A path model of associations between war-related exposure to trauma, nightmares, fear, insomnia, and posttraumatic stress among Ukrainian students during the Russian invasion

Aleksandra M. Rogowska [a,*], Iuliia Pavlova [b]

[a] Institute of Psychology, University of Opole, Opole 45-052, Poland
[b] Theory and Methods of Physical Culture Department, Lviv State University of Physical Culture, Lviv, Ukraine

ARTICLE INFO

ABSTRACT

The present study examined the associations between war-related exposure, nightmares, fear, insomnia, and PTSD symptoms among university students from Western Ukraine. An online cross-sectional study was performed among 1,072 university students (80% of whom were women) during the war. Eight questions were developed to assess exposure to war, and seven items were designed regarding nightmares of war. War-related PTSD symptoms were assessed using an abbreviated six-item PTSD checklist (PCL-6), insomnia was measured using the Athens Insomnia Scale (AIS), and to examine fear of war, the Fear of COVID-19 Scale (FoCV-19S) was adopted. Positive correlations were found between exposure to war, nightmares of war, fear of war, insomnia, and war-related PTSD. The path model using structural equation modelling (SEM) analysis showed that the chain mediation partially explains the relationship between war exposure and war-related PTSD symptoms via nightmares of war, fear of war, and insomnia among university students during the Russian invasion of Ukraine. Women scored significantly higher than men in fear of war and symptoms of insomnia and PTSD, but the path model was invariant across genders. Young adults require treatment focused primarily on nightmares, insomnia, and fear of war to prevent PTSD symptoms.

1. Introduction

From 24 February, 2022, when the Russian invasion of Ukraine began, massive military attacks have been harassing the civilian population, spreading death and destruction. The Ukrainian population is exposed every day to rocket and airstrikes using heavy artillery, destruction of civil infrastructure, and mass injuring, rape, killing, and torturing of both soldiers and civilians. Civilians must spend many hours in bomb shelters, with poor access to electricity, clean water, food, or medicine (de Alencar Rodrigues et al., 2022; Chaaya et al., 2022; Jawaid et al., 2022). According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), trauma exposure is defined as direct exposure not only to actual or threatened death but also exposure to serious injury and sexual violence. Exposure to trauma occurs when a traumatic event or a violent and accidental event was experienced personally or happened to a close family member or close friend. Trauma exposure can also occur in witnesses of such an event or in people who experience repeated or extreme exposure to the aversive

details of the traumatic event (e.g., paramedics and police officers).

In the DSM-5, post-traumatic stress disorder (PTSD) is classified as a mental health disorder that can develop as an emotional, cognitive, and behavioral response to a traumatic event. PTSD is characterized by a range of symptoms that are grouped into four clusters: (1) intrusion symptoms (reliving the traumatic event in intrusive memories, nightmares, or flashbacks of the traumatic event); (2) avoidance symptoms (efforts to avoid reminders or situations that might trigger memories of the traumatic event, including avoidance of places, people, activities, thoughts, feelings, or conversations related to the trauma); (3) negative alterations in cognitions and mood (changes in thoughts and feelings that occur as a result of the traumatic event, including persistent negative emotions and beliefs or expectations about oneself, others, or the world, distorted blaming, and feeling detached from others); and (4) arousal and reactivity symptoms (e.g., irritability, anger outbursts, or difficulty controlling behavior, reckless or self-destructive behavior, hypervigilance, problems with concentration or focus, and sleep disturbances). Additionally, individuals with PTSD commonly experience a

range of related problems that can impact their overall functioning and well-being, including depression and anxiety, substance abuse, physical health issues, difficulty with relationships, occupational and educational impairment, isolation, and social withdrawal.

In particular, exposure to a traumatic event may contribute to deteriorated sleep quality symptoms, nightmares, stressful dreams, insomnia, and nocturnal anxiety symptoms (Short et al., 2022; Weber and Wetter, 2022). Frightening dreams and war-related nightmares are commonly experienced during the war, impairing the quality of life and daily functioning of people living in military conflict zones (Davis et al., 2011; Gehrman et al., 2015; Harb et al., 2012; Harb and Schultz, 2020; Langston et al., 2010; Schultz et al., 2021). Schultz et al. (2021) suggest that students in conflict-affected areas appear to be particularly vulnerable. Trauma-related nightmares contribute to poorer sleep quality, insomnia and PTSD symptoms, which is presented particularly among veterans (Babson and Feldner, 2010; Davis et al., 2011; Gehrman et al., 2015; Harb et al., 2012; Harb and Schultz, 2020; López et al., 2019; Miller et al., 2017; Pigeon et al., 2013; Rosen et al., 2019). Moreover, nightmares and insomnia are viewed as core symptoms of PTSD (Ahmadi et al., 2022; Davis et al., 2011; Lancel et al., 2021; Lewis et al., 2020; Milanak et al., 2019). Experience of a traumatic event may also exacerbate symptoms of fear or anxiety, and vice versa. For example, Brawman-Mintzer et al. (2005) found the presence of somatic symptoms of a general anxiety disorder (GAD; e.g., muscle tension, autonomic hyperactivity, and vigilance and scanning clusters) among adults exposed to serious lifetime traumatic events. Ayazi et al. (2014) indicated that exposure to trauma is often associated with an anxiety diagnosis in war-affected populations. Furthermore, Thabed et al. (2018) showed that Palestinian children in the Gaza Strip continued to experience substantial trauma, fears, and PTSD after one and a half years of war. Fear was experienced among half of the children, and a positive association was presented between exposure to traumatic events, fear, and PTSD.

PTSD and anxiety-related disorders are frequent comorbid conditions following trauma (Beck et al., 2015). Although PTSD is not considered an anxiety-related disorder, epidemiological and neurobiological data have shown many similarities, including diagnosis, treatment, and comorbidities (Williamson et al., 2021). Common symptoms of both PTSD and GAD are mood changes (e.g., irritability, restlessness) or thinking (extreme worry), hypervigilance and concentrating problems, insomnia, sweating, avoidance of trauma cues (people, places, or things), and severe impairment or distress. Both fear and anxiety are symptoms of PTSD, according to the DSM-5. A predatory imminence theory (Perusini and Fanselow, 2015) suggests that anxiety, fear, and panic are a continuum of a coordinated brain and bodily defensive response to threats. Fear is an alarm response to present or imminent danger, whereas anxiety is a state-oriented preparation for a potentially threatening event. Although fear is an adaptive response to danger (allowing avoidance or escape from threatening situations), it can also be maladaptive if it persists in the absence of danger. Fear-based maladaptive responses (based on conditioning and associative learning processes) can be viewed as a major determinant of the development and maintenance of PTSD (Zoellner et al., 2020). However, impaired fear extinction and individual sensitivity to threat also play a key role, which can be both a factor of vulnerability and a consequence of exposure to trauma or PTSD. Data from a US Army Study showed a high prevalence of insomnia (85%), GAD (82.6%), and PTSD (69.7%) among military soldiers (Brownlow et al., 2017). Although the fear of war has been relatively rarely investigated in recent studies (e.g., Hajek et al., 2022; Kurapov et al., 2022; Pavlenko et al., 2022), to the best of our knowledge, the links between fear of war and PTSD or sleep disturbances have not been studied

Lam et al. (2023) suggest that explaining sleep-specific mechanisms underlying PTSD is crucial for future studies. Review studies have evidenced that exposure to a traumatic event can interfere with sleep problems, contributing to PTSD severity and vice versa; namely, PTSD is related to the development of sleep problems (Babson and Feldner, 2010; Miller et al., 2017). Research has shown bidirectional associations between daily PTSD symptoms and sleep disturbances among trauma-exposed adults (Slavish et al., 2022; Slavish et al., 2023). In particular, shorter sleep and poorer quality sleep predicted greater next-day PTSD symptoms, while PTSD symptoms predicted nightmares and poorer sleep quality at night. Additionally, Short et al. (2018) indicated that among people with clinical PTSD, nightmares could be predicted by PTSD-related factors, including PTSD severity, daily PTSD symptoms, and fear of sleep.

According to a neurobiological hypothesis, Germain et al. (2008) proposed that the amygdala and the medial prefrontal cortex can directly contribute to sleep disturbances in PTSD. The neurobiological models of fear conditioning and fear extinction, PTSD, and sleep-wake regulation suggest that the traumatic event can lead directly to PTSD and also partially via sleep disturbances (Germain et al., 2008). Trauma exposure directly alters the sleep-wake neurobiological mechanism of regulation. Consistent with the neurobiological hypothesis (Germain et al., 2008), we assume that both fear of war and sleep problems (insomnia and nightmares) partially mediate between trauma exposure and PTSD.

Previous studies have examined selected dimensions of sleep quality concerning PTSD symptoms severity among veterans from the USA and very rarely among civilians during the war. A review by Rahmani et al. (2022) suggests that while disasters and traumatic events are globally common, their impact varies disproportionately across cultural and ethnic contexts, especially in low-resource environments. Therefore, the study of the psychological impact of war and disaster should be continued among various cultures. This research concerns the young Ukrainian adult population living in Eastern Europe and speaking Ukrainian (one of the Slavic languages). The devastating effects of the war on the mental health of Ukrainians has been documented (Cheung et al., 2019; Chudzicka-Czupała et al., 2023; Eshel et al., 2023; Johnson et al., 2022; Kang et al., 2023; Konstantinov et al., 2022; Kurapov et al., 2022; Limone et al., 2022; Osokina et al., 2022; Pavlova et al., 2022; Rizzi et al., 2022; Roberts et al., 2019; Singh et al., 2021). Ukrainians will require psychological help for many years, so mental health risks in the Ukrainian population should be assessed successively during the war and monitored over the following years to plan appropriate treatment strategies. Unfortunately, the extent of the future work of psychologists is currently unknown as relatively little research has been published on the current exposure to war, fear of war, nightmares, insomnia, and risk of PTSD in Ukrainians. Furthermore, only two studies have been conducted among university students exposed to warfare in Ukraine, but other variables were examined than in the present study (Kurapov et al., 2022; Pavlenko et al., 2022).

Although previous studies have shown that war-related trauma exposure contributes to fear and nightmares of war, insomnia, and PTSD symptoms, no studies have empirically tested these complex relationships, especially in the context of the Russian war in Ukraine. Moreover, little is known about the mechanism of interactions between war-related sleep difficulties, fear, and PTSD symptoms among civilians involved in the war. However, knowing the mechanism, would enable us to focus on the treatment of critical areas for the development of PTSD in targeted high-risk groups.

The current study used a cross-sectional design to examine associations between exposure to war, nightmares of war, fear of war, insomnia symptoms, and war-related PTSD symptoms among university students from Ukraine during the Russian invasion. Gender differences in exposure to war, nightmares of war, fear of war, and symptoms of insomnia and war-related PTSD will also be taken into account in the study. Previous research has suggested that women may be more susceptible to fear, nightmares, and symptoms of insomnia and PTSD, as a result of trauma exposure (Ayazi et al., 2014; Goncalves et al., 2022; Milanak et al., 2019; Schredl and Reinhard, 2011; Short et al., 2022; Xu et al., 2023). Therefore, we hypothesize that all variables would be higher in

females than in males. Associations between variables will be examined using correlation and path analyses to fully explain the relationship between war-related exposure to the traumatic event, nightmares, fear, PTSD, and insomnia symptoms. Consistent with previous studies, we hypothesize that exposure to war will be a predictor of nightmares (Short et al., 2022; Weber and Wetter, 2022), fear of war (Ayazi et al., 2014; Brawman-Mintzer et al., 2005; Thabed et al., 2018), symptoms of insomnia (Short et al., 2022; Weber and Wetter, 2022), and war-related PTSD (Ahmadi et al., 2022; Babson and Feldner, 2010; Milanak et al., 2019). Nightmares will also be predicted by PTSD symptoms (Short et al., 2018; Slavish et al., 2022; Slavish et al., 2023). Both insomnia (Davis et al., 2011; Lam et al., 2023; Lancel et al., 2021; Lewis et al., 2020; Pigeon et al., 2013; Rosen et al., 2019) and fear of war (Beck et al., 2015; Brownlow et al., 2017; Germain et al., 2008; Williamson et al., 2021) are predictors of war-related PTSD. According to a neurobiological hypothesis (Germain et al., 2008) and recent longitudinal studies (Slavish et al., 2022, 2023), indirect paths are suggested between exposure to war and war-related PTSD via fear of war and insomnia. In addition, the relationship between fear of war and war-related PTSD is mediated by insomnia symptoms, and the indirect effect of PTSD on fear of war via nightmares is also hypothesized (Germain et al., 2008; Short et al., 2018; Slavish et al., 2022, 2023). The chain mediation model suggests that exposure to war may contribute to PTSD severity via increased nightmares, fear of war, and insomnia symptoms.

2. Materials and methods

2.1. Participants

A sample of 1,072 university students participated in the study, including 80% women ($n = 587$), with a mean age of 18 (range 16-39 years, $M = 18.16$, $SD = 1.89$). Participants represented three Ukrainian universities: Ternopil Volodymyr Hnatiuk National Pedagogical University ($n = 679$, 63%), Lviv State University of Physical Culture ($n = 379$, 36%), and National University "Yuri Kondratyuk Poltava Polytechnic" ($n = 1058$, $n = 14$, 1%). Most of the participants (85.9%) studied at universities located in western regions of Ukraine. I majority of people studied at the faculty of pedagogy and psychology ($n = 281$, 26%), arts ($n = 210$, 20%), physiotherapy ($n = 200$, 19%), chemistry and biology ($n = 194$, 18%), physical culture and sport ($n = 124$, 12%), pedagogy ($n = 61$, 6%), foreign languages ($n = 19$, 2%), and history ($n = 8$, 1%). Table 1 presents the main demographic characteristics of the study sample. Most participants declared single status of relationships (57%), were undertaking undergraduate studies (98%), were in the first

Table 1
Participant's characteristics ($N = 1072$).

Variable	Categories	n	%
Gender	Men	215	20
	Women	857	80
Relationships	Coupled	458	43
	Single	614	57
Study level	Bachelor	1052	98
	Master	19	2
Study year	First	498	47
	Second	387	36
	Third	105	10
	Fourth	66	6
	Fifth	2	0
	Sixth	14	1
Study type	Full-time	1048	98
	Part-time	24	2
Depression disorder	Not diagnosed	959	90
	Diagnosed	113	11
Anxiety disorder	Not diagnosed	998	93
	Diagnosed	74	7
Post-traumatic stress disorder	Not diagnosed	1043	97
	Diagnosed	29	>1

year of studies (47%), and were studying full-time (98%). Among students, 11% ($n = 113$) declared that they had been previously diagnosed professionally with depression, 7% ($n = 74$) with anxiety, and less than 1% ($n = 29$) with PTSD.

2.2. Study design and procedure

The cross-sectional online study was performed between September 26 and October 16, 2022, during the Russian invasion of Ukraine. We invited university students to participate in a Google Forms survey through Facebook groups, Viber groups, and Telegram channels. We also cooperated with student unions and student organizations from western Ukraine to distribute invitations. The first page of the survey contained information about the study and an informed consent form, assuring the students of the voluntary nature of their participation, anonymity, and confidentiality of the survey and that they could may terminate their participation at any time. The study was approved by Lviv State University of Physical Culture (No. 11, September 12, 2022). The inclusion criteria were to be at least 16 years old and to be a university student. The sample of 1087 individuals responded to the invitation of the study, but 15 people refused to participate, so the final sample included 1072 people. The response rate was 98%.

2.3. Measures

The demographic questions were about age (number of years), gender (with two categories: Women, Men), relationship status (i.e., Coupled or Single), faculty of study (open question), field of study (open question), study grade (from 1 to 6 study year), and the type of enrollment (Part-time, Full-time). In addition, we asked the participant whether they had "ever been diagnosed, treated, and monitored for any of the health problems listed in the table below (anxiety disorder, depression disorder, or posttraumatic stress disorder). They were asked to tick the appropriate box if the answer was YES, and only answer YES if a doctor or licensed professional (e.g., psychologist) told them that you have or have had this condition. They were asked to mark "NO" if their answer was negative."

We developed eight questions about self-reported exposure to war (EW) and seven about nightmares of war (NW) based on data from literature and typical experiences students may have had during the Russian invasion of Ukraine. In the pilot study, all EW and NW scale items were presented to a target group of 10 students for initial analysis to check whether all questionnaire items were clear and accurate or had any qualitative reservations. We asked participants if the instructions were understandable, whether the items were relevant to their experiences and the context of the current war in Ukraine, and if the answer options were appropriate and relevant to the question. The current version of the EW and NW questionnaires included in the study has been improved and slightly modified following the suggestions of the target group in the pilot study.

The EW questions referred to direct exposure to bomb explosions (EW 1), hiding in a bomb shelter (EW 2), hospitalization for war injuries (EW 3), emigration from the family home (EW 4), fighting soldier among relatives and friends (EW 5), hospitalization or death of a loved one (EW 6), emigration of relatives or friends (EW 7), and loss of material resources or deterioration of economic status (EW 8). We used a 6-point Likert-like response scale (0-5), where zero meant no exposure and five meant a high exposure. We added all the scores from particular items to create the EW scale (ranging from 0-40), where higher scores indicated higher exposure to war (Table S1 in supplementary materials). The internal consistency for the total EW in the study was adequate, with McDonald's $\omega = 0.70$. The confirmatory factor analysis (CFA) showed adequate fit indices for one-factor EW structure, $\chi^2/df = 3.78$, CFI = 0.97, RMSEA = 0.05, SRMR = 0.03.

Seven questions about nightmares of war (NW) were developed for this study: about dreaming of war (NW1); experiencing danger to life

(NW2); running from an enemy or hostilities (NW3); fighting the enemy (NW4); watching the destruction of war (NW5); witnessing the death and torture of others (NW6); and hiding in a shelter or other place (NW7). The participant used a 5-point Likert scale (from 0 = Never to 4 = Almost every night) to answer each question. Scores from particular items were summarized (ranging from 0-28), and a higher score on the NW scale indicates a more frequent experience of war nightmares (Table S2 in supplementary materials). The reliability for the total NW in the study was McDonald's ω = 0.89. The CFA indicated appropriate fit indices for one-factor NW scale, χ^2/df = 3.68, CFI = 0.99, RMSEA = 0.05, SRMR = 0.02.

Fear of war was assessed using a modified version of the Fear of COVID-19 Scale (FoCV-19S) (Ahorsu et al., 2022; Pavlenko et al., 2022; Bova, 2022). The original FoCV-19S measures the emotional and physiological response to the coronavirus pandemic on a 7-item scale (e.g., "My heart races or palpitates when I think about getting coronavirus-19"). The modification of the Fear of War (FW) scale was that the word "Coronavirus-19" was replaced with "war" in all seven items (Table S3 in supplementary materials). A participant rated the response on a 5-point Likert scale (from 1=Strongly disagree to 5=Strongly agree). The higher the scores (ranging from 7-35), the greater fear of war. The internal consistency of the FW was McDonald's ω = 0.89 in this study.

Insomnia was assessed using the Athens Insomnia Scale (AIS) (Soldatos et al., 2000; Boduliev, 2020). The AIS includes eight items related to various insomnia criteria during the past month, according to International Classification of Diseases, Tenth Revision (ICD-10). A higher score (ranging from 0-24) is interpreted as more severe insomnia symptoms. The reliability of the AIS was McDonald's ω = 0.85 in the current study.

The war-related posttraumatic stress disorder (PTSD) was assessed using the 6-item Abbreviated version of the PTSD Check List (PCL-6) (Weathers et al., 1999; Weathers et al., 2013; Lang and Stein, 2005; Lang et al., 2012). We modified the inventory by adding a specification of the stressful event regarding the Russian invasion of Ukraine (Table S4 in supplementary materials). Responses to each war-related stressful experience during the past month were rated on a 5-point Likert scale (from 1=Not at all to 5=Very often). The reliability in this study sample was McDonald's ω = 0.82.

2.4. Statistical analysis

The descriptive statistics, including mean (*M*), standard deviation (*SD*), median (*Mdn.*), skewness, and kurtosis, were performed for EW, NW, FW, insomnia, and PTSD as a preliminary analysis to check the assumptions for parametric tests. Since the sample size was large (*N* = 1072), and skewness and kurtosis ranged between ±1, the parametric statistics were conducted in the following steps. First, the independent samples Student's *t*-test was used to examine gender differences in EW, NW, FW, insomnia, and PTSD. The effect size was assessed using Cohen's *d* statistic. For the independent samples Student's *t*-test, the G*Power 3.1.9.7 showed that a sample size of 88 in each of compared groups is sufficient to detect a medium effect size (Cohen's *d* = 0.50), with α = 0.05 and a power of 0.95. The required sample size for correlation analysis should be 115 people (based on the medium effect size *r* = 0.30, α = 0.05, and a power of 0.95), and for multiple regression analysis with four predictors in the model should be 53 individuals (considering medium effect size *b* = 0.30, α = 0.05, and a power of 0.95). Post-hoc analysis showed that power in the current sample (*N* = 1072) is 1 for *t*-test, correlation, and regression analyses. Next, associations between all variables were examined using Pearson's correlations. Finally, a path analysis using structural equation modeling (SEM) was performed to verify the associations between exposure to war, nightmares of war, fear of war, insomnia, and PTSD symptoms, using AMOS ver. 26 for SPSS ver. 26. The Bootstrap technique (with 5000 sample replications and a 95% confidence interval) was applied to increase the accuracy of the

results. Several goodness of fit statistics were considered to assess the path model, including ML χ^2, *df* and *p*-value (the ratio χ^2/df < 2 is considered very good fit, between 2 and 3 – good, and acceptable < 5), standardized root mean squared residual (SRMR ≤ 0.08 is acceptable), root mean square error of approximation (RMSEA; acceptable fit if ≤ 0.08, adequate fit if < 0.06, and good if 0.04), and comparative fit index (CFI; acceptable if ≥ 0.90, and good if > 0.95) (Kline, 2011). Also, the possible moderating effect of gender on the path model of associations was examined using multigroup analysis (MGSEM). Configural invariance verified that the same model structure is valid in each gender, while metric invariance assumed that weight loadings are equal across groups (Gregorich, 2003). Chen (2007) suggests a change of ≤ –0.005 in CFI, supplemented by a change of ≥ .010 in RMSEA, as an indicator of non-invariance, in the case when the compared sample sizes are unequal. All statistical analyses (except SEM and MGSEM) were performed using the JAMOVI software (ver. 2.2.5., Sydney, Australia).

3. Results

3.1. A path model

As a preliminary analysis, we examined Person's correlations between war-related exposure and nightmares, considered composite scores, fear of war, insomnia, and war-related PTSD symptoms (Fig. 1). Exposure to war was related positively to nightmares of war (*r* = 0.37 [CI = 0.32, 0.42], *p* < 0.001), fear of war (*r* = 0.27 [CI = 0.22, 0.33], *p* < 0.001), insomnia (*r* = 0.30 [CI = 0.24, 0.35], *p* < 0.001), and war-related PTSD (*r* = 0.39, [CI = 0.33, 0.44], *p* < 0.001). Nightmares of war were associated positively but weakly with fear of war (*r* = 0.32, [CI = 0.27, 0.38], *p* < 0.001), and insomnia (*r* = 0.3, [CI = 0.34, 0.44], *p* < 0.001), while positively and moderately with war-related PTSD (*r* = 0.52, [CI = 0.48, 0.56], *p* < 0.001). Weak and positive relationships were found between fear of war and both insomnia (*r* = 0.30, [CI = 0.25, 0.36], *p* < 0.001) and war-related PTSD (*r* = 0.38, [CI = 0.33, 0.43], *p* < 0.001). Also, insomnia was related positively to war-related PTSD (*r* = 0.60, [CI = 0.56, 0.63], *p* < 0.001) at a moderate level.

The results of a path model are presented in Fig. 2 and Table 2. The fit statistics for the model were acceptable, including $\chi^2(1)$ = 7.9, *p* = 0.005, SRMR = 0.015, RMSEA = 0.080 [95% CI (0.036, 0.136)], and CFI = 0.995. All expected associations were significant (*p* < 0.001). Nightmares of war, fear of war, and insomnia partially mediate the relationships between exposure to war and war-related PTSD symptoms. The standardized total, direct, and indirect effects for all mediating relationships were significant at *p* < 0.001.

3.2. Gender differences

As a sensitivity analysis, we examined differences between women and men in variable scores and associations between them. No gender differences were found for exposure to war and nightmares of war (Table 3). Women (*n* = 857) scored higher than men (*n* = 215) in fear of war (with a medium effect size) and also in insomnia and PTSD (with a small effect size).

Furthermore, the MGSEM analysis was performed for the path model of associations between war-related exposure, nightmares, fear, insomnia, and PTSD. The configural MGSEM model fits the data well, suggesting that a path model of associations between variables is invariant across genders. In particular, an unconstrained model for women and men presented a good fit, including $\chi^2(2)$ = 4.797, *p* = 0.008, SRMR = 0.017, RMSEA = 0.060 [95% CI (0.026, 0.100)], CFI = 0.994. Furthermore, adequate fit was presented for metric model, where regression weights were constrained as equal, $\chi^2(11)$ = 1.963, *p* = 0.028, SRMR = 0.020, RMSEA = 0.030 [95% CI (0.010, 0.049)], CFI = 0.994. Therefore, gender invariance for the path model was confirmed in the study.
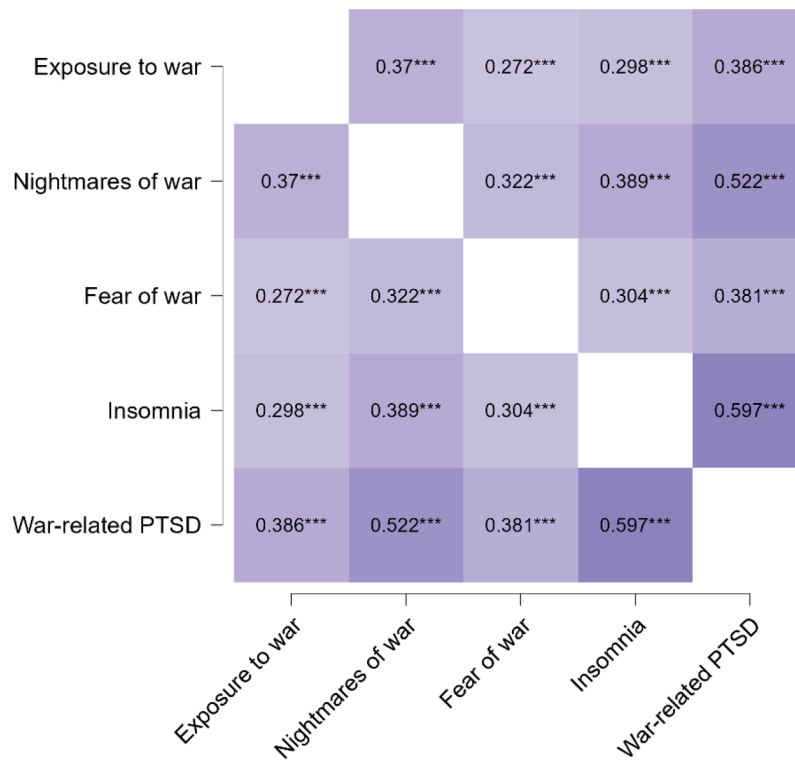
Fig. 1. Pearson's correlation between exposure to war, nightmares of war, fear of war, insomnia, and war-related PTSD symptoms.
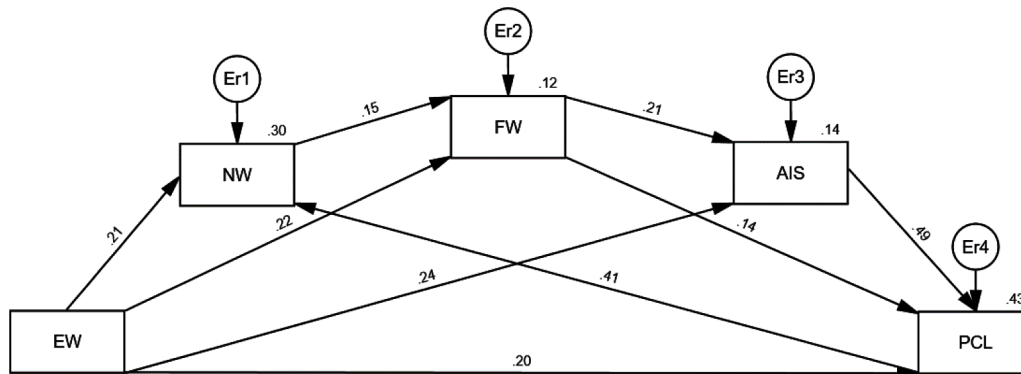

Fig. 2. A path model diagram showing associations between exposure to war (EW), nightmares of war (NW), fear of war (FW), insomnia (AIS), and war-related posttraumatic stress disorder (PCL). The numbers on the graph represent standardized regression weights (β). Er = error for endogenous variable in the model.

4. Discussion

4.1. A path model

All expected correlations were confirmed in this study, consistent with previous research (Ahmadi et al., 2022; Ayazi et al., 2014; Babson and Feldner, 2010; Brawman-Mintzer et al., 2005; Davis et al., 2011; Gehrman et al., 2015; Harb et al., 2012; Harb and Schultz, 2020; Lancel et al., 2021; Langston et al., 2010; Lewis et al., 2020; López et al., 2019; Milanak et al., 2019; Pigeon et al., 2013; Rosen et al., 2019; Schultz et al., 2021; Short et al., 2022; Thabed et al., 2018; Weber and Wetter, 2022), but the strength of the correlations ranged between weak and medium levels. In particular, exposure to war was positively related to nightmares of war, fear of war, insomnia, and war-related PTSD, which is in line with previous studies. Nightmares of war were positively associated with fear of war, insomnia, and war-related PTSD. Fear of war was positively linked to insomnia and war-related PTSD. Finally,

insomnia and war-related PTSD were also positively interrelated. In general, trauma-related nightmares characterize a high replication, recurrence, and impact of these symptoms on the lives of patients with PTSD (Hulot et al., 2022). Langston et al. (2010) showed an association between posttraumatic nightmares and increased impairment due to PTSD, anxiety, and depression among children and adolescents. According to the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), nightmares, intrusions, and sleep disturbances are criteria for PTSD. They are reported by 70–90% of patients with PTSD (Lewis et al., 2020). Additionally, PTSD and anxiety or fear are interrelated and commonly presented as an effect of traumatic experiences (Beck et al., 2015; Williamson et al., 2021). PTSD shares neurobiological features with anxiety disorders, including the neural circuits involved in the genesis of both disorders' symptoms. Therefore, in treating sleep disruption, nightmares, and insomnia, cognitive-behavioral therapy (CBT), psychotherapy based on fear extinction learning, selective serotonin reuptake inhibitors (SSRIs), and serotonin-norepinephrine

Table 2
Regression coefficients for the path model.

Predictor		Dependent	B	SE B	β	P
Exposure to war	=>	Nightmares of war	0.18	0.02	0.21	< 0.001
Exposure to war	=>	War-related PTSD	0.14	0.02	0.20	< 0.001
Exposure to war	=>	Insomnia	0.16	0.02	0.24	< 0.001
Exposure to war	=>	Fear of war	0.25	0.04	0.22	< 0.001
Insomnia	=>	War-related PTSD	0.52	0.03	0.49	< 0.001
Nightmares of war	=>	Fear of war	0.21	0.05	0.15	< 0.001
Fear of war	=>	Insomnia	0.12	0.02	0.21	< 0.001
War-related PTSD	=>	Nightmares of war	0.50	0.04	0.41	< 0.001
Fear of war	=>	War-related PTSD	0.09	0.02	0.14	< 0.001

reuptake inhibitors (SNRIs) have been found to be effective in both PTSD and anxiety-related disorders (Williamson et al., 2021).

Furthermore, a path model confirmed the hypotheses about the chain mediation model in the study. Exposure to war contributes to more nightmares of war, boosting fear of war, which increases insomnia symptoms, leading to increased levels of war-related PTSD. The chain mediation model partially explains the relationship between war exposure and war-related PTSD symptoms among university students during the Russian invasion of Ukraine. No gender differences were found in the pattern of interrelationships between variables in a path model. Insomnia partially mediates the relationships between fear of war and war-related PTSD symptoms. Also, the association between exposure to war and insomnia is mediated by a chain of nightmares and fear of war. Furthermore, the indirect effect of fear of war on war-related PTSD symptoms via nightmares of war was also confirmed.

Although most studies have evidenced that insomnia and nightmares exacerbate PTSD symptom severity, PTSD can also contribute to later sleep problems. People with PTSD may delay or avoid sleep due to nightmares, enhancing nocturnal cognitive activity and physiological arousal, ultimately leading to an increased sleep disturbance effect (Slavish et al., 2022). Slavish et al. (2023) examined the relationships between PTSD symptom severity, insomnia symptoms, nightmares, and sleep quality using three-point measurements (in a three-year longitudinal study) in the sample of World Trade Center 9/11 responders. Findings evidence that PTSD symptom severity and sleep-related variables were relatively stable. Individuals with more sleep problems (i.e., poorer sleep quality, more nightmares, and insomnia symptoms) had higher levels of PTSD. Previous insomnia symptoms were predictors of later PTSD, while PTSD symptoms and nightmares predicted nightmares at the next time.

The chain mediation model found in this study supports a neurobiological hypothesis (Germain et al., 2008), which suggests that a traumatic event triggers fear, leading directly or indirectly to PTSD through sleep disturbance. The amygdala and medial prefrontal cortex are crucial in sleep disturbances in PTSD patients (Germain et al., 2008).

Moreover, trauma exposure may directly alter a sleep-wake neurobiological regulation mechanism. The neurobiological mechanism (Germain et al., 2008) and previous longitudinal studies (Slavish et al., 2022; Slavish et al., 2023) explain the specific interplay between exposure to a war-related traumatic event, nightmares, fear, insomnia, and PTSD symptoms. Fear, nightmares, and insomnia are crucial in developing PTSD symptoms as a response to trauma, so these variables should be prioritized in future treatment strategies. Lancel et al. (2021) suggest imagery rehearsal therapy is helpful for those whose nightmares are particularly prominent and perpetuate sleep anxiety and insomnia. Harb et al. (2012) showed that imagery rehearsal is most effective in treating PTSD when the rescripted dream incorporates a better resolution of the nightmare story and excludes violent details.

4.2. Gender differences

In accordance with previous studies (Thabed et al., 2018), no gender differences were found for exposure to war. Also, nightmares of war were similarly frequent among female and male university students from Ukraine. The present result is inconsistent with the meta-analysis, which showed that women are more susceptible to nightmares than men (Schredl and Reinhard, 2011). Additionally, the study performed during the COVID-19 pandemic showed that nightmares about coronavirus were more likely in women than men (Goncalves et al., 2022). The current sample is primarily female, so unbalanced gender groups may influence the results. However, Schredl and Reinhard (2011) indicated that the gender difference in nightmares frequency increases with age and is not present among children and older people. Schredl (2014) suggests that gender-specific socialization processes may play a crucial role in explaining the higher frequency of nightmares in female adolescents and young and middle-aged adults. Since cultural context may also be involved in these socialization processes, cross-cultural studies must clarify the inconsistency between current and previous studies.

Ukrainian women scored significantly higher than men in fear of war (medium effect size), insomnia, and PTSD symptoms (small effect size). These results are in line with previous studies that showed gender differences in insomnia symptoms, PTSD, and fear of war (Ayazi et al., 2014; Goncalves et al., 2022; Milanak et al., 2019; Schredl and Reinhard, 2011; Short et al., 2022; Xu et al., 2023). A current review demonstrated that stress and anxiety increased during the pandemic and the war in Ukraine, with gender and uncertainty playing a critical role (Limone et al., 2022). Also, significant gender differences in both anxiety disorders and PTSD were found in other war-affected populations than Ukrainians (Ayazi et al., 2014). According to gender role orientation, women are more emotional, and tend to show their negative emotions (fear, anger, regret, and crying), worry more often, and are more likely to be neurotic and fearful. These traits lead to a higher risk of mental problems, including fear, insomnia, and PTSD symptoms.

Although gender differences were found in fear of war, symptoms of insomnia and PTSD, a path model was invariant across genders. This result suggests that the mechanism of interplay between exposure to war and war-related PTSD, via nightmares, fear of war, and insomnia, is universal and independent of gender. However, taking into account the unbalanced gender groups and the cross-sectional design of this study, these conclusions should be considered with caution. Further

Table 3
Gender differences in exposure to war, nightmares of war, fear of war, insomnia, and war-related PTSD symptoms ($N = 1072$).

Variable	Men ($n = 215$)		Women ($n = 857$)		$t(1070)$	p	Cohen's d
	M	SD	M	SD			
Exposure to war	10.15	5.50	10.28	6.16	-0.27	0.789	-0.02
Nightmares of war	6.27	5.35	6.68	5.18	-1.02	0.307	-0.08
Fear of war	16.08	6.78	21.49	6.77	-10.46	< 0.001	-0.80
Insomnia	4.77	3.80	6.20	4.06	-4.67	< 0.001	-0.36
Posttraumatic stress	10.94	4.10	12.10	4.31	-3.56	< 0.001	-0.27

longitudinal studies, with representative samples for gender and war-affected regions of the country, could verify the present results to a higher extent.

4.3. Limitation of the study

Although most hypotheses were confirmed in this study and the sample was large enough, the research has some limitations with regards to generalizability. The sample was conventional, predominantly undergraduate and female, so some bias may be associated with the study design and an imbalanced population in terms of gender. Furthermore, the student population represented two universities from western regions of Ukraine, which were relatively less exposed to direct hostilities. Therefore, the results of this study may not be similar to those from other parts of Ukraine. More research is needed from all over the country, involving representatives from a variety universities in Ukraine. We utilized online questionnaires with self-report measures to assess all variables in the study; as such, the results may be subject to a measurement error. In particular, the newly developed EW and NW scales require further expert evaluation and development. We conducted a cross-sectional study, so all causal relationships should be interpreted with caution. Longitudinal studies are required to fully confirm the chain mediation model.

5. Conclusions

A result of this study confirmed a positive correlation between exposure to war, nightmares of war, fear of war, insomnia, and war-related PTSD symptoms. Although women experienced higher fear of war, insomnia, and war-related PTSD symptoms than men, the path model of relationships between all variables was invariant across genders. The study confirmed the chain mediation model. The relationship between exposure to war and war-related PTSD is mediated by nightmares of war, fear of war, and insomnia symptoms. PTSD also increases nightmares, leading to higher fear of war and insomnia. The mechanism of interplay between these variables indicates that treatment should focus primarily on mitigating nightmares, fear, and insomnia symptoms, to prevent PTSD.

Several evidence-based intervention strategies are proposed to improve the mental health of Ukrainians during the war. The longitudinal study among treatment-seeking veterans indicated bidirectional relationships between insomnia and PTSD symptoms (Kartal et al., 2021), which may lead to mutual maintenance or exacerbation of both disorders. Therefore, insomnia may be the first variable to target in prevention and intervention programs among Ukrainians. Although Cognitive-Behavioral Therapy for Insomnia (CBT-I) is the most effective, Lancel et al. (2021) list many other intervention strategies that may be considered for treatment, such as relaxation training, treating traumatic sleep triggers, placing a picture of a loved one by the bed, sleeping with dim lights, playing soothing music or white noise when falling asleep, or using weighted blankets during sleep. Miller et al. (2020) emphasize the role of multidisciplinary and integrative approaches that require innovative assessment methods and multiple interventions in the comprehensive treatment of sleep disorders in PTSD, taking into account the patient's preferences. Pigeon and Gallegos (2015) suggest that a pharmacological and non-pharmacological approach should be implemented to increase the efficacy of therapy. For example, a combination of imagery rehearsal therapy and prazosin increases the efficacy of nightmares, while insomnia should be treated with CBT-I with benzodiazepine receptor agonists. Furthermore, combining CBT-I with imagery rehearsal therapy seems to be a promising approach to treating PTSD.

Statement of ethics

The study was approved by the Lviv State University of Physical Culture (No. 11, September 12, 2022). The trial was conducted in accordance with the Helsinki II Declaration. Informed consent was obtained from all participants.

CRediT authorship contribution statement

Aleksandra M. Rogowska: Conceptualization, Data curation, Formal analysis, Methodology, Supervision, Visualization, Project administration, Resources, Software, Writing – original draft, Writing – review & editing. **Iuliia Pavlova:** Conceptualization, Data curation, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors have no conflicts of interest to declare.

Data availability

The data that support the findings of this study are not publicly available due to privacy and ethical restrictions.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2023.115431.

References

Ahmadi, R., Rahimi-Jafari, S., Olfati, M., Javaheripour, N., Emamian, F., Ghadami, M.R., Khazaie, H., Knight, D.C., Tahmasian, M., Sepehry, A.A., 2022. Insomnia and posttraumatic stress disorder: a meta-analysis on interrelated association ($n = 57,618$) and prevalence ($n = 573,665$). Neurosci. Biobehav. Rev. 141, 104850 https://doi.org/10.1016/j.neubiorev.2022.104850.

Ahorsu, D.K., Lin, C.Y., Imani, V., Saffari, M., Griffiths, M.D., Pakpour, A.H., 2022. The fear of COVID-19 scale: development and initial validation. Int. J. Ment. Health Addict. 20, 1537–1545. https://doi.org/10.1007/s11469-020-00270-8.

Ayazi, T., Lien, L., Eide, A., Swartz, L., Hauff, E., 2014. Association between exposure to traumatic events and anxiety disorders in a post-conflict setting: a cross-sectional community study in South Sudan. BMC Psychiatry 14, 6. https://doi.org/10.1186/1471-244X-14-6.

Babson, K.A., Feldner, M.T., 2010. Temporal relations between sleep problems and both traumatic event exposure and PTSD: a critical review of the empirical literature. J. Anxiety Disord. 24 (1), 1–15. https://doi.org/10.1016/j.janxdis.2009.08.002.

Beck, J.G., Jones, J.M., Reich, C.M., Woodward, M.J., Cody, M.W., 2015. Understanding the role of dysfunctional posttrauma cognitions in the co-occurrence of posttraumatic stress disorder and generalized anxiety disorder: two trauma samples. Behav. Res. Ther. 70, 23–31. https://doi.org/10.1016/j.brat.2015.04.011.

Boduliev, O., 2020. The role of rating scales in the diagnosis of postoperative insomnia. Infus. Chemotherapy 3 (1), 12–13. https://doi.org/10.32902/2663-0338-2020-3.1-08.

Bova, A. A. (2022, November 9). The Ukrainian version of the Fear of COVID-19 Scale: adaptation in a sample of Kyiv students. Retrieved from osf.io/xw8ec.

Brawman-Mintzer, O., Monnier, J., Wolitzky, K.B., Falsetti, S.A., 2005. Patients with generalized anxiety disorder and a history of trauma: somatic symptom endorsement. J. Psychiatr. Pract. 11 (3), 212–215. https://doi.org/10.1097/00131746-200505000-00010.

Brownlow, J.A., Klingaman, E.A., Boland, E.M., Brewster, G.S., Gehrman, P.R., 2017. Psychiatric disorders moderate the relationship between insomnia and cognitive problems in military soldiers. J. Affect. Disord. 221, 25–30. https://doi.org/10.1016/j.jad.2017.06.023.

Chaaya, C., Devi Thambi, V., Sabuncu, Ö., Abedi, R., Osman Ahmed Osman, A., Uwishema, O., Onyeaka, H., 2022. Ukraine – Russia crisis and its impacts on the

mental health of Ukrainian young people during the COVID-19 pandemic. Ann. Med. Surgery 79, 104033. https://doi.org/10.1016/j.amsu.2022.104033.

Chen, F.F., 2007. Sensitivity of goodness of fit indexes to lack of measurement invariance. Struct. Equ. Model. 14 (3), 464–504. https://doi.org/10.1080/10705510701301834.

Cheung, A., Makhashvili, N., Javakhishvili, J., Karachevsky, A., Kharchenko, N., Shpiker, M., Roberts, B., 2019. Patterns of somatic distress among internally displaced persons in Ukraine: analysis of a cross-sectional survey. Soc. Psychiatry Psychiatr. Epidemiol. 54 (10), 1265–1274. https://doi.org/10.1007/s00127-019-01652-7.

Chudzicka-Czupała, A., Hapon, N., Chiang, S.K., Żywiołek-Szeja, M., Karamushka, L., Lee, C.T., Grabowski, D., Paliga, M., Rosenblat, J.D., Ho, R., McIntyre, R.S., Chen, Y. L., 2023. Depression, anxiety and post-traumatic stress during the 2022 Russo-Ukrainian war, a comparison between populations in Poland, Ukraine, and Taiwan. Sci. Rep. 13 (1), 3602. https://doi.org/10.1038/s41598-023-28729-3.

Davis, J.L., Pruiksma, K.E., Rhudy, J.L., Byrd, P., 2011. A comparison of lifelong and posttrauma nightmares in a civilian trauma sample: nightmare characteristics, psychopathology, and treatment outcome. Dreaming 21 (1), 70–80. https://doi.org/10.1037/a0022862.

de Alencar Rodrigues, J.A.R., Lima, N.N.R., Neto, M.L.R., Uchida, R.R., 2022. Ukraine: War, bullets, and bombs – millions of children and adolescents are in danger. Child Abuse Negl. 128, 105622 https://doi.org/10.1016/j.chiabu.2022.105622.

Eshel, Y., Kimhi, S., Marciano, H., Adini, B., 2023. Predictors of PTSD and psychological distress symptoms of Ukraine civilians during war. Disaster Med. Publ. Health Prep 17, e429. https://doi.org/10.1017/dmp.2023.69.

Germain, A., Buysse, D.J., Nofzinger, E., 2008. Sleep-specific mechanisms underlying posttraumatic stress disorder: integrative review and neurobiological hypotheses. Sleep Med. Rev. 12 (3), 185–195. https://doi.org/10.1016/j.smrv.2007.09.003.

Gehrman, P.R., Harb, G.C., Cook, J.M., Barilla, H., Ross, R.J., 2015. Sleep diaries of Vietnam War veterans with chronic PTSD: the relationships among insomnia symptoms, psychosocial stress, and nightmares. Behav. Sleep Med. 13 (3), 255–264. https://doi.org/10.1080/15402002.2014.880344.

Goncalves, M., Henriques, A., Costa, A.R., Correia, D., Severo, M., Lucas, R., Barros, H., Task Force COVID-19 ISPUP – INESC TEC, 2022. Insomnia and nightmare profiles during the COVID-19 pandemic in Portugal: characterization and associated factors. Sleep Med. 90, 44–52. https://doi.org/10.1016/j.sleep.2021.12.018.

Gregorich, S.E., 2003. Do self-report instruments allow meaningful comparisons across diverse population groups? Testing measurement invariance using the confirmatory factor analysis framework. Med. Care 44 (11), S78–S94. https://doi.org/10.1097/01.mlr.0000245454.12228.8f. Suppl 3.

Harb, G.C., Thompson, R., Ross, R.J., Cook, J.M., 2012. Combat-related PTSD nightmares and imagery rehearsal: nightmare characteristics and relation to treatment outcome. J. Trauma Stress 25 (5), 511–518. https://doi.org/10.1002/jts.21748.

Harb, G.C., Schultz, J.-H., 2020. The nature of posttraumatic nightmares and school functioning in war-affected youth. PLoS One 15 (11), e0242414. https://doi.org/10.1371/journal.pone.0242414.

Hajek, A., Kretzler, B., König, H.H., 2022. Social media addiction and fear of war in Germany. Psychiatry Int. 3, 313–319. https://doi.org/10.3390/psychiatryint3040025.

Hulot, J., Roseau, J.-B., Gomez-Merino, D., Chennaoui, M., Saguin, E., 2022. Clinical description of sleep and trauma-related nightmares in a population of French active-duty members and veterans with posttraumatic stress disorder. Encephale. https://doi.org/10.1016/j.encep.2022.10.002.

Jawaid, A., Gomolka, M., Timmer, A., 2022. Neuroscience of trauma and the Russian invasion of Ukraine. Nat. Hum Behav. 6, 748–749. https://doi.org/10.1038/s41562-022-01344-4.

Johnson, R.J., Antonaccio, O., Botchkovar, E., Hobfoll, S.E., 2022. War trauma and PTSD in Ukraine's civilian population: comparing urban-dwelling to internally displaced persons. Soc. Psychiatry Psychiatr. Epidemiol. 57 (9), 1807–1816. https://doi.org/10.1007/s00127-021-02176-9.

Kang, T.S., Goodwin, R., Hamama-Raz, Y., Leshem, E., Ben-Ezra, M., 2023. Disability and post-traumatic stress symptoms in the Ukrainian general population during the 2022 Russian invasion. Epidemiol Psychiatr Sci 32, e21. https://doi.org/10.1017/S204579602300015X.

Kartal, D., Arjmand, H.A., Varker, T., Cowlishaw, S., O'Donnell, M., Phelps, A., Howard, A., Hopwood, M., McFarlane, A., Bryant, R.A., Forbes, D., Cooper, J., Hinton, M., 2021. Cross-lagged relationships between insomnia and posttraumatic stress disorder in treatment-receiving veterans. Behav. Therapy 52 (4), 982–994. https://doi.org/10.1016/j.beth.2020.12.006.

Kline, R.B., 2011. Principles and Practice of Structural Equation Modeling. The Guilford Press, NY-London.

Konstantinov, V., Reznik, A., Isralowitz, R., 2022. The impact of the Russian–Ukrainian war and relocation on civilian refugees. J. Loss Trauma. https://doi.org/10.1080/15325024.2022.2093472.

Kurapov, A., Pavlenko, V., Drozdov, A., Bezliudna, V., Reznik, A., Isralowitz, R., 2022. Toward an understanding of the Russian–Ukrainian war impact on university students and personnel. J. Loss Trauma. https://doi.org/10.1080/15325024.2022.2084838.

Lam, L., Ho, F.Y., Wong, V.W., Chan, K.W., Poon, C.Y., Yeung, W.F., Chung, K.F., 2023. Actigraphic sleep monitoring in patients with posttraumatic stress disorder (PTSD): a meta-analysis. J. Affect. Disord. 320, 450–460. https://doi.org/10.1016/j.jad.2022.09.045.

Lancel, M., van Marle, H.J.F., Van Veen, M.M., van Schagen, A.M., 2021. Disturbed sleep in PTSD: thinking beyond nightmares. Front Psychiatry 12, 767760. https://doi.org/10.3389/fpsyt.2021.767760.

Langston, T.J., Davis, J.L., Swopes, R.M., 2010. Idiopathic and posttrauma nightmares in a clinical sample of children and adolescents: characteristics and related pathology. J. Child Adolescent Trauma 3, 344–356. https://doi.org/10.1080/19361521.2010.523064.

Lang, A.J., Stein, M.B., 2005. An abbreviated PTSD checklist for use as a screening instrument in primary care. Behav. Res. Ther. 43, 585–594.

Lang, A.J., Wilkins, K., Roy-Byrne, P.P., Golinelli, D., Chavira, D., Sherbourne, C., Rose, R.D., Bystritsky, A., Sullivan, G., Craske, M.G., Stein, M.B., 2012. Abbreviated PTSD checklist (PCL) as a guide to clinical response. Gen. Hosp. Psychiatry 34, 332–338.

Lewis, C., Lewis, K., Kitchiner, N., Isaac, S., Jones, I., Bisson, J.I., 2020. Sleep disturbance in posttraumatic stress disorder (PTSD): a systematic review and meta-analysis of actigraphy studies. Eur. J. Psychotraumatol. 11, 1767349 https://doi.org/10.1080/20008198.2020.1767349.

Limone, P., Toto, G.A., Messina, G., 2022. Impact of the COVID-19 pandemic and the Russia-Ukraine war on stress and anxiety in students: a systematic review. Front Psychiatry 13, 1081013. https://doi.org/10.3389/fpsyt.2022.1081013.

López, C.M., Lancaster, C.L., Wilkerson, A., Gros, D.F., Ruggiero, K.J., Acierno, R., 2019. Residual insomnia and nightmares postintervention symptom reduction among veterans receiving treatment for comorbid PTSD and depressive symptoms. Behav. Therapy 50 (5), 910–923. https://doi.org/10.1016/j.beth.2019.01.006.

Milanak, M.E., Zuromski, K.L., Cero, I., Wilkerson, A.K., Resnick, H.S., Kilpatrick, D.G., 2019. Traumatic event exposure, posttraumatic stress disorder, and sleep disturbances in a national sample of US adults. J. Trauma Stress 32 (1), 14–22. https://doi.org/10.1002/jts.22360.

Miller, K.E., Brownlow, J.A., Woodward, S, Gehrman, P.R., 2017. Sleep and dreaming in posttraumatic stress disorder. Curr. Psychiatry Rep. 19 (10), 71. https://doi.org/10.1007/s11920-017-0827-1.

Miller, K.E., Brownlow, J.A., Gehrman, P.R., 2020. Sleep in PTSD: treatment approaches and outcomes. Curr. Opin. Psychol. 34, 12–17. https://doi.org/10.1016/j.copsyc.2019.08.017.

Osokina, O., Silwal, S., Bohdanova, T., Hodes, M., Sourander, A., Skokauskas, N., 2022. Impact of the Russian Invasion on mental health of adolescents in Ukraine. J. Am. Acad. Child Adolesc. Psychiatry S0890-8567 (22), 01891–01893. https://doi.org/10.1016/j.jaac.2022.07.845.

Pavlova, I., Graf-Vlachy, L., Petrytsa, P., Wang, S., Zhang, S.X., 2022. Early evidence on the mental health of Ukrainian civilian and professional combatants during the Russian invasion. Eur. Psychiatry 65 (1), e79. https://doi.org/10.1192/j.eurpsy.2022.2335, 1–6.

Pavlenko, V., Kurapov, A., Drozdov, A., Korchakova, N., Reznik, A., Isralowitz, R., 2022. COVID-19 fear association with Ukrainian "help profession" student mental health, substance use, and resilience. J. Loss Trauma 27 (3), 292–295. https://doi.org/10.1080/15325024.2021.1961408.

Perusini, J.N., Fanselow, M.S., 2015. Neurobehavioral perspectives on the distinction between fear and anxiety. Learn. Memory 22 (9), 417–425. https://doi.org/10.1101/lm.039180.115.

Pigeon, W.R., Campbell, C.E., Possemato, K., Ouimette, P., 2013. Longitudinal relationships of insomnia, nightmares, and PTSD severity in recent combat veterans. J. Psychosom. Res. 75 (6), 546–550. https://doi.org/10.1016/j.jpsychores.2013.09.004.

Pigeon, W.R., Gallegos, A.M., 2015. Posttraumatic stress disorder and sleep. Sleep Med. Clin. 10 (1), 41–48. https://doi.org/10.1016/j.jsmc.2014.11.010.

Rahmani, M., Muzwagi, A., Pumariega, A.J., 2022. Cultural factors in disaster response among diverse children and youth around the world. Curr. Psychiatry Rep. 24 (10), 481–491. https://doi.org/10.1007/s11920-022-01356-x.

Rizzi, D., Ciuffo, G., Sandoli, G., Mangiagalli, M., de Angelis, P., Scavuzzo, G., Nych, M., Landoni, M., Ionio, C., 2022. Running away from the war in Ukraine: the impact on mental health of internally displaced persons (IDPs) and refugees in transit in Poland. Int. J. Environ. Res. Publ. Health 19, 16439. https://doi.org/10.3390/ijerph192416439.

Roberts, B., Makhashvili, N., Javakhishvili, J., Karachevskyy, A., Kharchenko, N., Shpiker, M., Richardson, E., 2019. Mental health care utilisation among internally displaced persons in Ukraine: results from a nation-wide survey. Epidemiol. Psychiatr. Sci. 28 (1), 100–111. https://doi.org/10.1017/S2045796017000385.

Rosen, R.C., Cikesh, B., Fang, S., Trachtenberg, F.L., Seal, K.H., Magnavita, A.M., Bovin, M.J., Green, J.D., Bliwise, D.L., Marx, B.P., Keane, T.M., 2019. Posttraumatic stress disorder severity and insomnia-related sleep disturbances: longitudinal associations in a large, gender-balanced cohort of combat-exposed veterans. J. Trauma Stress 32 (6), 936–945. https://doi.org/10.1002/jts.22462.

Schredl, M., Reinhard, I., 2011. Gender differences in nightmare frequency: a meta-analysis. Sleep Med. Rev. 15 (2), 115–121. https://doi.org/10.1016/j.smrv.2010.06.002.

Schredl, M., 2014. Explaining the gender difference in nightmare frequency. Am. J. Psychol. 127 (2), 205–213. https://doi.org/10.5406/amerjpsyc.127.2.0205.

Schultz, J.H., Forsberg, J.T., Harb, G., Alisic, E., 2021. Prevalence and characteristics of posttraumatic nightmares in war- and conflict-affected students. Nature Sci. Sleep 13, 423–433. https://doi.org/10.2147/NSS.S282967.

Short, N.A., Allan, N.P., Stentz, L., Portero, A.K., Schmidt, N.B., 2018. Predictors of insomnia symptoms and nightmares among individuals with posttraumatic stress disorder: An ecological momentary assessment study. J. Sleep. Res. 27 (1), 64–72. https://doi.org/10.1111/jsr.12589.

Short, N.A., Austin, A.E., Wolfson, A.R., Rojo-Wissar, D.M., Munro, C.A., Eaton, W.W., Bienvenu, O.J., Spira, A.P., 2022. The association between traumatic life events and insomnia symptoms among men and women: results from the Baltimore epidemiologic catchment area follow-up study. Sleep Health 8 (2), 249–254. https://doi.org/10.1016/j.sleh.2021.11.008.

Singh, N.S., Bogdanov, S., Doty, B., Haroz, E., Girnyk, A., Chernobrovkina, V., Murray, L. K., Bass, J.K., Bolton, P.A., 2021. Experiences of mental health and functioning among conflict-affected populations: a qualitative study with military veterans and displaced persons in Ukraine. Aust. J. Otolaryngol. 91 (4), 499–513. https://doi.org/10.1037/ort0000537.

Slavish, D.C., Briggs, M., Fentem, A., Messman, B.A., Contractor, A.A., 2022. Bidirectional associations between daily PTSD symptoms and sleep disturbances: a systematic review. Sleep Med. Rev. 63, 101623 https://doi.org/10.1016/j.smrv.2022.101623.

Slavish, D.C., Ruggero, C.J., Briggs, M., Messman, B.A., Contractor, A.A., Miao, J., Oltmanns, J.R., Waszczuk, M.A., Luft, B.J., Kotov, R., 2023. Longitudinal associations between PTSD and sleep disturbances among World Trade Center responders. Sleep Med. 101, 269–277. https://doi.org/10.1016/j.sleep.2022.11.021.

Soldatos, C.R., Dikeos, D.G., Paparrigopoulos, T.J., 2000. Athens insomnia scale: validation of an instrument based on ICD-10 criteria. J. Psychosom. Res. 48, 555–560.

Thabet, A.M., Thabet, S.S., Vostanis, P., 2018. The relationship between Trauma due to war, post traumatic stress disorder and fears among Palestinian children. EC Paediatrics 7 (3), 171–178.

Weathers, F.W., Ruscio, A.M., Keane, T.M., 1999. Psychometric properties of nine scoring rules for the clinician-administered posttraumatic stress disorder scale. Psychol. Assess. 11, 124–133.

Weathers, F.W., Litz, B.T., Keane, T.M., Palmieri, P.A., Marx, B.P., Schnurr, P.P., 2013. The PTSD Checklist for DSM-5 (PCL-5). Scale Available from the National Center for PTSD; National Center for PTSD, Hartford, VT, USA.

Weber, F.C., Wetter, T.C., 2022. The many faces of sleep disorders in posttraumatic stress disorder: an update on clinical features and treatment. Neuropsychobiology 81 (2), 85–97. https://doi.org/10.1159/000517329.

Williamson, J.B., Jaffee, M.S., Jorge, R.E., 2021. Posttraumatic stress disorder and anxiety-related conditions. Continuum 27 (6), 1738–1763. https://doi.org/10.1212/CON.0000000000001054 (N. Y.).

Xu, W., Pavlova, I., Chen, X., Petrytsa, P., Graf-Vlachy, L., Zhang, S.X., 2023. Mental health symptoms and coping strategies among Ukrainians during the Russia–Ukraine war in March 2022. Int. J. Soc. Psychiatry. https://doi.org/10.1177/00207640221143919.

Zoellner, L.A., Ojalehto, H.J., Rosencrans, P., Walker, R.W., Garcia, N.M., Sheikh, I.S., Bedard-Gilligan, M.A., 2020. Anxiety and fear in PTSD☆. Emot. Posttraumatic Stress Disord. 43–63. https://doi.org/10.1016/B978-0-12-816022-0.00002-8.