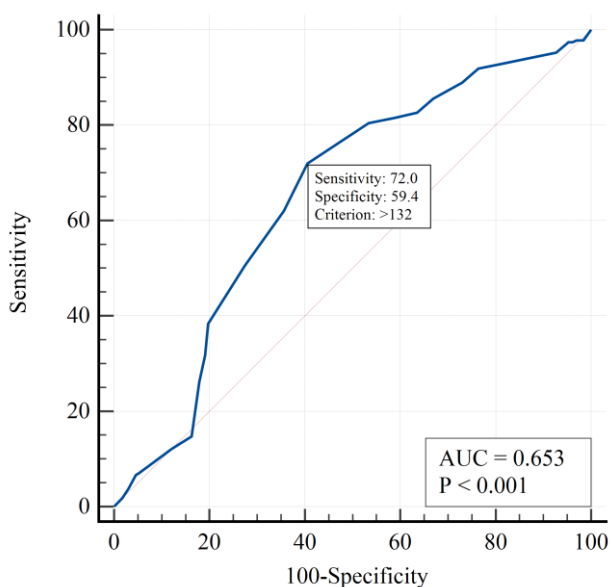


Figure 4 Receiver Operating Characteristic (ROC) curve predicts pain chronicity risk according to M-PTSD 3 months after inpatient treatment in the military medical clinical center. Abbreviation: AUC

– Area under curve.

Slika 4. ROC krivulja predviđa rizik kroničnosti boli prema M-PTSP-u 3 mjeseca nakon bolničkog liječenja u vojnom medicinskom kliničkom centru. Kratica: AUC – Površina ispod krivulje.

When the analysis was adjusted for the NRS pain intensity at admission and the type of injury (gunshot and mine-explosive injuries), similar trends were observed. The HADS coefficient increased slightly to 1.81 ± 0.36 with a significance level of <0.001 and an OR of 6.10 (95% CI: 3.03–12.3). The M-PTSD at 3 months remained significant with a similar coefficient (0.086 ± 0.013 , significance: <0.001 , OR: 1.09, 95% CI: 1.06–1.12). The CQLS scores at discharge, 1 month, and 3 months post-injury showed even stronger inverse associations with coefficients of -2.52 ± 0.29 , -1.71 ± 0.13 , and -1.73 ± 0.13 respectively, all with significance levels of <0.001 . For each model, an increase in the risk of pain chronicity was found regardless of the injury type. These adjusted models reinforce the importance of

psychological factors and quality of life in predicting chronic pain, highlighting the potential benefits of targeted interventions in these areas for wounded

soldiers. The results of this analysis are presented in Table 3.

Table 3 Coefficients of logistic regression models predicting the risk of pain chronicity when standardized by Numerical Rating Scale (NRS) pain intensity at admission and type of injury in soldiers with gunshot and mine-explosive injuries.

Tablica 3. Koeficijenti logističkih regresijskih modela za predviđanje rizika od kroničnosti boli kada se standardiziraju prema intenzitetu boli na Numeričkoj ocjenskoj skali (NRS) pri prijmu i vrsti ozljede u vojnika s prostrijelnim i minsko-eksplozivnim ozljedama.

Factor variable <i>Faktorska varijabla</i>	Coefficient, b±m <i>koeficijent</i>	Significance level <i>Razina značaja</i>	OR (95% CI)	AUC (95% CI)
HADS	1.81±0.36	<0.001	6.10 (3.03–12.3)	0.99 (0.99–1.00)
M-PTSD after 1 month <i>Nakon 1 mjeseca</i>	0.005±0.012	0.652	–	0.55 (0.52–0.58)
M-PTSD after 3 months <i>Nakon 3 mjeseci</i>	0.086±0.013	<0.001	1.09 (1.06–1.12)	0.65 (0.62–0.68)
CQLS at discharge <i>Kod otpusta</i>	–2.52±0.29	<0.001	0.08 (0.05–0.14)	0.98 (0.97–0.99)
CQLS after 1 month <i>Nakon 1 mjeseca</i>	–1.71±0.13	<0.001	0.18 (0.14–0.23)	0.98 (0.97–0.99)
CQLS after 3 months <i>Nakon 3 mjeseci</i>	–1.73±0.13	<0.001	0.18 (0.14–0.23)	0.98 (0.97–0.99)

Abbreviations: HADS - Hospital Anxiety and Depression Scale; M-PTSD - Mississippi Scale for Combat-Related Post-traumatic Stress Disorder; CQLS - Chaban Quality of Life scale; OR – Odds Ratio; AUC – area under curve.

Skracénice: HADS – skala bolničke napetosti i depresije; M-PTSD – Mississippi skala za posttraumatski stresni poremećaj povezan s borbom; CQLS – Chaban skala kvalitete života; OR – Odds Ratio; AUC – područje ispod krivulje.

Discussion

Our analysis emphasizes the impact of psychological distress, as measured by HADS, and the presence of PTSD symptoms in patients previously diagnosed with ASD, particularly three months post-injury, on the likelihood of the chronic pain outcome. Additionally, the significant negative relationship between the quality of life measures (CQLS) at discharge and subsequent evaluations with chronic pain emphasizes the importance of addressing psychological well-being and enhancing quality of life as pivotal components of post-injury care. These findings suggest that interventions aimed at reducing anxiety, depression, and PTSD symptoms, along with efforts to improve quality of life, could be crucial in mitigating the risk of adverse outcomes in affected populations regardless of the type of sustained injury.

Life-saving measures greatly increase survival rates and decrease complications in injured soldiers. Although pain management is essential for improving results, the frequent under-treatment of pain and its effect on the effectiveness of these life-saving interventions is not well-studied.²²

Chronic pain significantly impacts the readiness for return to duty among soldiers following rehabilitation. Only 75% of these soldiers reported

feeling fully mission-capable.²³ Also, nearly 38% experienced a time-loss injury within one year of returning to duty.²³ Moreover, nearly all soldiers demonstrated at least one dysfunctional movement pattern.²³ These findings underscore the urgent need for enhanced rehabilitation strategies to improve mission readiness and minimize the risk of future injuries in soldiers.²³

Engagement in jobs with high risks may lead to the development of ASR. ASR can interfere with the functioning of a military unit and pose a danger to the team in the context of a combat mission,⁹ so studying this issue in soldiers during the war in Ukraine was a priority for us.

We know that the early treatment of pain following trauma improves long-term outcomes, whereas inadequately managed pain can lead to a higher incidence of PTSD (1) and poorer outcomes in PTSD treatment.¹¹

The most commonly reported mental health issues among US military veterans were PTSD and depression. Studies focusing on soldiers deployed to Iraq and Afghanistan have highlighted issues within the military healthcare system regarding the management of chronic pain, which is associated with adverse outcomes following transitions to subsequent treatment stages. Identified issues included alcohol and drug use, suicidal ideation, intentional self-harm,

and all-cause mortality. Additionally, research suggests that a multimodal approach to treating chronic pain, which includes the use of opioids, may mitigate the risk of severe adverse outcomes linked to chronic pain and opioid utilization.²⁴⁻²⁶

It was estimated that between 14% and 16% of service members who had served in non-combat roles in Afghanistan or Iraq suffered from PTSD or depression.²⁷ Therefore, understanding the relationship between military service and a patient's physical and mental health is crucial for improving the quality of care and could potentially save lives.²⁷

Some studies indicate that group psychotherapy has an impact on the treatment of PTSD in patients with combat trauma.²⁸ There is also evidence of a genetic predisposition to PTSD in Vietnam War veterans.²⁹ However, we were unable to find published studies that demonstrate the association of chronic pain with ASR and PTSD.

In soldiers who sustained gunshot wounds during combat operations, 82.1% of treatment cases of PTSD are associated with chronic pain and treatment resistance.¹⁰ The results of another study¹² show that among civilian patients who have experienced a traumatic event, PTSD is diagnosed in 82.5% of cases. It is necessary to continue researching the issue of chronic pain in soldiers after injuries, as this can improve the long-term outcomes of PTSD treatment and improve the quality of life of soldiers after hospitalization.

While the study highlights important predictors of chronic pain in wounded soldiers, it is essential to acknowledge its limitations. Firstly, the retrospective nature of the study design introduces inherent biases and limitations in data collection. Secondly, the diagnosis of conditions such as PTSD and ASR presents challenges, which were addressed through efforts to standardize diagnostic procedures as much as possible. Despite these efforts, variability in diagnosis may still affect the study's outcomes. Lastly, the findings' applicability is primarily within the context of military medicine, limiting their generalizability. However, it is speculated that the results could extend to professions requiring high performance under pressure, suggesting potential broader implications.

Chronic pain, ASR, and PTSD significantly reduce soldiers' quality of life, posing a complex challenge in military medicine. Despite the high expertise of military physicians, especially noted during the Russian aggression in Ukraine, pain management outcomes are unsatisfactory, signaling a potential national healthcare crisis. This crisis stems not only from the high prevalence of chronic pain among veterans but also from the co-occurrence of

PTSD, worsening their well-being.

Observations indicate that soldiers with severe anxiety and depression after ASR are more likely to develop chronic pain, with the transition possibly beginning at the injury's onset. This suggests a direct link between initial trauma and chronic pain, underscoring the need for in-depth research into how different types of injuries affect pain's chronicity.

Data shows an inverse relationship between chronic pain severity and soldiers' quality of life, with PTSD's association with chronic pain highlighting the need for integrated treatment approaches. Therefore, it is crucial to focus research on improving pain management and PTSD interventions, addressing both symptoms and their root causes to enhance soldiers' lives and address wider health and security issues.

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References

1. Vysokovsky M, Avital G, Betelman-Mahalo Y. et al. Trends in prehospital pain management following the introduction of new clinical practice guidelines. *J Trauma Acute Care Surg* 2021;91:S206-s12.
2. Nakar H, Sorkin A, Nadler R. et al. Trends in prehospital pain management: two decades of point-of-

- injury care. *Isr Med Assoc J* 2022;24:584-90.
3. Benov A, Salas MM, Nakar H. et al. Battlefield pain management: A view of 17 years in Israel Defense Forces. *J Trauma Acute Care Surg* 2017;83:S150-s5.
 4. Kuchyn I, Horoshko V. Chronic pain in patients with gunshot wounds. *BMC Anesthesiol* 2023;23:47.
 5. Mills SEE, Nicolson KP, Smith BH. Chronic pain: a review of its epidemiology and associated factors in population-based studies. *Br J Anaesth* 2019;123:e273-e83.
 6. Adler AB, Svetlitzky V, Gutierrez IA. Post-traumatic stress disorder risk and witnessing team members in acute psychological stress during combat. *BJPsych Open* 2020;6:e98.
 7. Hamrin V, Jonker B, Scahill L. Acute stress disorder symptoms in gunshot-injured youth. *J Child Adolesc Psychiatr Nurs* 2004;17:161-72.
 8. Adler AB, Gutierrez IA. Acute Stress Reaction in Combat: Emerging Evidence and Peer-Based Interventions. *Curr Psychiatry Rep* 2022;24:277-84.
 9. Svetlitzky V, Farchi M, Ben Yehuda A, Start AR, Levi O, Adler AB. YaHaLOM training in the military: Assessing knowledge, confidence, and stigma. *Psychol Serv* 2020;17:151-9.
 10. Kuchyn IL, Horoshko VR. Predictors of treatment failure among patients with gunshot wounds and post-traumatic stress disorder. *BMC Anesthesiol* 2021;21:263.
 11. Margaux SM, Helit N, Ben A, Tarif B, Avraham Y, Elon G. Battlefield pain management: A view of 17 years in Israel Defense Forces. *J Trauma Acute Care Surg* 2019;86:376-7.
 12. Lewis SJ, Arseneault L, Caspi A. et al. The epidemiology of trauma and post-traumatic stress disorder in a representative cohort of young people in England and Wales. *Lancet Psych* 2019;6:247-56.
 13. Downie WW, Leatham PA, Rhind VM, Wright V, Branco JA, Anderson JA. Studies with pain rating scales. *Ann Rheum Dis* 1978;37:378-81.
 14. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand* 1983;67:361-70.
 15. Boxley L, Flaherty JM, Spencer RJ, Drag LL, Pangilinan PH, Bieliauskas LA. Reliability and factor structure of the Hospital Anxiety and Depression Scale in a polytrauma clinic. *J Rehabil Res Dev* 2016;53:873-80.
 16. Keane TM, Caddell JM, Taylor KL. Mississippi Scale for Combat-Related Post-traumatic Stress Disorder: three studies in reliability and validity. *J Consult Clin Psychol* 1988;56:85-90.
 17. Bhattarai JJ, Oehlert ME, Weber DK. Psychometric properties of the Mississippi Scale for Combat-Related Post-traumatic Stress Disorder based on veterans' period of service. *Psychol Serv* 2020;17:75-83.
 18. Chaban O, Khaustova O, Bezsheiko V. Reliability and validity of Chaban quality of life scale: ECNP; 2016 [Available from: <https://www.ecnp.eu/presentationpdfs/70/P.2.h.301.pdf>].
 19. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods* 2007;39:175-91.
 20. Kanada Y. Statistical analysis using free statistical software EZR (Easy R) [in Japanese]. *J-STAGE* 2015;56:2258-66.
 21. Janssens A, Martens FK. Reflection on modern methods: Revisiting the area under the ROC Curve. *Int J Epidemiol* 2020;49:1397-403.
 22. Betelman Mahalo Y, Avital G, Radomislensky I. et al. Pain management for casualties receiving life-saving interventions in the prehospital scenario: Raising awareness of our human nature. *J Trauma Acute Care Surg* 2021;91:S201-s5.
 23. Rhon DI, Teyhen DS, Kiesel K. et al. Recovery, Rehabilitation, and Return to Full Duty in a Military Population After a Recent Injury: Differences Between Lower-Extremity and Spine Injuries. *Arthrosc Sports Med Rehabil* 2022;4:e17-e27.
 24. Meerwijk EL, Larson MJ, Schmidt EM. et al. Nonpharmacological Treatment of Army Service Members with Chronic Pain Is Associated with Fewer Adverse Outcomes After Transition to the Veterans Health Administration. *J Gen Intern Med* 2020;35:775-83.
 25. Adams RS, Meerwijk EL, Larson MJ, Harris AHS. Predictors of Veterans Health Administration utilization and pain persistence among soldiers treated for postdeployment chronic pain in the Military Health System. *BMC Health Serv Res* 2021;21:494.
 26. Meerwijk EL, Adams RS, Larson MJ, Highland KB, Harris AHS. Dose of Exercise Therapy Among Active Duty Soldiers With Chronic Pain Is Associated With Lower Risk of Long-Term Adverse Outcomes After Linking to the Veterans Health Administration. *Mil Med* 2022;188:e1948-56.
 27. Inoue C, Shawler E, Jordan CH, Moore MJ, Jackson CA. Veteran and Military Mental Health Issues. *StatPearls*. Treasure Island (FL): StatPearls Publishing, 2024.
 28. Cvitanušić S, Britvić D, Filipčić I, Frančišković T. Predictors of Chronic Combat-Related Post-Traumatic Stress Disorder Group Psychotherapy Favorable Outcomes; A Prospective Cohort Study in Croatia. *Psychiatr Danub* 2022;34:455-63.
 29. O'Toole BI, Burton MJ, Rothwell A, Outram S, Dadds M, Catts SV. Intergenerational transmission of post-traumatic stress disorder in Australian Vietnam veterans' families. *Acta Psychiatr Scand* 2017;135:363-72.

