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Correlation between cephalgia and chronic stress progression in wartime

Pavlo Ometsynskyi*

Medical Intern
Municipal Non-Profit Enterprise "1st City Polyclinic in Lviv"
79000, 20 Ruska Str., Lviv, Ukraine
https://orcid.org/0009-0002-5932-298X

Abstract. The aim of this study was to explore the main correlations between chronic stress and the progression of cephalalgia in Ukrainian refugees. A total of 83 Ukrainian refugees participated in the study, with data collected using a questionnaire-based method. The most significant differences in stress levels were observed between the age groups of 14-19 years and 35-39 years ($p = 0.009$). This finding supports the hypothesis that stress influences the development of cephalalgia and highlights that stress levels differ significantly between these age groups, likely due to the distinct life circumstances and stressors characteristic of each group. Using one-way analysis of variance (ANOVA), the F statistic was calculated to compare variations between groups and within each group. For instance, a value of $F = 2.19$ at $p = 0.035$ demonstrated a statistically significant difference in stress levels among different age groups. This result indicated that age had a noticeable effect on stress levels, and consequently, on the progression of cephalalgia. Additionally, the correlation coefficient between participants' age and stress was found to be -0.101 at $p = 0.006$. This revealed a weak but statistically significant inverse relationship between age and the stress indicator. Given that p-value is below 0.05, this correlation can be considered significant. Although the relationship was weak, it suggested a small but clinically relevant connection between chronic stress and cephalalgia as influenced by age

Keywords: refugees; headache; fear; anxiety; neurological disorders

INTRODUCTION

The year 2022 marked a turning point for the world after the COVID-19 pandemic, particularly for Ukrainians. The war brought not only physical destruction but also profound psychological stress, which manifested in a range of physical symptoms, among which cephalalgia (headache) emerged as one of the most prevalent. A key issue is that populations affected by military actions often suffer from chronic cephalalgia, which worsens under constant stress and proves challenging to treat.

According to N.M. Malinovska & I.A. Andriychuk [1], emotional trauma resulting from military actions induces severe stress, which may be both acute and chronic, persisting in the victim's life. Prolonged stress impacts all aspects of life and leads to serious mental health consequences, including post-traumatic stress disorder (PTSD), depression, anxiety, sleep disturbances, and other psychosomatic issues. The authors noted that the most detrimental effects on war victims arise from auditory and visual stimuli associated with explosions, as well as the loss of loved ones. These factors are often accompanied by fear, anxiety, and severe headaches. To mitigate such anxiety, the authors suggested engaging in basic psychological self-education to provide foundational support to loved ones prior to seeking professional assistance. S.Y. Romanenko [2] and L. Stovner *et al*. [3] emphasised that children are particularly vulnerable to cephalalgia and chronic stress due to their developing and highly malleable psyches. Their research highlighted that 15% to 50% of visits to paediatric neurologists and psychiatrists are related to complaints of headaches and anxiety. 62% of these cases involve primary cephalalgia, while the remainder are secondary. The study also notes a gender difference in reported cases: 38% of girls report cephalalgia compared to 27% of boys, suggesting that boys may exhibit greater mental resilience to stress.

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*Corresponding author

Under conditions of constant danger, uncertainty, and anxiety, stress-induced headaches become a frequent physiological response to the stressors of war. The progression of cephalalgia is closely associated with chronic stress, particularly in situations of aggression, where individuals experience significant psychological pressure. Stress in military contexts can be particularly intense due to fear, anxiety, traumatic events, and other factors that contribute to the development or exacerbation of cephalalgia. N.V. Lebedynets & A.S. Negriy [4] described similar phenomena in their work, drawing parallels between anxiety-induced cephalalgia and the processes of accelerated ageing. Cortisol, the primary stress hormone, plays a critical role in many bodily processes. Under conditions of chronic stress, persistently elevated cortisol levels can significantly impact health and expedite ageing. Post-traumatic cephalalgia is often accompanied by fluctuations in cortisol and adrenaline levels. In control groups at rest or without stress, normal cortisol levels range between 6-23 µg/dl (micrograms per decilitre) in the blood. However, during intense stress, cortisol levels can rise to 30-50 µg/dl, depending on the stress's intensity and duration.

Similar changes have been noted by N. Yatsuk *et al*. [5] and S. Freischmidt [6], who highlighted those post-traumatic disorders, particularly those arising from military conflicts, are frequently characterised by cephalalgia, often as a primary symptom. These researchers concluded that creating comfortable and peaceful conditions helps reduce stress levels, thereby minimising cephalalgia. The highest levels of stress and severe headaches were reported among Ukrainian refugees who fled the country before or at the onset of the war and among military personnel. Among refugees, approximately 35-40% are prone to cephalalgia or tension headaches caused by chronic stress. Among military veterans diagnosed with PTSD, the prevalence of headaches reaches 60-65%. In contrast, the lowest levels of anxiety and headaches were observed in individuals who chose to remain in Ukraine despite the ongoing danger. This decision appeared to provide a modest sense of stability, sparing them from the severe symptoms experienced by others.

It is important to note that women of reproductive age were significantly impacted by chronic stress resulting from the war. This stress was primarily manifested in menstrual dysfunction among young girls and hormonal imbalances [7]. Additional complications included difficulties with conception and the development of neoplasms in the uterine cavity and ovaries, which have proven challenging to treat [8]. Clinically, these women often experienced severe migraine attacks, and in some cases, gave birth to anxious newborns. Such conditions require timely diagnosis and appropriate treatment. I. Petukhova *et al.* [9] emphasised the importance of prioritising the prevention and mitigation of stress as a key provocateur of cephalalgia, alongside the timely management of anxiety disorders. However, notable gaps remain in the research, particularly regarding the mechanisms underlying the development of cephalalgia during wartime and its correlation with chronic stress. The aim of this study was to determine the influence of chronic stress on the development and progression of cephalalgia in Ukrainian refugees. The specific objectives were: to describe the characteristics of cephalalgia resulting from chronic stress caused by military conflict; to provide basic recommendations for preventing or alleviating manifestations of stress-related cephalalgia among Ukrainian refugees.

MATERIALS AND METHODS

To achieve the research objectives, a questionnaire method was employed. The survey was conducted in 2024 at the Municipal Non-Profit Enterprise "1st City Polyclinic in Lviv" in Lviv, Ukraine, among Ukrainians affected by the war who remain in Ukraine, as well as Ukrainian refugees residing in Poland and Spain. Refugees from both countries were combined into a single general group, without division by location. Participants were selected based on key criteria: Ukrainian refugees from areas affected by hostilities (primarily from the eastern regions of Ukraine) and individuals who witnessed or experienced shelling and missile attacks (residents of the northern, southern, and western regions of Ukraine). A total of 83 individuals participated in the study, comprising 52 women and 31 men across various age groups. The participants were recruited six months prior to the full-scale invasion and within six months following 24 February 2022. The study was conducted face-to-face and anonymously, with participants fully informed about the measures taken to ensure the confidentiality of their personal information. They were also made aware of the study's purpose, as well as any potential risks associated with participation. All participants provided informed consent for their involvement in the survey and the collection of their data.

To assess levels of anxiety and sleep quality, in addition to the core questionnaire focusing on headache, participants were asked detailed questions regarding their psycho-emotional state and sleep patterns. The study did not analyse dynamic changes over time; rather, it focused on comparing survey responses before the invasion and after the onset of war. For more detailed analysis, the participants were divided into age categories: children (0-14 years), adolescents (14-19 years), and older adults (35-39 years). It is important to note that individuals aged 19-35 were not surveyed due to the absence of this age category in the study design. This segmentation facilitated the examination of age-related differences in stress perception and the development of cephalalgia, allowing for an assessment of how different age groups responded to war-related stressors. This approach ensured a diverse sample, providing a comprehensive overview of the impact of war on the mental and physical health of individuals across different genders and age groups.

The study revealed a wide range of reactions to stressful events caused by war among different demographic groups. A standardised questionnaire was used for the survey, encompassing key parameters for assessing the presence or absence of cephalalgia (Table 1). This questionnaire facilitated the collection of data on the frequency, intensity, and duration of headaches among participants, as well as the identification of potential relationships between these symptoms and stress induced by war. The standardised approach to data collection ensured the reliability and validity of the findings.

Table 1. Sample questionnaire for investigating the presence of cephalgia

Question	Sex		Full years	Date of filling
	Males	Females		
Please indicate what type of headache you are experiencing?				
At what age did you first experience a headache?				
Does the pain move around your head?				
How long (hours) does the headache last?				
What medications are you taking (if any)?				
If you take headache medicine, how long (hours) will the headache last?				
How would you rate the severity of your headache? (on a scale from 0 – almost no pain, to 10 – very severe)				
How many hours do you sleep?				
Do you have difficulty falling asleep or staying asleep (yes, no)?				
Does a headache wake you up from a sound sleep (yes, no)?				
How many cups of coffee, tea, or caffeinated beverages do you drink (per day)?				
Has this figure (number of cups) changed after February 2022?				
Do you smoke? If so, how long have you been smoking (in years)?				
How often do you drink alcohol (per month)?				
If you are employed, please indicate the nature of your work (check one or more options): 1. Stationary. 2. Mobile. 3. Physical. 4. Working with a computer. 5. Working with people. 6. Flexible schedule. 7. Military.				
How concerned are you about your overall health (scale from 0 – I feel completely healthy to 10 – very concerned)				
Do you do any form of sports or physical exercise?				
How relaxed or tense did you feel until February 2022? (scale from 0 – completely relaxed to 10 – extremely tense)				
How relaxed or tense do you feel right now? (scale from 0 – completely relaxed to 10 – extremely tense)				
How frequent have your headache attacks (per month) been over the past 2 years?				
In your opinion, to what extent did martial law conditions affect the frequency and severity of your headaches? (scale from 0 – did not notice to 10 – very much affected)				

Source: created by the author

To analyse the effects of chronic stress, fear, and anxiety on health, respondents were categorised into three groups: healthy, mildly ill, and seriously ill. This classification considered their lifestyle, including alcohol and tobacco consumption. The healthy group comprised individuals without any underlying pathology, while the mildly ill and seriously ill groups included those with existing chronic diseases or conditions in the acute phase. Chronic conditions in these groups included cardiovascular diseases (e.g., ischaemic heart disease, diffuse cardiosclerosis, prior myocardial infarction, hypertension), chronic inflammatory diseases of the respiratory and digestive systems, and musculoskeletal disorders. This categorisation enabled an investigation of how varying health statuses and behavioural factors, such as alcohol and tobacco use, interact with stress and influence overall health. The results of this analysis provided valuable insights into the role of lifestyle in determining respondents' resilience to stress and identified population groups most vulnerable to the adverse effects of chronic stress.

One-way analysis of variance (ANOVA) was employed to detect statistically significant differences between the means of multiple groups classified based on a single independent variable or factor. This method enabled researchers to evaluate whether an independent variable (such as age, education level, or other characteristics) significantly influenced changes in the dependent variable. One-way ANOVA compared the variation within groups to the variation between groups, allowing determination of whether differences in means are attributable to the independent variable or random fluctuations. This approach provided data on the F statistic, which measured the relative magnitude of variation between groups compared to within groups. In this analysis, the main groups were compared based on age and gender, with the severity of cephalalgia symptoms serving as the primary dependent variable.

A t-test was conducted to assess statistically significant differences in headache frequency between military personnel, refugees affected by war, and pre-war baseline indicators. The primary objective of this test was to evaluate whether the differences in headache frequency or intensity between these groups were statistically significant when compared to pre-war data. If the obtained t-value exceeded the critical t-value, the null hypothesis was

rejected, indicating a statistically significant difference in headache frequency between military personnel, refugees, and pre-war data. The critical t-value was set at 0.01 (1%), establishing a significance level of 0.01. This implied that there was a 1% probability of incorrectly rejecting the null hypothesis. This study adhered to the principles outlined in the Declaration of Helsinki on ethical principles for medical research involving human subjects [10], and informed consent was obtained from all participants.

RESULTS

Analysis of stress factors impact on the frequency of cephalgia among different demographic groups

The study included 83 participants, comprising 52 women and 31 men from various age groups. This diverse sample allowed for the collection of comprehensive data, enabling the consideration of gender and age differences in the analysis. The survey results revealed significant variations in stress responses and the occurrence of cephalalgia between men and women. These findings indicate the presence of gender differences in participants' reactions, which may reflect distinct perceptions or experiences of the phenomena under investigation (Table 2). Such differences warrant further analysis to gain a deeper understanding of their nature and to account for them when interpreting the study results. Notably, refugee women exhibited a stronger reaction to life stressors compared to refugee men. This suggests that women may respond more acutely to stressful situations or perceive a higher level of tension in daily life.

Table 2. Comparative characteristics of the frequency of cephalgia attacks depending on gender and age

Characteristics	Refugee men (total number in the group)	Refugee women (total number in the group)	Frequency of attacks of cephalgia in men of this group	Frequency of cephalgia attacks among women of this group
Age 0-14 years	8 people	10 people	5 cases (62.5%)	4 cases (40%)
Age 14-19 years	14 people	11 people	9 cases (64.2%)	8 cases (72.7%)
Age 35-39	9 people	31 people	8 cases (88.8%)	26 cases (83.8%)
Military (out of the total number, those who were discharged from military service)	2 people	-	2 cases (100%)	-
Other complaints	Complaints of anxiety, depression. Phantom pain – the military	Complaints of anxiety, depression, reproductive system disorders	-	-
Comments	-	-	The group of people aged 14-19 perceived any stress factors with vulnerability and the frequency of cephalgia attacks increased	Women had more frequent attacks of cephalalgia than men in the age group 35-39 years

Source: created by the author

These differences may be attributed to both psychological and sociocultural factors that influence the perception and experience of stress across different gender groups. The correlation coefficient between participants' age and the studied indicator was -0.101 at $p = 0.006$. This represents a weak but statistically significant inverse relationship between age and the occurrence of the studied indicator. With p-value of 0.001 (or 0.1%), the results are statistically significant, allowing for the rejection of the null hypothesis. An increase in cephalalgia attacks was observed within the group reporting severe cephalalgia (Table 3). Despite the small correlation coefficient, the findings suggest that as participants' age increases, the studied indicator tends to decrease slightly.

Table 3. Dynamics of the main indicators of respondents before the start of the full-scale invasion and after (before February 24, 2022 and after)

Category of respondents	Increase of cephalgia attacks (per month)								
	Before 24.02.2022	After 24.02.2022	%	Average value		Decreasing the coefficient		Average value taking into account the coefficient	
				In category	Total		In category	In category	Total
Healthy	2.3	3.1	34.8	56.8%	62.1%	1	66.7%	34.8%	60.4%
Mild cephalgia	3.7	6.8	83.8			1.5		125.7%	
Severe cephalalgia	5.2	7.9	51.9			2.5		129.8%	

Source: created by the author

Children and adolescents were combined into a single group, referred to as the younger group. The most severe stress levels and, consequently, the most complex cases of cephalalgia in a war context were observed in this younger

group, aged 14-19 years. One-way ANOVA revealed a significant difference in stress levels among the different age groups ($F = 2.19$, $p = 0.035$). The most pronounced differences were identified between the 14-19 and 33-39 age groups ($p = 0.009$). These findings suggest that younger individuals experience war-related stress more acutely than adults, potentially due to lower life resilience or limited experience in managing extreme situations. The study also accounted for lifestyle factors, including smoking and alcohol consumption (Table 4). This approach allowed for an analysis of how varying health behaviours interact with stressful conditions and influence overall health outcomes. The results provided valuable insights into which population groups are most vulnerable to the adverse effects of stress and highlighted lifestyle modifications that could contribute to improved health under conditions of chronic stress.

Table 4. Distribution of respondents depending on lifestyle and bad habits

Category of respondents	Increase of cephalgia attacks (per month)							
	Before 24.02.2022	After 24.02.2022	%	Average value		Decreasing the coefficient		Average value taking into account the coefficient	
				In category	Total		In category	In category	Total
Lead an active lifestyle	2.5	4.8	92	79%	62.1%	1	50%	92%	60.4%
Lead a sedentary lifestyle	4.7	7.8	66			2		131.9%	
Smoke	4.5	7.7	71.1	64.7%		2	50%	142.2%	
Do not smoke	2.4	3.8	58.3			1		58.3%	
Moderate or no alcohol consumption	4.6	6.1	32.6	50.6%		1.5	75%	48.9%	
Often drink alcohol	3.5	5.9	68.6			2		137.1%	

Source: created by the author

The overall level of stress, and consequently the risk of cephalalgia, was closely associated with the number of traumatic factors, including exposure to episodes of military operations. This indicates that the greater the exposure to traumatic situations, the higher the level of perceived stress experienced. This relationship underscores the importance of considering the number and intensity of adverse events in a person's life when assessing their psycho-emotional state and developing appropriate supportive measures. The study revealed that perceived stress levels significantly increased in participants under the following circumstances: direct experience of a difficult event ($p = 0.022$), witnessing the misfortunes of others ($p = 0.004$), traumatic events involving loved ones and friends ($p = 0.015$), and intense fear of potential misfortunes or threats ($p = 0.005$). These findings demonstrate that not only personal experiences of trauma but also empathy for others and fear of possible dangers have a considerable impact on stress levels. A negative correlation was observed between the level of perceived stress and the intensity of positive emotions experienced in the weeks following the onset of the war. This suggests that higher levels of stress are associated with fewer positive emotions [10]. Conversely, perceived stress was positively correlated with the intensity of negative emotions, indicating that greater stress leads to more intense negative emotional experiences. Furthermore, direct and significant correlations were identified between perceived stress levels and symptoms of anxiety and depression ($p = 0.000$). This highlights the importance of assessing perceived stress as a critical indicator of potential psychophysiological disorders. High levels of perceived stress may predict the onset of anxiety and depressive disorders, emphasising the need for early detection and intervention to prevent serious mental health conditions.

Comprehensive approach to the treatment of cephalgia

The findings of the study underscore the critical importance of preventing and treating neurological disorders that contribute to cephalalgia. Key measures include psychological and social support, pharmacological treatment, physical activity, and various relaxation techniques. Providing psychological support and counselling to survivors of military conflicts is essential in helping them overcome stress and manage their emotions. Military conflicts often result in profound psychological trauma, frequently accompanied by elevated stress levels [11]. Psychological support plays a vital role in mitigating this stress by teaching relaxation techniques, fostering resilience, and managing anxiety. Following a conflict, individuals may experience a range of negative emotions, including fear, anger, sadness, and despair. Psychological counselling helps stabilise emotional states, build self-control skills, and encourage the constructive expression of feelings. A crucial component of psychological support involves addressing PTSD and other psychological consequences of conflict [12]. Therapy may focus on overcoming traumatic memories, rebuilding self-esteem, and facilitating a return to normal life. In addition to individual counselling, group therapy offers a platform for individuals to share their experiences and provide mutual support. This collective approach helps to alleviate feelings of isolation and alienation. Survivors of military conflicts often encounter challenges in adapting to civilian life. Psychological support aids in developing adaptive skills, addressing new life challenges, and setting positive goals for the future.

The results indicate that treating cephalalgia (headache) often requires an integrated approach, which may include the use of various medications. Depending on the type and intensity of the headache, the following categories of medications may be prescribed: analgesics, anti-inflammatory drugs, psychotropic medications (to alleviate stress and anxiety), and specific treatments for migraines. Headache treatment is tailored to the individual, considering the type of cephalalgia, pain intensity, and accompanying symptoms. In addition to managing acute pain, preventive measures are often recommended, involving the long-term use of antidepressants, antiepileptic drugs, or beta-blockers to reduce the frequency of headache attacks [13-15]. Lifestyle modifications are also advised, including avoiding headache triggers, ensuring regular rest, engaging in physical activity, and maintaining a nutritious diet.

As part of the study, a survey was conducted to assess anxiety and sleep among Ukrainian refugees, particularly those affected by shelling in Ukraine. The impact of these sleep changes on the effectiveness of cephalalgia treatment, especially in terms of the frequency of headache episodes, was also evaluated. The findings showed that a 50% reduction in headache frequency was associated with improved sleep quality and psychosocial factors. This suggests that better sleep not only alleviates the physical symptoms of migraine but also enhances the psycho-emotional well-being of patients, ultimately improving treatment outcomes. Participants were selected based on specific criteria: Ukrainian refugees from areas experiencing active hostilities (primarily in eastern Ukraine) and individuals who had witnessed or been victims of shelling and rocket attacks (residents of northern, southern, and western Ukraine). To assess anxiety and sleep quality, the questionnaire included detailed questions about the psycho-emotional state and sleep patterns in addition to primary questions about cephalalgia. The study did not focus on dynamic changes over time but instead aimed to compare survey results before the invasion with those collected after the start of the war.

Dependence of cephalgia occurrence on military stressful conditions

Military conflicts significantly increase the risk of developing or exacerbating cephalalgia (headaches) due to exposure to various stressors, trauma, and adverse conditions. Chronic stress, driven by a persistent sense of danger, anxiety, and uncertainty, is a potent trigger for headaches [16, 17]. Stress activates the sympathetic nervous system, potentially causing muscle tension, vascular changes, and, consequently, cephalalgia. Combat participants often endure both physical and psychological trauma. Traumatic brain injuries are a common cause of post-traumatic headaches, while psychological traumas, such as PTSD, are strongly associated with frequent headaches. Furthermore, the conditions under which military personnel operate often prevent them from achieving regular, high-quality sleep – an essential factor in headache prevention. Sleep deprivation or poor sleep quality can contribute significantly to the development of cephalalgia [18]. In the challenging environment of military conflicts, access to adequate water and food is often limited, leading to dehydration and nutritional deficiencies – both recognised triggers for headaches. Additionally, the constant noise from explosions, gunfire, and other combat activities can provoke cephalalgia, particularly in individuals already suffering from migraines or other headache disorders. Given these contributing factors, military conflicts not only lead to new cases of cephalalgia but also markedly worsen the condition of those with pre-existing headaches [19, 20]. This underscores the critical need for comprehensive medical and psychological support for victims, along with the development of specialised rehabilitation programmes for combatants to mitigate the risk and alleviate the symptoms of cephalalgia.

War conditions, including anxiety, fear, and traumatic experiences, can significantly increase the intensity and frequency of headaches in individuals affected by conflict. The constant psychological pressure and emotional stress associated with military conflicts not only exacerbate existing headaches but also contribute to new cases of cephalalgia, further deteriorating the overall health of those affected. This underscores the urgent need to establish or expand specialised centres for the treatment of headaches and migraines, a critical step towards enhancing the quality of medical care during wartime. Such centres should be staffed with specialists experienced in managing these conditions [21, 22]. The development of facilities focused on the diagnosis and treatment of headaches and migraines – leveraging advanced medical technologies and innovative treatment methods – represents a significant advancement in the prevention and management of cephalalgia. To ensure comprehensive care, it is essential to involve a multidisciplinary team of specialists, including neurologists, psychotherapists, physiotherapists, and dietitians. These integrated efforts can significantly improve the quality of life for patients by providing necessary support and effective treatments, irrespective of their location.

DISCUSSION

The results of the study indicate significant gender differences in stress responses and the development of headaches. A survey of 83 participants, comprising 52 women and 31 men, revealed distinct variations in responses to stressors, often resulting in differing frequencies of headaches. These findings suggest both biological and psychological differences between the sexes in their perception of stress, as well as the influence of social factors such as gender roles and expectations. Women may exhibit greater susceptibility to stress due to a combination of physiological factors (e.g., hormonal fluctuations) and social pressures (e.g., balancing career and family responsibilities). These factors could make women more vulnerable to stress and its physical manifestations, such as headaches. In contrast, men may experience such symptoms less intensely, potentially due to different stress-coping mechanisms or cultural norms that encourage emotional suppression or the dismissal of physical symptoms [23]. The observed gender differences may also reflect disparities in how men and women interpret and report stressful situations. Women may be more inclined to openly discuss their emotional and physical reactions, while men might avoid such discussions. This variance in self-reporting can influence the identification of stress-related issues and may partially explain the differences observed in survey results.

S. Kind & J.D. Otis [24] discussed the close connection between the occurrence of cephalalgia and PTSD. This aligns with the findings of the present study, as chronic stress caused by war and the onset of cephalalgia are closely related but cannot be classified strictly as PTSD. Additionally, this disorder differs from the condition described in the study, as PTSD is more commonly diagnosed in military personnel than in civilian refugees. Patients with PTSD often experience elevated levels of anxiety, depression, and disability, and show a greater tendency to use opioids for pain relief. This dual burden significantly worsens their condition and complicates both treatment and recovery processes. Notably, such individuals frequently report the progression of cephalalgia symptoms alongside heightened anxiety when recalling traumatic events. Similar findings were observed by J.V. Miller *et al*. [25], who investigated structural brain changes associated with cephalalgia. They found that cephalalgia most commonly affected younger individuals, with headache frequency linked to an increase in radial diffusion within the brain. An increase in radial diffusion suggests a disruption in white matter integrity, which could impair neural pathways involved in pain transmission. These changes may lead to more frequent and intense headaches and an increased risk of chronic pain. PTSD can induce structural changes in the brain that contribute to the chronicity of headaches. Specifically, PTSD may cause alterations in key brain regions such as the amygdala and hippocampus, which are crucial for emotion regulation and the stress response. These structural changes can heighten pain sensitivity and increase the frequency and duration of headaches, making them more resistant to treatment and potentially leading to chronic pain.

According to A. Stubberud *et al*. [26] and K. Al-Quliti [27], stress is frequently identified as a significant trigger for migraines, yet the mechanisms by which it influences the onset and progression of the disease remain poorly understood. Further research is necessary to elucidate how stress factors contribute to the initiation and chronic course of migraines. Additionally, stress trigger patterns are highly individualised, making it challenging to establish general cause-and-effect relationships. This heterogeneity implies that stress impacts migraine development differently across individuals, necessitating a more personalised approach to both research and treatment. Chronic stress can lead to cortical sensitisation and increased excitability of the cerebral cortex, which may provoke migraine attacks, contribute to the chronicity of migraines, and exacerbate symptoms. The authors noted that stress can worsen cephalalgia episodes, intensifying symptoms such as photophobia and anxiety, which further deteriorate the patient's overall condition. This highlights the importance of stress management as a critical component of migraine treatment and prevention. However, these observations require robust research validation to substantiate their relevance, though they provide a foundation for future studies. B. Colombo *et al.* [28] examined cephalalgia associated with stress in children, a focus distinct from the present study, which primarily involved adult participants but included some adolescents to draw age-based parallels. His findings suggest that chronic stress in childhood has long-term detrimental effects, with recovery and psychological adaptation taking significantly longer in children than in adults due to the immaturity of the developing brain and psyche. D. Smirni & M. Carotenuto [29] reached similar conclusions, linking prolonged stress in children to long-term health effects. They further explored the relationship between parental stress, particularly maternal stress, and the child's mental state. Their study demonstrated that children closely internalise parental concerns – especially maternal worries – regardless of gender. M. Vives-Mestres *et al.* [30] and B.M. LiaBraaten *et al*. [31] corroborated this, noting that maternal migraines and associated fears about the future often lead to poorly controlled cephalalgia in children, which responds only to interventions addressing the psycho-emotional state. This approach emphasises the significance of examining the interplay between maternal stress and children's physiological responses, a relationship that has been insufficiently explored. Such comprehensive research enhances the understanding of how maternal stress affects child health, potentially paving the way for novel preventative and therapeutic strategies. Moreover, studies investigating structural brain changes associated with cephalalgia provide further evidence of its impact. Research supports the hypothesis of sympathetic dysfunction, revealing significantly lower serotonin and norepinephrine levels in individuals with PTSD and those suffering from migraines. These findings suggest a potential link between impaired neurotransmitter systems and increased sensitivity to stress, contributing to both the onset and chronicity of migraines. Additional research in this area could deepen our understanding of migraine pathophysiology and lead to innovative treatment possibilities.

O. Babateen *et al*. [32] and E.K. Seng [33] provided a thorough evaluation of cephalalgia in the context of its comorbidity with mental disorders, particularly anxiety and depression, within the framework of PTSD. Similar conclusions were drawn in the present study. This alignment is consistent with the understanding that cephalalgia rarely occurs without an underlying cause; it is often preceded by a specific "catalyst". In the current study, only 8.9% of participants reported suffering from migraines, a figure notably lower than the global prevalence of migraines, which stands at approximately 14%. This discrepancy may be attributed to various factors, including the specificity of the sample, diagnostic criteria, or methodological differences in research approaches. The reduced prevalence of migraines in this sample may also suggest the presence of certain local factors influencing the frequency of the condition, which warrants further investigation. Following the onset of pulsatile cephalalgia, symptoms such as photophobia, phonophobia, nausea, and vomiting were observed, though these occurred less frequently than reported in other studies. In contrast, the most common complaints associated with cephalalgia among participants were anxiety, fear, and occasionally depressive states. Notably, these symptoms were significantly more prevalent among women. These findings reinforce the widely recognised observation that migraines are more prevalent in women and tend to present with more pronounced symptoms. This gender difference may be attributed to hormonal, genetic, and other biological factors. Such data highlight the importance of considering gender-specific characteristics when

studying and managing migraines.

S. Fuensalida-Novo *et al*. [34] and F. Viero *et al*. [35] have reported significant gender differences in the prevalence and manifestation of chronic stress-related headaches. These differences are particularly notable among men and women with tension-type headaches and should be carefully considered by clinicians when managing this condition. Gender-specific factors may influence the effectiveness of therapeutic interventions, underscoring the need for individualised treatment approaches tailored to the needs of each gender. Research suggests that multimodal treatment strategies, which integrate various therapeutic modalities, yield better outcomes for individuals with tension-type headaches. However, the development and implementation of such strategies must account for potential gender differences to optimise symptom management and enhance the quality of life for patients.

Some scientists have paid attention not only to mental changes during attacks of cephalgia, but also to structural, chemical processes as a result of the mental trauma suffered. Thus, A. Sannes *et al*. [36] and B. Tuka *et al.* [37] proved that the occurrence of cephalgia is associated with some genetic features in the C allele of the NRCAM gene (rs2300043), that is, it was significantly stronger compared to other men in this study. This indicates a possible genetic predisposition to increased sensitivity to stressful situations, which is manifested through the manifestation of headache. The discovery of such a connection emphasises the importance of taking genetic factors into account when studying and treating headache, especially in men with this genetic variation. Other and distinctive are the studies of N. Tamulevicius *et al*. [38], and E. Caronna & P. Pozo-Rosich [39], which demonstrated the interaction of viral load during the coronavirus pandemic in stressed students with cephalgia. During the survey of students, it was found that all of them experienced less severe symptoms of cephalgia compared to people who had experienced stress as a result of war. In addition, changes were noted in the blood and brain structure, which are characteristic of viral diseases. According to the results of the study by N. Shah *et al.* [40], patients need to be educated about the nature of their condition and possible triggers that can cause or exacerbate symptoms. The authors described 549 people with severe symptoms of cephalgia of various genesis. These patients were treated with medication and psychotherapy. As a result, most of them were able to achieve remission. It should be noted that when using psychotherapeutic correction, recovery came faster. What is distinctive in this study is that the scientist included people with a symptom complex: headache, giant cell arteritis, sleep apnea. Each patient suffering from primary headaches should keep a detailed headache diary. It is necessary to record each headache episode: its duration, intensity, possible triggers, as well as factors that aggravate or relieve symptoms. This approach will help to identify patterns and improve the effectiveness of treatment, as it allows you to better understand the impact of various factors on the patient's condition.

M. Westergaard *et al.* [41] and D. McGeary *et al*. [42] emphasised the challenges in estimating the prevalence of comorbid PTSD and pain among refugees due to several factors. The high mobility of refugee populations complicates long-term follow-up and regular medical monitoring. This study included 172 individuals with prolonged cephalalgia who had experienced stressful events resulting in the development of PTSD. Individuals with predominant psychotic disorders were excluded from the analysis. The outcomes of cephalalgia treatment before and after intervention were compared. Following treatment, significant improvements were observed, including symptom relief, the absence of depressive and anxiety symptoms related to headaches, and an overall enhancement in quality of life. Refugees often endure multiple traumatic experiences, complicating the differentiation between various mental and physical consequences of trauma [43]. This study differs from the presented work in terms of sample size, the severity of cephalalgia symptoms, and the applied treatment methods. In this case, psychotherapeutic interventions were the most effective for addressing cephalalgia and anxiety, contrasting with findings from other researchers. This effectiveness is attributed to the neurotic nature of the symptoms and the absence of psychotic disorders, as highlighted by comparisons with other studies. Limited access to healthcare services in many refugee settings further hinders the regular evaluation of psychological and physical health, complicating diagnosis and care delivery.

M. Delussi *et al*. [44] and T.J. Schwedt [45] conducted a survey of 202 women with cephalalgia (with and without aura) to identify characteristics of headaches in women. These studies differed from the current work as they focused solely on women experiencing headaches of various origins, predominantly due to stress, anxiety, and overwork. Among the participants, 190 reported that headache symptoms worsened during periods of physiological hormonal fluctuations. The authors noted that women exhibit greater sensitivity to stressors and, consequently, to cephalalgia compared to men, irrespective of a migraine diagnosis. This phenomenon is supported by extensive studies in both animals and humans, which highlight biochemical differences in stress responses between the sexes. A. Polk *et al*. [46] and I. Patniyot & W. Qubty [47] examined 147 individuals with cephalalgia across diverse nationalities, age groups, and genders. Their findings revealed that migraines were generally milder in men than in women. The authors attributed this difference to hormonal factors, particularly fluctuations in oestrogen levels, which influence the body's stress response. Hormonal changes in women, such as those during the menstrual cycle, pregnancy, or menopause, were found to increase vulnerability to stressors, subsequently affecting the frequency and severity of migraines and other stress-related conditions. When comparing age categories, adolescents experienced headaches more frequently than adults, regardless of the presence of stressors. This observation suggests that hormonal changes during adolescence may play a role in the increased prevalence of headaches within this age group.

V. Baglioni *et al.* [48] and G. Lambru *et al*. [49] provided valuable insights into cephalalgia in children and adolescents, comparing their findings with symptoms observed in adults. The authors highlighted that the presentation of headaches in children differs significantly from that in adults and even adolescents. Notably, among 125 children examined by neurologists in their study, 102 presented with

cephalalgia accompanied by a range of other psychoneurological symptoms, which precluded defining cephalalgia as an independent diagnosis [50]. In contrast to earlier studies and the presented research, D. Kamonseki *et al*. [51] and S. Ashina *et al.* [52] concluded that stress-induced headaches in children and adolescents often have a compressive nature. Furthermore, such headaches can arise even in war conditions, a finding consistent with the observations of the present study. It is noteworthy that while this study focused on the age-related aspects of cephalalgia, it did not incorporate gender as a variable for analysis. The greatest diagnostic challenge identified was in newborns, owing to the inability to conduct direct surveys or comprehensive examinations. These findings suggest that stress in wartime conditions has a significant impact on the development and exacerbation of cephalalgia symptoms. Moreover, cephalalgia is often accompanied by increasing levels of anxiety and depression, compounding the burden on affected individuals.

CONCLUSIONS

The study demonstrated that stress contributes to an increase in the frequency and intensity of cephalalgia. The majority of respondents reported a deterioration in their health, characterised by a higher frequency of cephalalgia attacks under conditions of heightened stress and tension. A one-way ANOVA revealed a significant difference in stress levels among different age groups ($F = 2.19$, $p = 0.035$). The most pronounced differences were observed between the 14-19 and 35-39 age groups ($p = 0.009$), indicating that younger individuals are more likely to experience elevated stress during wartime compared to adults. This heightened risk can be attributed to the effects of military conflicts, which increase the likelihood of cephalalgia onset or exacerbate pre-existing headaches due to stress, trauma, and other contributing factors. The exacerbation of symptoms in war survivors is often reflected through anxiety, fear, and the psychological impact of traumatic events, all of which intensify the frequency and severity of cephalalgia.

Comprehensive programs aimed at restoring psychological health and facilitating societal reintegration for survivors play a critical role. Given the established link between stress and cephalalgia, it is imperative to ensure that war survivors have access to psychological support and treatment. Effective management of cephalalgia in such individuals may require a multidisciplinary approach, combining pharmacological treatments with psychological and social interventions to achieve optimal symptom control. The findings underscore the significant impact of war on the progression of cephalalgia through stressors and psychological pressure, emphasising the importance of supporting survivors of military conflicts. A limitation of the study was the exclusion of two key age categories: children and elderly individuals. Additionally, the analysis focused on cephalalgia categorised as mild or severe, with no data available for moderate severity. Future research and clinical observations are needed to further elucidate the mechanisms underlying the interaction between stress and cephalalgia during wartime, as well as to refine treatment strategies for affected populations.

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CONFLICT OF INTEREST

None.

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Кореляція між прогресуванням цефалгії і хронічного стресу в умовах війни

Павло Омецинський

Лікар-інтерн
Комунальне некомерційне підприємство «1-а міська поліклініка м. Львова»
79000, вул. Руська, 20, м. Львів, Україна
https://orcid.org/0009-0002-5932-298X

Анотація. Метою роботи було навести основні кореляції між хронічним стресом та прогресуванням цефалгії в українських біженців. Для здійснення дослідження було опитано 83 українських біженців (методом анкетування). Найсуттєвіші відмінності у рівнях стресу були виявлені між віковими групами 14-19 років та 35-39 років ($p = 0,009$). Тобто це підтверджує гіпотезу впливу стресу на розвиток цефалгії та вказує на те, що рівень стресу суттєво відрізняється між цими віковими категоріями, що може бути пов'язано з різними життєвими обставинами та стресовими факторами, характерними для кожної з груп. За допомогою однофакторного дисперсійного аналізу обчислено статистику F, яка порівнювала варіації між групами в порівнянні із результатами всередині кожної групи. Наприклад, значення $F = 2,19$ при $p = 0,035$ свідчив про те, що існувала статистично значуща різниця в рівнях стресу серед різних вікових груп, що вказує на те, що віковий фактор має помітний вплив на стресовий рівень і відповідно – цефалгію. Коефіцієнт кореляції між віком учасників дорівнював -0,101 при $p = 0,006$. Це свідчило про наявність слабкого, але статистично значущого зворотного зв'язку між віком і досліджуваним показником. Оскільки p-значення менше 0,05, можна стверджувати, що виявлений кореляційний зв'язок був значущим. Хоча зв'язок і був слабким, він вказує на те, що з віком існує невеликий, але клінічно значний зв'язок між хронічним стресом і цефалгією

Ключові слова: біженці; головний біль; страх; тривога; неврологічні розлади