RESEARCH

Mental health of university students twenty months after the beginning of the full-scale Russian-Ukrainian war

Marina Polyvianaia[1], Yulia Yachnik[1], Jörg M. Fegert[2,3,4], Emily Sitarski[2,3,4], Nataliia Stepanova[1] and Irina Pinchuk[1,5*]

Abstract

Background Russia's full-scale military invasion of Ukraine on February 24, 2022 led to an increase of anxiety and depressive states, psychosomatic manifestations, and a tendency to abuse alcohol and psychoactive substances in the population. The aim of this paper is to examine the mental health burden among university students twenty months after war and to identify risk and protective factors for mental health problems.

Methods A cross-sectional study was conducted among Ukrainian students in October 2023 ($n = 1398$). The online survey included sociodemographic data collection, evaluation of psychological well-being and measured depression, anxiety, PTSD symptoms and insomnia. Normality of included variables was verified by Kolmogorov–Smirnov test. An independent-samples t-test, Mann–Whitney U-test, χ2 test and analysis of variance were used to compare the data. Differences in PHQ-9 and GAD-7 levels based on sociodemographic characteristics were analyzed using ANOVA. Correlation between variables was calculated with Pearson correlation, adjusted with Benjamini-Hochberg procedure. To develop the predictive model the XGBoost algorithm was employed, additionally, the SHAP algorithm was utilized.

Results Symptoms of PTSD, as well as moderate and severe symptoms of anxiety, depression, and insomnia, were reported by 48.1%, 34.1%, 33.6%, and 19.3% of students, respectively. The severity of these symptoms varied based on factors such as sex, age, prior trauma experiences, and living conditions. Additionally, the type of relocation (within Ukraine or abroad) significantly influenced mental health outcomes. A majority of participants (68.5%) reported the experience of war-related traumatic events. Factors linked to higher depression symptom scores included lower initial well-being, greater social media use, female gender, exposure to multiple traumatic events, experiences of assault or sexual violence, the loss of a loved one, pre-existing and ongoing mental health treatment during the war, and the use of psychotropic medications.

Conclusions Ukrainian university students face a significant mental health burden due to the ongoing war, with high rates of reported PTSD, anxiety, depression, and insomnia symptoms. These findings highlight the importance of tailored mental health interventions through different stakeholders that take into account individual needs, past experiences, burdens and social media usage.

*Correspondence:
Irina Pinchuk
irina.pinchuk@knu.ua

Introduction

Young people in the transition to adulthood are especially vulnerable to worsening mental health and psychosocial disorders [1]. The onset of mental disorders peaks at age 15 years [2] and at least half of emerging adults develop a threshold disorder with a need for care at age 25 years [3]. According to McGorry et al. [1] recent megatrends like war, conflict and climate change contribute to intensify the mental health burden of young people.

Russia's full-scale invasion of Ukraine on February 24, 2022, exacerbated mental health issues across the population [4, 5]. Already early surveys conducted in March 2022 revealed that high percentages of the Ukrainian population reported symptoms of stress (52.7%), anxiety (54.1%), and depression (46.8%) during the initial phase of the war [6]. According to Fujii et al. [7], the burden of mental health symptoms among the Ukrainian population was highest in the first month of full-scale war and then tended to decline, but six months later it was still significantly higher than pre-war levels.

Ukrainian students are particularly affected by mental health issues as they experience the compounded stress of ongoing conflict and the pressures of academic life [8–13]. Amid the ongoing war, medical education in Ukraine is being restructured, with infrastructure destruction forcing universities and hospitals to relocate. Students face major challenges, including air alarms, shelling, limited online resources, reduced clinical training, and fewer academic hours [14]. However, as the conflict continues and is characterized by new events, developments and attacks, updated research and regular monitoring is needed on how the war continues to affect the psychological well-being of Ukrainian university students. For example, in a comparative study of Vinnytsia Medical University students in 2022 and 2023, the authors found a surprisingly significant decrease in the number of people with clinical signs of PTSD by 10.8%, as well as a trend towards a decrease in anxiety-depressive symptoms [15]. Such findings have to be put in context through different studies that involve more Ukrainian universities and cross-regional areas.

Furthermore, little is known about risk and protective factors which affect the mental health among Ukrainian students. Tamilina et al. [16] found that in wartime conditions, Ukrainian male students demonstrate lower levels of anxiety and increased feelings of safety compared to their female colleagues. Recent study results show that optimism, hope, resilience, post-traumatic growth, using emotional support and life in occupation predicted life satisfaction in a study sample of 593 Ukrainian students [17]. However, there is a need to learn more about risk and protective factors of severe mental health symptoms, e.g., PTSD, anxiety, depression and insomnia, in the ongoing war within a larger sample of Ukrainian university students to tailor mental health interventions.

According to numerous studies on mental health problems in military contexts [18–22], the most commonly reported disorders in the population are post-traumatic stress disorder, depression, anxiety disorders and alcohol abuse. Based to a meta-analysis conducted by Hoppen and Morina [23], PTSD and depression were recognized as the most common mental disorders among war survivors around the world. Carpiniello [24] studied the effects of a war on the mental health of refugees and those living in war zones. The prevalence of anxiety, depression and post-traumatic stress disorder was found to be two to three times higher among people who were exposed to armed conflict compared to those who were not, with women and children being the most vulnerable to the effects of a war.

Findings from previous studies found the development of PTSD and depression in victims of military conflicts to be associated with various predictors. These include female sex [25], age [26], previous traumatic experiences [27], sexual violence [28], presence of torture and number of potentially traumatic events [29], socioeconomic status, employment, education and social support [30, 31], independence [32], previous academic performance and drug use [33] and post-migration stress [34]. In addition, the results of a nationwide cross-sectional study among Ukrainians after the first year of Russian invasion [35] showed that displacement from a previous place of residence due to war and, especially, entry into a new cultural environment significantly contribute to mental health problems.

Taking into account the experience of previous studies of the context of war, the aims of this study are to assess the mental health of Ukrainian students twenty months after the war began, focusing on symptoms of anxiety, depression, PTSD, and insomnia. We aim to identify key risk and protective factors affecting the mental health among students and provide a clearer understanding of how the ongoing conflict continues to influence the psychological well-being of young adults in Ukraine.

Materials and methods
Study design
We report the results of a cross-sectional study on the mental health of students currently affected by the war in Ukraine. The study population included all youth aged

18 years or older attending university in Ukraine, either in person or online (including those residing abroad but attending a Ukrainian university online). A total of 2,364 students responded to the survey in 2023, and after removing observations with missing variables (i.e., questionnaires in which replies to the mental health symptom surveys were missing), 1,398 responses were eligible for analysis. Of these, 1,284 (91.8%) resided within Ukraine, and 114 (8.2%) resided abroad. The minimum size of a representative sample with a 3% statistical error and 95% reliability is 1051 students.

Participant recruitment

Students aged 18 years or older attending university in Ukraine (either in person or online) were recruited for the study. Data collection took place in October 2023. Invitations to participate in the online survey were sent to 17 universities. In addition, university students were invited to participate via social media channels of the respective universities. Each university independently chose its own strategy for distributing the surveys among students. Researchers had no control over how universities disseminated information about the survey or how they engaged students in participation. However, the sample size was sufficiently large to support robust statistical analysis.

Participants were asked to read a description of the study and complete an informed consent form. All participants were informed that they could withdraw their data at any time, and that all collected data would remain anonymous and confidential.

All questionnaires were self-administered, conducted in Ukrainian, and completed online. Regardless of the questionnaire result, participants were provided with guidance on mental health resources available to them at the end of the survey. The ethics committee of the Institute of Psychiatry at the Taras Shevchenko National University of Kyiv, Ukraine, approved this study. Qualtrics was used to create and distribute the questionnaire and facilitate subsequent data analysis.

Measures

The survey included sociodemographic data collection about age, sex, year of study as well as measures about relocation experience (internal/external displacement), living conditions during the war (lived alone, with partner, with parents or relatives, etc.), trauma experience (war, shellings, loss, sexual trauma et etc.), professional and non-professional help-seeking pre- and during the war (yes/no), intake of psychotropic medications during war (yes/no), current need of support (yes/no), stopped education (yes/no) and use of social networks (hours per day).

Mental health was evaluated by psychological well-being on the 0–10 scale before and during full-scale war, according to their self-assessment, and measured depression, anxiety, PTSD symptoms and insomnia.

Patient Health Questionnaire-9 (PHQ-9) was applied to evaluate the level of depression. It contains 9 items, answers to which vary from 0 to 3. The scale score was interpreted as: 0–4– none/minimal depression, 5–9– mild, 10–14– moderate, 15–19– moderately severe and ≥20– severe depression [36]. To assess anxiety levels, we used General Anxiety Disorder-7 (GAD-7) scale. The scale consists of 7 items. Each answer is scored from 0 to 3 points. According to the score, 0–4 indicate minimal anxiety, 5–9– mild, 10–14– moderate, and ≥15– severe anxiety [37]. Primary Care Screen for DSM-5 criterion of PTSD (PC-PTSD-5), a 5-item screen questionnaire, was used to scan for probable PTSD in the individuals. Each question in PC-PTSD-5 has two answer variants, Yes or No, where Yes equals 1 point and No equals 0 points. A positive answer to 3 or more questions indicates probable PTSD [38]. The presence of insomnia was identified using ISI (Insomnia Severity Index), a 7-item self-report questionnaire. A mean score from 1 to 7 stands for the absence of insomnia, 8–14 points for sub-threshold insomnia, 15–21 for moderate insomnia, and 22–28 for severe insomnia [39].

All questionnaires used were adapted and translated into Ukrainian [40–43].

Statistical analysis

Normality of included variables was verified by Kolmogorov–Smirnov test. Independent Student's t-test and Mann–Whitney U-test were utilized to compare the difference between two groups of normally distributed and non-normally distributed variables. $\chi2$ test was performed to analyze the difference of categorical variables. Differences in PHQ-9 and GAD-7 levels based on sociodemographic characteristics were analyzed using ANOVA. Correlation between variables was calculated with Pearson correlation, adjusted with Benjamini-Hochberg procedure.

All regressions were run using data with no missing relevant variables. To test the robustness of the regressions, we compared the characteristics of participants with and without missing exposure or outcome data for each of the regressions. In addition, we ran regressions after imputing missing data using missForest, a random forest imputation algorithm [44]. All covariates were used for imputation.

The predictive model was built using XGBoost algorithm. The following performance characteristics of the predictive model were calculated: area under curves (AUCs) of the receiver operating characteristic curves (ROC) and decision curve analysis (DCA). Additionally,

the SHAP (SHapley Additive exPlanations) algorithm was utilized to demonstrate the influence of the features on the model.

The XGBoost algorithm is essentially a collection of decision trees, where each tree considers a subset of the data columns to make predictions. These predictions are then aggregated to form a more sophisticated and accurate model. For a detailed understanding of the XGBoost algorithm, please consult the documentation available at https://xgboost.readthedocs.io/en/stable/.

To assess the performance of our model accurately, we needed to define both a training and a test sample. Instead of randomly dividing our data, we adopted a K-fold split approach. This involved creating 10 folds of similar sizes, ensuring that at each iteration, 9 folds were utilized for training the prediction while the remaining one was reserved for testing. To maintain a balanced distribution of our dependent variable across these folds, we employed a stratified K-fold procedure. For more information, refer to the documentation of Scikit-Learn at sklearn.model_selection.StratifiedKFold.

All the analyses above were conducted using Python 3.11 software, and p value < 0.05 was defined as statistically significant.

Results

The mean age of participants was 19.6 ± 3.2 years and the majority (82%) were in the age group 18–20 years, the majority were females (75.5%). 560 (40.1%) students had experience of displacement during the war, in Ukraine or abroad. 244 (17.5%) of them returned home at the time of the survey. Only 6.8% of students lived alone during the war, the rest lived either with their parents, or with friends, or had their own family. Due to the war, 6.1% of students stopped studying at the university in 2023.

The psychological well-being of respondents measured on a scale from 0 to 10, according to their self-assessment, before the war was 6.76 ± 2.58, after 20 months of war 5.41 ± 2.45. The decrease in level psychological well-being is statistically significant (t = -17.048; $p = 0.000$).

Based on the results of the study, 672 (48.1%) of all respondents screened positive for PTSD symptoms. Concerning the different types of traumatic events, the following represent the percentages of students who had been exposed to a traumatic event and that also fell above the PTSD cut off. Most participants (68.5%) noted the war as a traumatic event. Many students have experienced traumas such as the death of loved ones (29.8%), immediate exposure to shelling or bombing (16.2%), physical (12.1%) and sexual (7.0%) violence, assault (10.7%), seeing someone killed or seriously injured (10.2%). In addition, 7.9% of students mentioned property loss/damage; 4.7% were under occupation and 5 respondents (0.4%) were in captivity.

The results of the PHQ-9 scale revealed symptoms of depression in 1199 (85.8%) respondents. Among them, mild depression symptoms were noted in 401 (33.5%), moderate depression symptoms in 330 (27.5%), moderately severe depression symptoms in 269 (22.4%) and severe depression symptoms in 199 (16.6%). Factors associated with depressive symptoms by PHQ-9-points can be found in Table 1. There were significant differences ($p < 0.001$) in depression symptom scores by ANOVA between sex (F = 56.196216), multiple trauma (F = 18.863597), support sought pre-war (F = 17.448173) and professional support sought during the war (F = 41.810278), current need of support (F = 65.409471), stopped education (F = 12.895695), taking psychotropic medications during war (F = 41.810278) and excessive use of social media (F = 20.220748).

The similar pattern was observed for anxiety symptom scores. Anxiety symptoms were found in 924 (66.1%) students (GAD-7). Of them 475 (51.4%) respondents demonstrated moderate and severe anxiety symptoms, 449 (48.6%) had a mild level of symptoms (Table 2). Statistically significant associations ($p < 0.001$) according to ANOVA is noted between anxiety symptoms and sex (F = 56.196216), multiple trauma (F = 22.691939), non-professional support sought during war (F = 44.970622) and professional support sought during the war (F = 49.063930), current need of support (F = 54.126732) and excessive use of social media (F = 24.207491). At the same time, for both anxiety and depression symptoms, there were no significant differences between relocation experience.

Insomnia has been recorded in 57.0% respondents. Subthreshold values of insomnia on the ISI scale (8–14 points) of them were noted by 66.0% of respondents, clinically significant insomnia (15–21 points) by 29.0% and severe insomnia (22–28 points) by 5.0% of students.

In general, it can be stated that symptoms of depression, anxiety and PTSD in varying degrees of severity are present simultaneously in many respondents (Fig. 1). Thus, if one of the students shows symptoms of depression, then with a high degree of confidence we can assume that he or she will also have symptoms of anxiety and PTSD.

Based on the above, and also because the depression symptom variable (PHQ-9) showed the highest internal consistency and relatively equal distribution in a sample, it was decided to build the XGBoost prediction model only for the depression symptom variable. The results obtained for the predictive model of depression symptom can be extrapolated to anxiety and post-traumatic stress symptoms.

To identify the optimal parameters for our model, we employed a hyper optimization process using Ray Tune and the NevergradSearch algorithm. This involved using

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Table 1 Socio-demographic factors associated with depression symptoms among students

Variables	Categories	Overall	Depressive symptoms by PHQ-9-points					Mean PHQ-9 (SD)	F	p
		n = 1398 (100.0%)	0–4 None n (%)	5–9 Mild n (%)	10–14 Moderate n (%)	15–19 moderately severe n (%)	20–27 Severe n (%)			
Gender	Male	342 (24.5)	81 (23.7)	103 (30.1)	74 (21.6)	52 (15.2)	32 (9.4)	5.81 ± 4.96	56.196216	0.0000000000001**
	Female	1056 (75.5)	118 (11.2)	298 (28.2)	256 (24.2)	217 (20.6)	167 (15.8)	8.46 ± 5.64		
Age	Mean± Std (Median)	19.56 ± 3.18 (19)	19.87 ± 3.69 (19)	19.5 ± 2.94 (19)	19.89 ± 4.25 (19)	19.27 ± 1.69 (19)	19.17 ± 2.5 (18)	7.81 ± 5.60	0.167903	0.682
Relocation *Including*:	Yes	560 (40.1)	57 (10.2)	173 (30.9)	135 (24.1)	122 (21.8)	73 (13.0)	11.85 ± 6.2	0.166201	0.684
	No	838 (59.9)	142 (17.0)	228 (27.2)	195 (23.3)	147 (17.5)	126 (15.0)	11.45 ± 6.9		
	Within Ukraine	436 (32.2)	38 (8.7)	143 (32.8)	106 (24.3)	93 (21.3)	56 (12.9)	-	-	-
	Abroad	253 (18.1)	26 (10.3)	74 (29.3)	56 (22.1)	59 (23.3)	38 (15.0)	-	-	-
	Returned home	244 (17.5)	21 (8.6)	75 (30.7)	56 (23.0)	63 (25.8)	29 (11.9)	-	-	-
Living conditions during war	Alone	95 (6.8)	9 (9.5)	31 (28.4)	21 (22.1)	18 (19.0)	20 (21.0)	12.8 ± 6.6	6.263004	0.012*
	With someone	1303 (93.2)	190 (14.6)	374 (28.7)	309 (23.7)	251 (19.3)	179 (13.7)	11.5 ± 6.6		
Trauma experience *Including*:	Yes	1274 (91.1)	168 (13.2)	368 (28.9)	301 (23.6)	252 (19.8)	185 (14.5)	11.7 ± 6.6	2.748667	0.096
	No	124 (8.9)	31 (25.0)	33 (26.6)	29 (23.4)	17 (13.7)	14 (11.3)	6.17 ± 5.65		
	Accident	75 (5.4)	12 (16.0)	15 (20.0)	20 (26.7)	18 (24.0)	10 (13.3)	-	-	-
	Loss	582 (41.6)	68 (11.7)	162 (27.8)	137 (23.6)	127 (21.8)	88 (15.1)	-	-	-
	Witness	197 (14.1)	20 (10.2)	45 (22.8)	45 (22.8)	49 (24.9)	38 (19.3)	-	-	-
	Sexual trauma	98 (7.0)	3 (3.0)	12 (12.3)	31 (31.6)	22 (22.5)	30 (30.6)	-	-	-
	War	958 (68.5)	126 (13.2)	280 (29.2)	221 (23.1)	192 (20.0)	139 (14.5)	-	-	-
	Assault	150 (10.7)	11 (7.3)	27 (18.0)	37 (24.7)	37 (24.7)	38 (25.3)	-	-	-
	Occupation	89 (6.4)	8 (10.1)	28 (31.5)	20 (22.5)	18 (20.2)	14 (15.7)	-	-	-
	Shellings	318 (22.7)	37 (11.6)	87 (27.4)	79 (24.8)	69 (21.7)	46 (14.5)	-	-	-
	Multiple trauma	2.0 ± 3.9 (2)	1.56 ± 1.22 (1)	1.88 ± 1.3 (2)	2.07 ± 1.44 (2)	2.21 ± 1.49 (2)	2.25 ± 1.38 (2)	7.81 ± 5.60	18.863597	0.00002**
Support sought pre-war	Yes	162 (11.6)	35 (21.6)	28 (17.3)	44 (27.2)	47 (29.0)	162 (11.6)	15.0 ± 6.6	17.448173	0.00003**
	No	1236 (88.4)	191 (15.5)	366 (29.6)	302 (24.4)	225 (18.2)	152 (12.3)	11.16+-6.49		
Non-professional support sought during war	Yes	571 (40.8)	63 (11.0)	166 (29.1)	135 (23.7)	123 (21.5)	84 (14.7)	12.2 ± 6.4	8.578101	0.004*
	No	827 (59.2)	136 (16.4)	235 (28.4)	195 (23.6)	146 (17.7)	115 (13.9)	7.05 ± 5.40		

Table 1 (continued)

Variables	Categories	Overall	Depressive symptoms by PHQ-9-points					Mean PHQ-9 (SD)	F	p
		n = 1398 (100.0%)	0–4 None n (%)	5–9 Mild n (%)	10–14 Moderate n (%)	15–19 moderate-ly severe n (%)	20–27 Severe n (%)			
Professional support sought during war	Yes	210 (15.0)	11 (5.3)	42 (20.0)	51 (24.3)	57 (27.1)	49 (23.3)	14.5 ± 6.5	41.810278	0.0000000001**
	No	1188 (85.0)	188 (15.8)	359 (30.2)	279 (23.5)	212 (17.9)	150 (12.6)	7.29 ± 5.42		
Taking psychotropic medications during war	Yes	97 (6.9)	2 (2.1)	11 (11.3)	24 (24.7)	32 (33.0)	28 (28.9)	14.5 ± 6.5	41.810278	0.0000000001**
	No	1301 (93.1)	197 (15.1)	390 (30.0)	306 (23.5)	237 (18.2)	171 (13.2)	7.50 ± 5.48		
Current need of support	Yes	221 (15.8)	8 (3.6)	34 (15.4)	45 (20.3)	68 (30.8)	66 (29.9)	15.70 ± 6.33	65.409471	0.000000000000001**
	No	1177 (84.2)	191 (16.2)	367 (31.2)	285 (24.2)	201 (17.1)	133 (11.3)	10.84 ± 6.39		
Stopped education	Yes	85 (6.1)	6 (7.1)	19 (22.4)	15 (17.6)	27 (31.8)	18 (21.2)	13.9 ± 6.8	12.895695	0.0003**
	No	1313 (93.9)	193 (14.7)	382 (29.1)	315 (24.0)	242 (18.4)	181 (13.8)	11.46 ± 6.58		
Social networks (hours)	Mean± Std	6.68 ± 4.5	5.65 ± 3.9	6.27 ± 4.3	6.91 ± 4.8	6.95 ± 4.8	7.82 ± 4.9	11.6 ± 6.6	20.220748	0.000007**
Total		n = 1398 (100.0%)	199 (14.2)	401 (28.7)	330 (23.6)	269 (19.2)	199 (14.2)	7.81 ± 5.60		

Note: *$p < 0.05$, **$p < 0.001$

Bayesian optimization to explore 4092 different models, dynamically selecting parameters for trials based on previous runs. This yielded optimal parameters: max $\delta = 2$, $\alpha = 16$, $\lambda = 4$, $\gamma = 3.32289$. The mean predictive accuracy of the final XGBoost regression model was 0.469, measured by the R coefficient of correlation between actual and predicted delta, with a RMSE score of 5.858 across the 10 folds. Subsequently, we applied these optimal parameters to the entire dataset to investigate the model's explain ability.

The top 10 important features of the regression model are visualized in the bar charts in Fig. 2. The main predictor in the model is pre-war subjective wellbeing. Notably, various other significant features influencing shifts in depression symptom scores include use of social media, sex, multiple traumatic experiences, experience of sexual trauma, assault and loss of a close one, seeking professional mental health support before and during the war, and use of mental health medications. Namely, the SHAP summary suggests that lower initial subjective wellbeing, higher use of social media, female sex, multiple traumatic experiences, experience of assault, sexual trauma and loss of a close one, seeking professional mental health support before and during the war, and use of mental health medications predicted increases in depression symptom score.

Additionally, the SHAP summary presents the ranking of important features and their impact on the depression outcome (Fig. 3). After assessing the strongest interactions, we found that people with high subjective wellbeing pre-war, when exposed to several traumatic events, had lower depression symptom scores compared to those, who had lower subjective wellbeing pre-war. However, when exposed to three and more traumatic events, high subjective wellbeing pre-war was instead connected with increased depression symptom scores. This pattern was most pronounced with those suffering 3–4 traumatic experiences.

Interestingly, sexual trauma alone predicted higher levels of depression symptoms compared to cases, when sexual trauma was part of multiple trauma experience. Additionally, the use of mental health medications by people with higher subjective wellbeing pre-war predicted a higher depression symptom rate.

Women, in general, had higher depression symptom scores than men, but seeking non-professional support by women was associated with a lower depression symptom rate relative with those who didn't have such support, with men showing the inverse effect.

More intensive use of social media predicted higher depression symptom scores. Interestingly, relocation during the war seemed to dampen the positive and negative effect of social media use. That is, those spending more than 10 h per day in social media tended to show higher depression symptom scores but to a lesser degree when having experienced relocation; and, the opposite, for

Table 2 Socio-demographic factors associated with anxiety symptoms among students

Variables	Categories	Overall	Anxiety symptoms by GAD-7 -points				Mean GAD-7 (SD)	F	p
		n = 1398 (100.0%)	0–4 None n (%)	5–9 Mild n (%)	10–14 Moderate n (%)	15–21 Severe n (%)			
Gender	Male	342 (24.5)	166 (48.5)	105 (30.7)	45 (13.2)	26 (7.6)	5.81 ± 4.96	56.196216	0.0000000000001**
	Female	1056 (75.5)	308 (29.1)	344 (32.6)	212 (20.1)	192 (18.2)	8.46 ± 5.64		
Age	Mean± Std (Median)	19.56 ± 3.18 (19)	19.40 ± 2.65 (19)	19.80 ± 3.64 (19)	19.53 ± 3.52 (19)	19.46 ± 3.05 (19)	7.81 ± 5.60	0.167903	0.682
Relocation *Including*:	Yes	560 (40.1)	165 (29.5)	206 (36.8)	101 (18.0)	88 (15.7)	8.10 ± 5.44	0.127492	0.721
	No	838 (59.9)	309 (36.9)	243 (29.0)	156 (18.6)	130 (15.5)	7.62 ± 5.69		
	Within Ukraine	436 (32.2)	128 (29.4)	158 (36.2)	81 (18.6)	69 (15.8)	-	-	-
	Abroad	253 (18.1)	70 (27.7)	99 (39.1)	43 (17.0)	41 (16.2)	-	-	-
	Returned home	244 (17.5)	67 (27.5)	96 (39.3)	49 (20.1)	32 (13.1)	-	-	-
Living conditions during war	Alone	95 (6.8)	28 (29.5)	29 (30.5)	18 (18.9)	20 (21.1)	8.57 ± 5.55	3.701455	0.054
	With someone	1303 (93.2)	446 (34.2)	420 (32.2)	239 (18.4)	198 (15.2)	7.75 ± 5.60		
Trauma experience *Including*:	Yes	1274 (91.1)	415 (32.6)	415 (32.6)	241 (18.9)	203 (15.9)	7.97 ± 5.57	4.408642	0.036*
	No	124 (8.9)	59 (47.6)	34 (27.4)	16 (12.9)	15 (12.1)	6.17 ± 5.65		
	Accident	75 (5.4)	21 (28.0)	28 (37.3)	18 (24.0)	8 (10.7)	-	-	-
	Loss	582 (41.6)	178 (30.6)	188 (32.3)	119 (20.4)	97 (16.7)	-	-	-
	Witness	197 (14.1)	49 (24.9)	63 (32.0)	43 (21.8)	42 (21.3)	-	-	-
	Sexual trauma	98 (7.0)	13 (13.2)	28 (28.6)	28 (28.6)	29 (29.6)	-	-	-
	War	958 (68.5)	312 (32.6)	308 (32.1)	176 (18.4)	162 (16.9)	-	-	-
	Assault	150 (10.7)	27 (18.0)	47 (31.3)	36 (24.0)	40 (26.7)	-	-	-
	Occupation	89 (6.4)	24 (27.0)	26 (29.2)	22 (24.7)	17 (19.1)	-	-	-
	Shellings	318 (22.7)	93 (29.2)	106 (33.3)	61 (19.2)	58 (18.3)	-	-	-
	Multiple trauma	2.0 ± 3.9 (2)	1.7 ± 1.24 (1)	2.03 ± 1.4 (2)	2.2 ± 1.45 (2)	2.33 ± 1.5 (2)	7.81 ± 5.60	22.691939	0.000002**
Support sought pre-war	Yes	162 (11.6)	31 (19.1)	46 (28.4)	40 (24.7)	45 (27.8)	10.38 ± 5.79	6.807342	0.009*
	No	1236 (88.4)	443 (35.8)	403 (32.6)	217 (17.6)	173 (14.0)	7.47 ± 5.48		
Non-professional support sought during war	Yes	571 (40.8)	149 (26.1)	199 (34.9)	106 (18.6)	117 (20.5)	8.92 ± 5.70	44.970622	0.00000000003**
	No	827 (59.2)	325 (39.3)	250 (30.2)	151 (18.3)	101 (12.2)	7.05 ± 5.40		
Professional support sought during war	Yes	210 (15.0)	32 (15.3)	66 (31.4)	50 (23.8)	62 (29.5)	10.78 ± 5.69	49.063930	0.000000000004**
	No	1188 (85.0)	442 (37.2)	383 (32.3)	207 (17.4)	156 (13.1)	7.29 ± 5.42		

Table 2 (continued)

Variables	Categories	Overall	Anxiety symptoms by GAD-7 -points				Mean GAD-7 (SD)	F	p
		n = 1398 (100.0%)	0–4 None n (%)	5–9 Mild n (%)	10–14 Moderate n (%)	15–21 Severe n (%)			
Taking psychotropic medications during war	Yes	97 (6.9)	11 (11.3)	24 (24.8)	35 (36.1)	27 (27.8)	11.97 ± 5.55	9.921866	0.002*
	No	1301 (93.1)	463 (35.6)	425 (32.7)	230 (17.7)	183 (14.0)	7.50 ± 5.48		
Current need of support	Yes	221 (15.8)	26 (11.8)	61 (27.6)	65 (29.4)	69 (31.2)	11.33 ± 5.35	54.126732	0.0000000000003**
	No	1177 (84.2)	448 (38.1)	388 (32.9)	192 (16.3)	149 (12.7)	7.15 ± 5.39		
Stopped education	Yes	85 (6.1)	18 (21.2)	27 (31.8)	28 (32.9)	12 (14.1)	9.14 ± 5.25	5.811194	0.016*
	No	1313 (93.9)	456 (34.7)	422 (32.1)	229 (17.5)	206 (15.7)	7.72 ± 5.60		
Social networks (hours)	Mean± Std	6.68 ± 4.53	5.95 ± 4.21	6.58 ± 4.31	7.23 ± 4.87	7.72 ± 4.94	7.81 ± 5.60	24.207491	0.000001**
Total		n = 1398 (100.0%)	474 (33.9)	449 (32.1)	257 (18.4)	218 (15.6)	7.81 ± 5.60		

Note: *$p < 0.05$, **$p < 0.001$

those who used social media less than 7 h per day, which seemed to have a protective effect but of a smaller magnitude for relocated individuals.

Moreover, intensive use of social media predicted higher depression symptom scores among those who experienced war-related traumatic events compared to those who didn't. And lower use of social media predicted higher depression symptom scores among those who sought professional mental health support before the war.

Online education for those who sought professional support during the war predicted lower depression symptom scores. And, inversely, online education was related to higher depression scores for those who didn't seek professional support during the war.

Discussion

The aim of this study was to investigate prevalence and predictors of mental health burden, especially symptoms of anxiety, depression, PTSD and insomnia, among Ukrainian university students during the Russian-Ukrainian war as well as to identify risk and protective factors of mental health burden.

Our results indicate high levels of psychological distress in Ukrainian university students almost 20 months after the beginning of the Russian full-scale war on Ukraine. Symptoms of depression were the most common, followed by anxiety symptoms, insomnia and PTSD symptoms respectively. Regarding the severity of symptoms, the prevalence was the highest among moderate and severe PTSD symptoms, followed by anxiety, depression and insomnia, respectively.

Based on study findings from war-affected populations on mental health outcomes, we also found depression and anxiety symptoms to be the most prevalent [23, 24]. At a first glance, it is surprising that PTSD symptoms are the least prevalent in our sample compared to other studies with war-affected samples who found a high prevalence of PTSD symptoms [23, 24]. However, when considering that moderate and severe PTSD symptoms had the highest prevalence compared to the severity of other mental health symptoms in our sample, this in turn fits with previous study results. Furthermore, this might be explained by the big overlaps of mental health symptoms.

Additionally, compared to the results of our 2022 study [45], the number of respondents with more severe levels of depression increased in 2023. This is in contrast to the findings of Pavlova et al. [46]. However, in our study, the level of anxiety shifted to milder levels in 2023, compared to 2022, and PTSD symptoms also became less severe which points in the same direction as the findings by Fujii et al. [7]. Our findings can be explained by the fact that people adapt to the war context and learn to survive, this reduces anxiety, and activates resilience trajectories. At the same time, losses during the war increase over time and this "feeds" depressive symptoms.

Several factors critically predicted increases in depression symptom score including lower initial wellbeing, higher use of social media, female sex, multiple traumatic experiences, experience of assault, sexual trauma and loss of a close one, seeking professional mental health support before and during the war, and use of mental health medications. Former research supports our findings for wellbeing [45], female sex [25], multiple traumatic
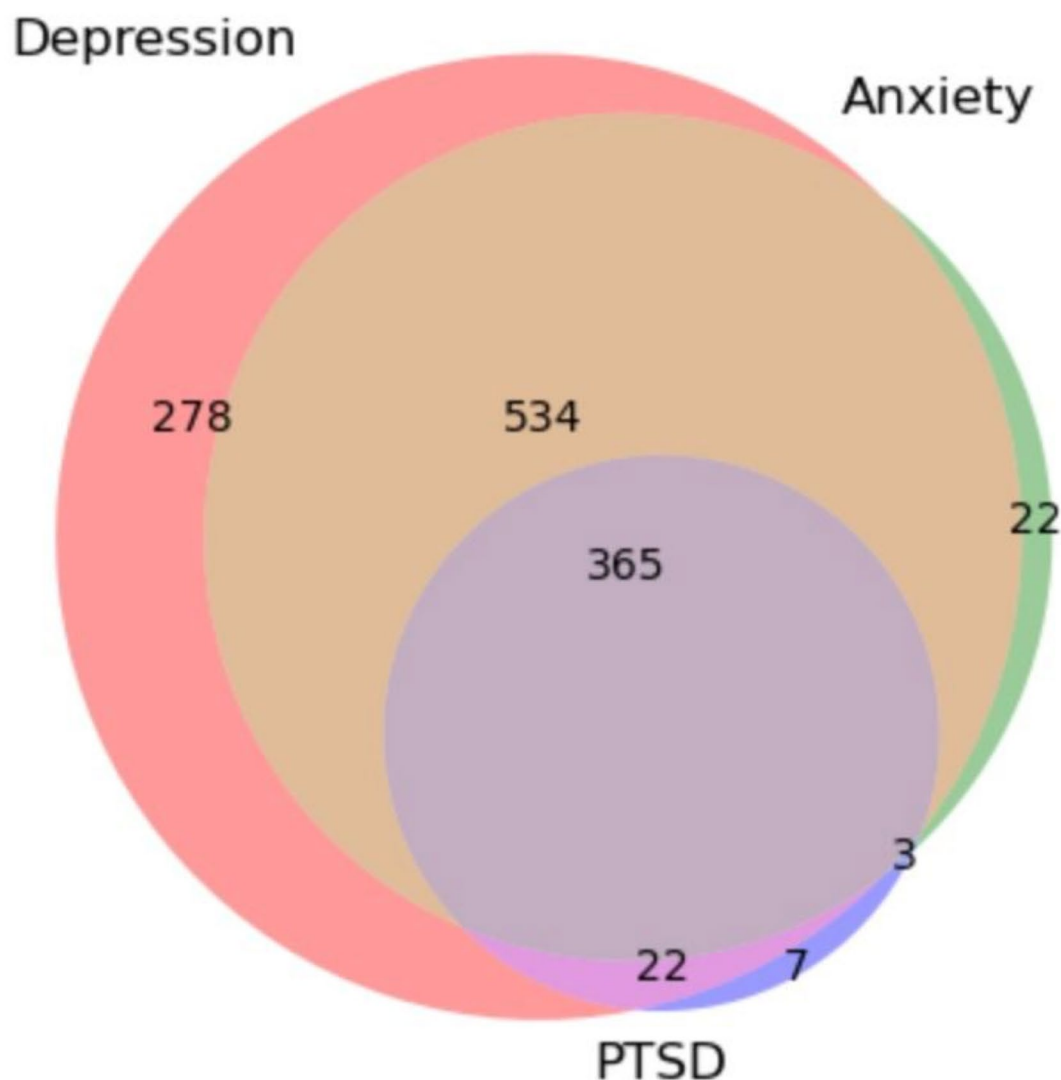
Fig. 1 Intersection of scale results in 2023 study (absolute number of respondents)

experiences [27], including loss of a close one and assault [45], and sexual trauma [28].

Regarding social media use, our findings are also in line with former research that links high, problematic or even addictive social media use in adolescents aged 11 to 19 years [47], and in young adults [48, 49] to depressive symptoms. Additionally, Riad et al. [50] found social media use to be associated with higher levels of anxiety and depressive symptoms among university students in the Czech Republic following the war in Ukraine. The authors explain this by arguing that social media is commonly used as a source for news and information by the younger generation. News content conveyed through social media might be presented more emotionally than in official news portals and simultaneously, high social media use increases the risk that young adults consume

fake news, especially during conflict times and in times of uncertainty.

Findings from Israel revealed that the frequency of news consumption during the 2014 Gaza war was associated with anxiety and sleeping disorders [51]. The frequency of exposure to COVID-19 pandemic-related news was shown to be a predictor for greater anxiety and depression among adults in the U.S [52]. Therefore, the prediction of a higher use of social media on increases in depression score in our sample of Ukrainian university students is comprehensible as they might feel hopeless due to the consumption of a huge amount of content about the latest events in the war which takes place in their home country and for the majority also their place of residence.
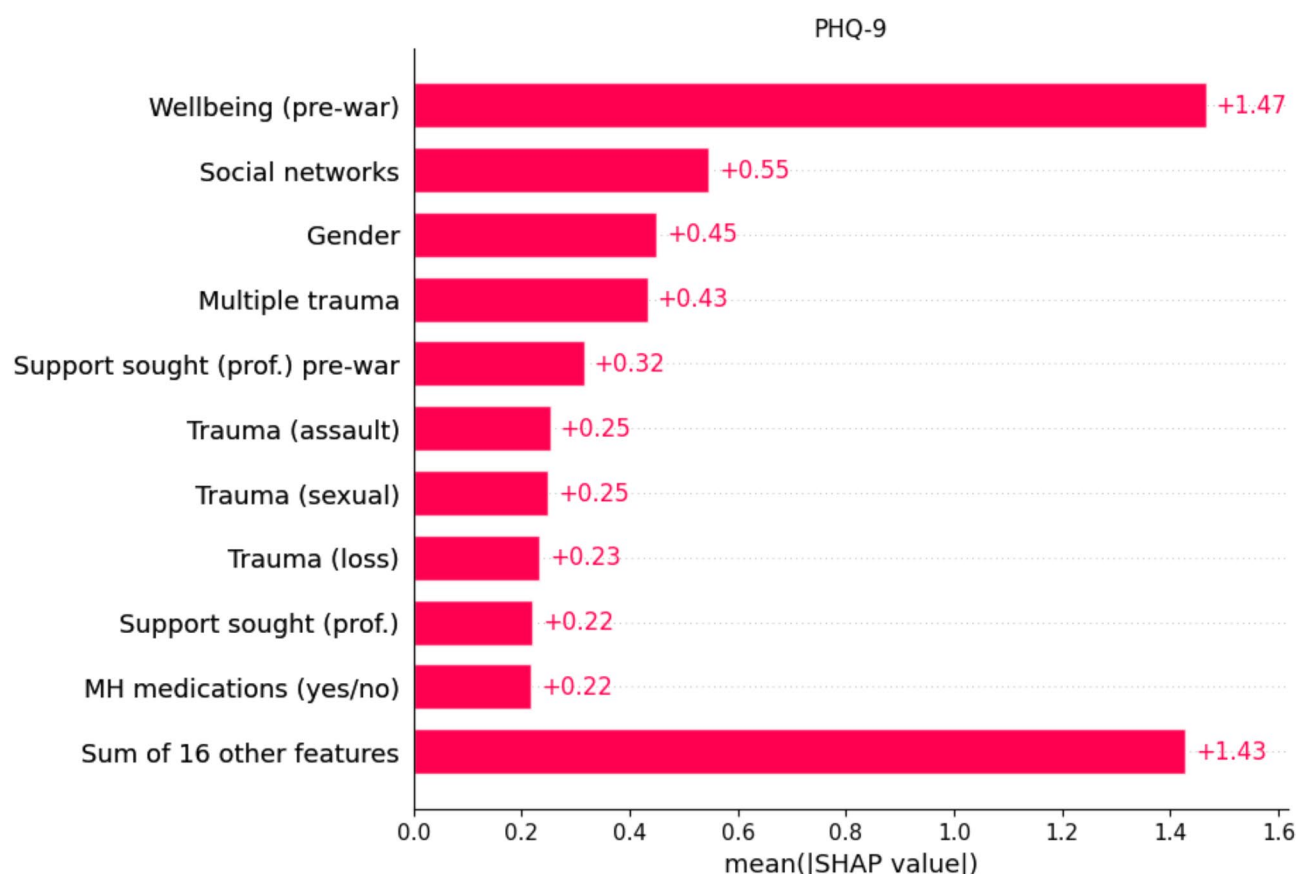
Fig. 2 Horizontal bar plots for the top 10 important features of XGBoost regression model

Paradoxically, we found seeking professional mental health support before and during the war and use of mental health medications to be predictors for increases in depression symptom score. On the one hand, this might be explained by the perceived effectiveness of receiving professional mental health support or medications [53]. The same authors found poor self-rated health and severe mental illness to be associated with lower perceived effectiveness of medication. As the prevalence of moderate and severe symptoms of anxiety, depression, PTSD and insomnia were relatively high among our sample (34.1%, 33.6%, 48.1% and 19.3%, respectively), effectiveness of seeking professional mental health support and of using medications during war might be perceived low.

On the other hand, the association between seeking professional support pre-war on increased depression symptoms might be influenced by lower initial wellbeing which appeared to be the strongest predictor on increase in depression symptom score in our model. In a scoping review, Østergaard et al. [54] identified pre-existing mental health conditions to exacerbate in a population affected by armed conflict. Moreover, the authors identified access to health care as one of the main vulnerability factors affecting the association between conflict and mental health conditions. Ukrainian university students with pre-existing mental health problems who sought professional help before war might struggled to access mental health care during war which might led to increased depression symptom scores.

However, our results show that the opposite of risk factors not necessarily act as protective factors against mental health problems. Experiencing multiple traumatic experiences (3–4) and use of mental health medications seemed to dampen the positive effect of a higher pre-war subjective wellbeing. The former finding can be linked to trauma research. From research on adverse childhood experiences (ACE) we know that from 4 or more ACE the risk for physical and mental health problems in adulthood significantly increases [55].

Considering that, it is not surprising that the interaction between experience of war-related traumatic events and an intensive use of social media predicted higher depression symptom scores compared to those who didn't experience war-related traumatic events. Furthermore, if participants experienced relocation, the risky effect of a high social media use as well as the protective effect of a lower social media use on depression
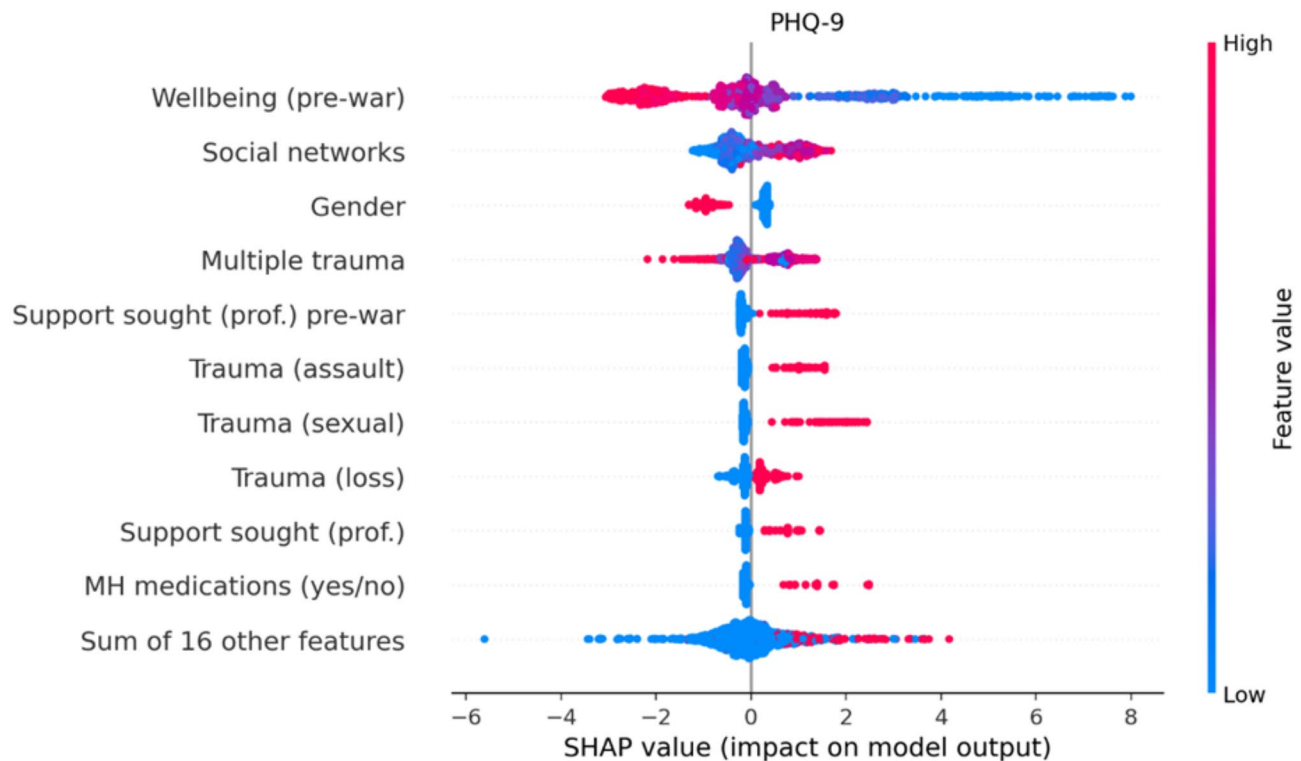
Fig. 3 The SHAP summary (the ranking of important features and their impact on the depression outcome)

symptoms is smaller. This might be explained by further stressors that are linked to relocation, e.g. post-migration conditions, possible separation from family, unemployment, inadequate housing [56].

The majority of participants in our sample who indicated that they have experienced relocation stated that they were relocated within Ukraine, followed by relocation abroad and returned home, respectively. The type of relocation can also have an influence on mental health outcomes. A meta-analysis on the extent of compromised mental health among refugees, including internally displaced persons, asylum seekers, and stateless persons, found poorer mental health outcomes in refugees compared to non-refugees, in general, and lower mental health indices in internally displaced refugees and in repatriated refugees than in externally displaced refugees [56]. Furthermore, refugees from conflicts that remained ongoing scored lower than those from conflicts that had been resolved.

We found that the actual protective effect of a lower use of social media on depression symptom scores in our study turned into a risk factor for increased depression symptoms when it interacts with seeking of professional help pre-war. While this might be explained by pre-existing vulnerabilities, as mentioned before, interestingly, the interaction between online education and seeking professional help during war predicted lower depression symptom scores and vice versa. Furthermore, closures

of educational facilities are associated with restricted access to peers and loss of daily structure [57]. The disadvantages of online education might increase the risk for developing mental health problems during war, while seeking professional help during war seems to serve as a buffer for Ukrainian university students taking online classes.

Last but not least, seeking non-professional support had a protective effect only in women while for men it predicted higher depression symptom scores. Former research found women with common mental disorders were more likely to have sought some form of non-professional help than men [58]. Therefore, female students in our sample may sought help from a non-professional source at an early stage of depression symptoms where low-threshold support can be just effective as higher-threshold care, while in male students the severity of symptoms may have been more pronounced at the time of seeking help and, thus, a more indicated form of mental health care is needed.

Limitations

This study should be interpreted in light of several limitations. First, our sample consists of students. Student samples for psychological studies are associated with issues of representativeness, generalizability and comparability of results [59, 60]. Therefore, the interpretation of our results should be interpreted with caution and

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accordingly to sample size and study design. However, in the context of war in which this study was conducted, this study design also had significant advantages (e.g., rapid data collection and data analysis for regular monitoring). In addition, the obtained proportions of responses relative to the total number of students attending universities varied by region. We had a low response rate that might be explained by the fact that the invitation to participate in the survey was sent to university management rather than directly to each student. The low response rate was probably reinforced even more by the still existing stigma surrounding mental health issues in Ukraine [61]. Similar trends have been observed in other online surveys [62]. Nevertheless, our data were comparable to the results of other studies on students in Ukraine during the war [63, 64], which supports the idea that our study may reflect certain aspects of the broader population. Also our sample consisted of a larger proportion of females than males. Second, given the study's cross-sectional design, we were not able to thoroughly evaluate the risk and protective factors of students' mental health during war, as well as how these symptoms change over time. Furthermore, we cannot establish causality between the psychiatric conditions and exposure to war. This should be evaluated using longitudinal study designs. Third, the self-administered nature of the survey is a limitation. Fourth, only questionnaires with complete answers were subjected to statistical analysis, however, we confirmed that participants with and without missing data were similar, and the regression results after imputing missing values were similar to the main regressions. Finally, the scales used in this study may miss trauma reactions specific to the Ukrainian setting.

Conclusion

The present study revealed a high prevalence of depression, anxiety, insomnia and PTSD symptoms in Ukrainian university students almost 20 months after the beginning of the Russian full-scale war on Ukraine. Additionally, moderate and severe mental health symptoms were found in at least every fifth respondent. Almost half of the respondents showed moderate and severe symptoms of PTSD. We found lower initial wellbeing, higher use of social media, female sex, multiple traumatic experiences, experience of assault, sexual trauma and loss of a close one, seeking professional mental health support before and during the war and use of mental health medications to be risk factors for increased depression scores. Additionally, the present study showed that Ukrainian university students have a risk of multiple psychological stress during the war which means that symptoms of mental disorders might co-occur.

Our findings emphasize the need for an immediate response to support the mental health of university students in Ukraine on different levels and through different stakeholders. Mental health support needs to be tailored to the individual needs, previous experiences, burdens and living conditions of each young adult. This requires a stepped-care approach with multilevel, trauma-informed interventions, including low-threshold offers (e.g. online mental health screening tools, websites with psychoeducational elements, etc.) as well as high-threshold approaches (e.g. digital professional support, counseling, specialized treatment, evidence-based interventions for individuals and groups [65, 66]. There needs to be greater access and quicker connections to mental health support systems where young people can receive effective help. Interventions should also aim to reduce social media use by young people, support psychoeducation and destigmatize mental disorders to promote early professional and non-professional help-seeking. Psychologists, university teachers, university administrations and politicians have a crucial role in realizing mental health support for students. Furthermore, research results on this topic have to be disseminated to the broader public as well as to other researchers and research areas. This is important to connect research findings of different academic teams, to close research gaps and finally to enhance mental health student support appropriately to the Ukrainian context.

Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request and subject to approval from the other authors.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of the Institute of Psychiatry of the Taras Shevchenko National University of Kyiv (No. 1/17.07.2023) and was conducted in accordance with the principles of the Declaration of Helsinki. All participants gave their informed consent for inclusion before participating in the study.

Clinical trial number
Not applicable.

Competing interests
JMF reports the following conflict of interest (last five years): Research from EU, BMG (Federal Ministry of Health), BMBF (Federal Ministry of Education and Research), BMFSFJ (Federal Ministry of Family, Senior Citizens, Women

Author details
[1]Institute of Psychiatry, Taras Shevchenko National University of Kyiv, Zdanovska str., 36, Kyiv 03022, Ukraine
[2]Department of Child and Adolescent Psychiatry/Psychotherapy, University Hospital Ulm, Ulm, Germany
[3]Competence Area Mental Health Prevention in the Competence Network Preventive Medicine Baden-Württemberg, Ulm, Germany
[4]German Center for Mental Health (DZPG), partner site Ulm, Ulm, Germany
[5]Ukrainian Psychiatric Association, Kyiv, Ukraine

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