

Exposure to COVID-19 during the First and the Second Wave of the Pandemic and Coronavirus-Related PTSD Risk among University Students from Six Countries – A Cohort Study [†]

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Abstract: The aim of this study is to reveal differences in exposure to coronavirus disease (COVID-19) and its consequences during the first (W1) and the second (W2) wave of the pandemic in the six countries among university students. The following purpose is to show the prevalence and associations between exposure to COVID-19 and coronavirus-related posttraumatic stress syndrome (PTSD) risk during W2. The repeated cross-sectional study was conducted among university students from Germany, Poland, Russia, Slovenia, Turkey, and Ukraine (W1: N = 1684; W2: N = 1741). Exposure to COVID-19 was measured by eight-item questionnaire, and coronavirus-related PTSD risk by PCL-S. The exposure to COVID-19 symptoms was higher during W2 than W1 among students from all countries, except Germany where the increase in testing was the strongest. Students from Poland, Turkey, and in the total sample were more frequently hospitalized for COVID-19 in W2. In these countries and Ukraine, students were more often in quarantine. In all countries, participants were more exposed to infected friends/relatives and loss of a family member/friend due to COVID-19 in W2 than W1. The increase in exposure to losing job due to COVID-19 was noted only in Ukraine. The economic status during W2 has worsened only in Poland and improved in Russia. It was due to the significant wave of the restrictions in Russia, and stringer restrictions in Poland. The prevalence of coronavirus-related PTSD risk at three cutoff scores (25, 44, and 50) was at 78.20%, 32.70%, and 23.10%, respectively. The prediction models for different severity of PTSD risk differed. Experiencing COVID-19 symptoms, loss of friends/relatives, losing job and worsening economic status due to the COVID-19 were positively associated with high and very high coronavirus-related PTSD risk, while having infected friends/relatives was associated with the moderate risk.

Keywords: COVID-19; exposure to COVID-19; PTSD; students; cross-national

1. Introduction

The novel coronavirus disease 2019 (COVID-19) caused by the SARS-CoV-2 virus has become a highly viral and infectious disease globally. The World Health Organization (WHO) [1] declared the COVID-19 pandemic on March 11, 2020. The pandemic is an unexpected, global phenomenon that has affected people not only by indirect exposure to the disease but also in an indirect way via its various consequences, e.g., economic. The COVID-19 pandemic is the most profound global economic recession in the last eight decades [2]. Additionally, research shows that mental health problems associated with the pandemic extend to the general population and are not exclusively limited to individuals who have been infected [3]. Therefore, due to financial instability, the current pandemic can affect the mental health of individuals who are not at severe risk of becoming infected with COVID-19. The COVID-19 pandemic has considerably affected mental health. The review of the epidemiology of mental health indicates that psychiatric epidemic cooccurs with the COVID-19 pandemic [4].

One of the groups that are particularly susceptible to mental health deterioration during the ongoing pandemic is university students. Research has shown that student status predicts mental health deterioration risk [5–8]. The education sector has been strongly disturbed by the COVID-19 pandemic due to the International Labour Organization [9]. The factors contributing to students' mental health issues in pre-pandemic period are academic pressure [10] and financial obligations that may lead to poorer performance [11], and health concerns [12]. The additional factor is a young age. Even though young adults are less susceptible to the COVID-19 infection [13], they are more susceptible to mental health issues during the ongoing pandemic [14–16].

Post-Traumatic Stress Disorder (PTSD) and the COVID-19 Pandemic

Post-traumatic stress disorder (PTSD) is in the category of trauma- and stressors-related stress disorders [DSM V]. The DSM-IV criteria for post-traumatic stress disorder (PTSD) relating to exposure assumed that the person experienced or was confronted with an event involving actual or threatened death or serious injury or a threat to the physical integrity of self or others (A1) and second, that the person's response involved intense fear, helplessness, or horror (A2) [17]. However, in DSM V, significant changes have been introduced. The DSM-5 requires certain triggers, whether directly experienced, witnessed, or happening to a close family member or friend, but exposure through media is excluded unless the exposure is work-related. The second criterion of subjective response (A2) has been removed [18].

Pandemics are classified as natural disasters. PTSD is one of the most often studied psychiatric disorders and related to natural disasters [19]. However, the DSMV definition notes that a life-threatening illness or debilitating medical condition is not necessarily considered to be a traumatic event. Therefore, there is a claim that exposure to the COVID-19 pandemic cannot be treated as a traumatic experience causing PTSD due to the new criteria in DSM-V [20]. There is an ongoing debate regarding the possibility of the anticipatory threat of COVID-19 and its consequences to be a traumatic experience and, therefore, the possibility of psychological responses coherent with PTSD [21]. Also, recent research [22] strongly supports this claim and emerging research in this area. Following that research, we recognize COVID-19 as a traumatic stressor event that can cause PTSD-like response.

Probable PTSD related to the pandemic ranges from 7% to even 67% in general population [20]. The meta-analysis of 14 studies conducted during the first wave of the pandemic, between February and April, revealed high rate of the post-traumatic stress (23.88%) in the general population [23]. The prevalence rate of PTSD in students presents

a wide range of variety. In the group of home-quarantined Chinese university students ($n = 2485$) one month after the breakout, the prevalence was 2.7%. However, Chi et al. [24] revealed that in a sample of Chinese students ($n = 2038$), the prevalence of clinically relevant PTSD reached 30.8% during the pandemic. Among a numerous sample of French university students ($n = 22,883$) rate of probable PTSD one month after the COVID-19 lockdown was 19.5% [25].

The predictors of PTSD in the Chinese university student sample were older age, knowing people who had been isolated, higher level of anxious attachment, adverse experiences in childhood, and lower level of resilience. However, gender, family intactness, subjective socioeconomic status (SES), the number of confirmed cases of COVID-19 in participants' areas turned out to be irrelevant predictors [24]. However, the meta-analysis showed that gender and age were not significant moderators of PTSD [23]. The research showed a significant association between the exposure to COVID-19 and the severity of PTSD symptoms in the university student samples [25,26]. The general exposure to COVID-19 turned out to be a significant risk factor for anxiety in Czech, Polish, Turkish, and Ukrainian university students while irrelevant for anxiety in Colombian, German, Israeli, Russian and Slovenian students during the first wave of the pandemic [27]. The same study showed that also depression risk is associated with the general exposure to COVID-19 among university students from the Czech Republic, Israel, Russia, Slovenia and Ukraine. However, in Colombia, Germany, Poland, and Turkey the exposure was irrelevant for depression risk among university students [27].

The aim of this study is to verify the differences in the exposure to COVID-19 in university students from Germany, Poland, Russia, Slovenia, Turkey, and Ukraine between the first wave (May–June 2020) (W1) and the second wave (mid-October–December 2020) (W2) of the COVID-19 pandemic. The countries in our study represent the cultural diversity depicted by traditional vs. secular and survival vs. self-expression values. The Inglehart-Welzel World Cultural Map [28] aggregates all countries into eight clusters based on the dimensions of those values. Four out of eight value clusters are exemplified in our study. Protestant Europe is represented by Germany; Catholic Europe by Poland and Slovenia; Orthodox Europe by Ukraine and Russia; and African-Islamic region by Turkey. Therefore, these countries represent a great diversity of global cultural values. To present the ongoing pandemic situation in each of the six countries, we will refer to the Oxford COVID-19 Government Response Tracker (OxCGRT), which enables tracking the stringency of government responses to the COVID-19 pandemic across countries and time [29]. The stringency level is composed of multiple indicators. It refers to community mobility: school closings, workplace closings, cancelation of public events, restrictions on gathering, public transport closings, stay at home requirements, restrictions on internal movement, international travel restrictions; economic measures: income support, debt/contract relief, fiscal measures, and international support. The final set of indices relates to public health issues: public information campaigns, testing policy, contact tracking, emergency investment in health care, investments in vaccines, facial coverings, and vaccination. The stringency of governments responses is the reaction to the pandemic spread in each country. Those detailed measurements are rescaled to a value ranging from 0 to 100, where 100 denotes the strictest restrictions. The timing was crucial for the stringency level evaluation. The stringency value in this study was evaluated based on the mean of the given stringency value in the first and the last day of data collection in each country. The index well portrays the pandemic situation for the general population in each country.

The mean index value varied in the W1 varied between 47.91 in Slovenia to 82.64 in Ukraine. During the W2, the lowest index was observed in Russia (44.80) while the highest was in Poland (75.00). The greatest increase of the OxCGRT was noted in Slovenia, while the greatest decrease of the index in Ukraine. The detailed description is shown in Figure 1a. Since the national restrictions refer mainly to closing workplaces and economic measures, we assumed that in the countries that significantly waved the restrictions during W2 (e.g., Russia), the portion of university students who reported exposure to the

COVID-19 pandemic in aspects of losing a job and deterioration of the economic status would be lower during W2. We have also analyzed the mean number of daily new cases and deaths based on an interactive web-based dashboard to track COVID-19 [30] (mean of the first and the last day of conducting the study in each country during the first and the second wave). The data on the mean number of daily cases presented in Figure 1b and on the mean number of deaths in Figure 1c shows that in four countries (Germany, Russia, Turkey, and Ukraine), despite the higher number of daily cases and deaths due to COVID-19 during W2, the restrictions decreased. The largest increase in daily cases and deaths during W2 compared to W1 was noted in Poland, Russia, Turkey, and Ukraine. Our following hypothesis was that in countries with a higher number of cases and deaths during W2, the proportion of students reporting higher exposure to COVID-19 (symptoms, testing, hospitalizing, being in a strict 14-days quarantine, having infected friends/family, and experiencing death of friends/relatives) in W2 will be higher compared to W1.

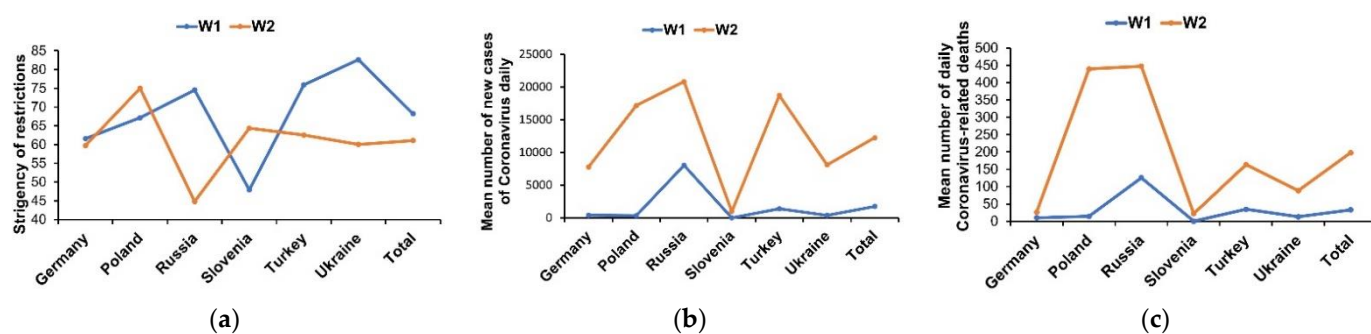


Figure 1. Figures present the following data in six countries (Germany, Poland, Russia, Slovenia, Ukraine, and Turkey) during the first (W1) and the second (W2) wave of the COVID-19 pandemic: (a) Stringency of restrictions; (b) mean number of new daily cases of COVID-19; (c) mean number of new daily COVID-19-related deaths.

The second aim is to reveal whether different aspects of the exposure to COVID-19 and its consequences (symptoms, testing, hospitalizing, being in quarantine, having infected friends/family, and experiencing death of friends/relatives, losing a job, worsening of an economic status) predict coronavirus-related PTSD severity risk in international samples of university students from the six countries.

2. Materials and Methods

2.1. Participants

The required sample size for each country group was computed a priori by the means of G*Power software (Düsseldorf, Germany) [31]. To detect a medium effect size of Cohen’s $W = 0.03$ with given 95% power in a 2×2 χ^2 contingency table, $df = 1$ (two groups in two categories each, two tailed), $\alpha = 0.05$, G*Power suggests we would need 145 participants in each country group (non-centrality parameter $\lambda = 13.05$, critical $\chi^2 = 3.84$, power = 0.95). All the respondents were eligible for the study and confirmed their student status.

The cross-sectional study was conducted in six countries within a total of 1684 students during the first wave of the pandemic: Germany ($n = 270$, 16%), Poland ($n = 300$, 18%), Russia ($n = 285$, 17%), Slovenia ($n = 209$, 13%), Turkey ($n = 310$, 18%), and Ukraine ($n = 310$, 18%) and a total of 1741 during the second wave: Germany ($n = 276$, 16%), Poland ($n = 341$, 20%), Russia ($n = 274$, 15%), Slovenia ($n = 206$, 12%), Turkey ($n = 312$, 18%), and Ukraine ($n = 332$, 19%).

The total sample of German students was recruited from University of Bamberg during the first measurement (W1) ($n = 270$, 100%) and the second measurement (W2) ($n = 276$, 100%). The Polish sample during W1 consisted of 300 students recruited from Maria Curie-Skłodowska University (UMCS) in eastern Poland ($n = 149$, 49%) and from University of Opole (UO) in the south of Poland ($n = 151$, 51%). During W2 Polish sample was comprised of 341 students from the same universities: UMCS ($n = 57$, 17%) and UO

($n = 284$, 83%). There were 285 Russian students in W1 and 274 in W2. Russian students were recruited from universities located in Sankt Petersburg: Peter the Great St. Petersburg Polytechnic University (W1: $n = 155$, 54%; W2: $n = 156$, 54%), Higher School of Economics (HSE) University (W1: $n = 90$, 31%; W2: $n = 39$, 14%), and St. Petersburg State University of Economics and Finance (W1: $n = 42$, 15%; W2: $n = 78$, 29%). The total sample in Slovenia was comprised of students recruited from University of Primorska in Koper during W1 ($n = 209$, 100%) and W2 ($n = 206$, 100%). During W1 Turkish students were from eleven Turkish universities mostly located in eastern Turkey: Bingöl University, Bingöl ($n = 148$, 48%); Atatürk University, Erzurum ($n = 110$, 35%); Muğla Sıtkı Koçman University, Muğla ($n = 35$, 11%); Ağrı İbrahim Çeçen University, Ağrı ($n = 6$, 2%); Fırat University, Elazığ ($n = 3$, 0.8%); Kırıkkale University, Kırıkkale ($n = 1$, 0.3%); Adnan Menderes University, Aydın ($n = 1$, 0.3%); Başkent University, ($n = 3$, 1%); Boğaziçi University ($n = 1$, 0.3%), Dicle University, Diyarbakır ($n = 1$, 0.3%), and Istanbul University ($n = 1$, 0.3%). During W2 Turkish students were recruited from seven Turkish universities: Atatürk University, Erzurum ($n = 110$, 35%); Ağrı İbrahim Çeçen University, Ağrı ($n = 71$, 23%); Bingöl University, Bingöl ($n = 57$, 18%); Iğdır University, Iğdır ($n = 26$, 8%); Muğla Sıtkı Koçman University, Muğla ($n = 20$, 7%); Başkent University, ($n = 16$, 5%); and Bursa Uludağ University, Bursa ($n = 12$, 4%). Ukrainian students represented Lviv State University of Physical Culture (W1: $n = 310$, 100%; W2: $n = 332$, 100%;).

Female students constituted 70% of the sample ($n = 1174$) during W1 and 73% ($n = 1275$) during W2. The majority of the participants lived in rural areas and small towns W1 ($n = 1021$, 61%) in and in W2 ($n = 1029$, 59%). Most of students were at the first cycle studies (bachelors' level) (W1: $n = 1269$, 75%; W2: $n = 1324$, 76%).

Detailed descriptive statistics for each country during W1 and W2 are presented in Table 1.

All questions included in the Google Forms questionnaire were designated as mandatory in Poland, Slovenia, Czechia, Ukraine, and Russia. In those countries, participants were unable to omit any response. However, in the German sample, the study conducted via SoSci Survey. Therefore, the hot-deck imputation was introduced to deal with a low number of missing data ($n = 5$, 0.02%).

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Table 1. Demographic characteristics of the study sample in the six countries.

Demographic Variables	TOTAL		Germany		Poland		Russia		Slovenia		Turkey		Ukraine	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
W1														
Gender														
Women	1174	69.70	193	71.50	220	73.40	193	67.00	178	85.20	173	55.80	217	70.00
Men	504	29.90	75	27.80	80	26.60	92	32.20	31	14.80	133	42.90	93	30.00
Did not want to say	6	0.40	2	0.70	0	0.00	0	0.00	0	0.00	4	1.30	0	0.00
Place of residence														
Village	449	26.70	53	19.60	140	46.80	7	2.50	85	40.70	52	16.80	112	36.10
Town	572	34.00	177	65.60	94	31.20	81	28.40	65	31.10	41	13.20	114	36.80
City	481	28.60	33	12.20	61	20.30	171	60.00	40	31.10	101	32.60	75	24.20
Agglomeration	182	10.70	7	2.60	5	1.70	26	9.10	19	9.10	116	37.40	9	2.90
Level of study														
Bachelor	1269	75.30	137	50.70	170	56.80	245	86.10	143	68.40	283	91.30	291	93.90
Master	340	20.20	96	36.60	130	43.20	33	11.60	61	29.20	1	0.30	19	6.10
Postgraduate	67	4.00	35	13.00	0	0.00	7	2.50	0	0.00	25	8.10	0	0.00
Doctoral	8	0.50	2	0.70	0	0.00	0	0.00	5	2.40	1	0.30	0	0.00
TOTAL	1684	100	270	100	300	100	285	100	209	100	310	100	310	100
W2														
Gender														
Women	1275	73.20	158	57.20	308	90.30	204	74.50	161	78.20	215	68.90	229	69.00
Men	454	26.10	116	42.00	29	8.50	70	25.50	45	21.80	97	31.10	97	29.20
Did not want to say	12	0.70	2	0.70	4	1.20	0	0.00	0	0.00	0	0.00	0	0.00
Place of residence														
Village	442	25.40	48	17.40	145	42.80	10	3.60	66	32.00	61	19.60	111	33.40
Town	587	33.70	173	62.70	140	41.10	68	24.80	80	38.80	13	4.20	113	34.00
City	559	32.10	41	14.90	50	14.70	181	66.10	52	25.20	132	42.30	103	31.00
Agglomeration	149	8.60	10	3.60	5	1.50	15	5.50	8	3.90	106	34.00	5	1.50
Other	4	0.20	4	1.40	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Level of study														
Bachelor	1324	75.90	134	48.60	220	64.50	232	84.70	146	70.90	291	93.30	301	90.70
Master	384	22.10	122	44.20	121	35.50	38	13.90	60	29.10	12	3.80	31	9.30
Postgraduate	23	1.30	19	6.90	0	0.00	4	1.50	0	0.00	0	0.00	0	0.00
Doctoral	10	0.70	1	0.40	0	0.00	0	0.00	0	0.00	9	2.90	0	0.00
TOTAL	1741	100	276	100	341	100	285	100	209	100	310	100	310	100

Note. W1—first wave of the COVID-19 pandemic (May–June 2020), W2—the second wave of the COVID-19 pandemic (mid-October–December 2020).

2.2. Study Design

This repeated cross-sectional study among students from Germany, Poland, Russia, Slovenia, Turkey, and Ukraine were conducted during the first wave (W1) (May–June 2020) and the second wave (W2) (mid-October–December 2020) of the pandemic. The results regarding the first measurement (W1) have been already carefully described with regard to depression and anxiety in a previous publication [27].

A cross-national first measurement was conducted online between May and June in the following countries: Germany (2–25 June), Poland (19 May–25 June), Russia (1–22 June), Slovenia (14 May–26 June), Turkey (16–29 May), and Ukraine (14 May–2 June). The second measurement during W2 was conducted between mid-October and December 2020 in Germany (15 October–1 November), Poland (11 November–1 December), Russia

(28 October–8 December), Slovenia (10 October–15 December), Turkey (18 November–8 December), and Ukraine (15 October–15 November).

The survey study was conducted via Google Forms in all countries except Germany. This country exploited the SoSci Survey. The invitation to participate in the survey was sent to students by researchers via a variety of means, e.g., Moodle e-learning platform, student offices, email, or social media. The average time of data collection was 23.26 min (SD = 44.03). In Germany students were offered a possibility to enter the lottery for a 20€ Amazon gift card as an incentive to participate. No form of compensation was offered as an incentive to participate in five other countries. To minimize bias sources, the student sample was highly diversified as regards its key characteristics: the type of university, field of study and the cycle of study. Sampling was purposive. The selection criterion was university student status. The study followed the ethical requirements of the anonymity and voluntariness of participation.

2.3. Ethics Statement

The study protocol was approved by the ethics committee of the University Research Committee at the University of Opole, Poland, decision no. 1/2020. The study followed the ethical requirements of the anonymity and voluntariness of participation. Each person answered the informed consent question. Following the Helsinki Declaration, a written informed consent was obtained from each student before inclusion.

2.4. Measurements

Exposure to COVID-19 [32] was assessed based on eight questions regarding the coronavirus consequences: (1) Have you experienced symptoms that could indicate the coronavirus infection?; (2) Have you been tested for the coronavirus?; (3) Were you hospitalized for the coronavirus?; (4) Did you have to be in strict quarantine for at least 14 days, in isolation from loved ones because of the coronavirus infection?; (5) Has anyone in your family, among friends, or relatives been infected with the coronavirus?; (6) Has any of your relatives died of the coronavirus?; (7) Have you or a loved one lost their job because of the coronavirus?; and (8) Are you currently experiencing a worsening of your functioning or economic status due to the coronavirus pandemic's effects? Individuals answered each of these questions (0 = No, 1 = Yes).

Demographic data included questions regarding gender, place of residence (Village, Town, City, Agglomeration), the current level of study (Bachelor, Master, Postgraduate, Doctoral), field of study (Social Sciences, Humanities and Art, Natural Sciences, Medical and Health Sciences), year of study, and the study mode (full-time vs. part-time). The questionnaire was primarily designed in Polish and English. In the second step, it was translated from English to German, Russian, Slovenian, Turkish, and Ukrainian, using backward translation by a team consisting of native speakers and psychology experts, according to the guidelines [33].

The coronavirus-related PTSD was assessed using the 17 item PTSD Check List-Specific Version (PCL-S) [34] on a five-point Likert scale ranging from 1 (not at all) to 5 (extremely), with the total score ranging from 17 to 85. Higher scores indicated higher PTSD levels. A lower cutoff score (25) [35] is valid for the screening reasons. However, higher cutoff points (44) and (50) [36] are dedicated for diagnosis or to minimize false positives.

We have used this particular version of PTSD measurement as we wanted to be sure that we measure a coronavirus-related PTSD. Therefore, we have utilized the specific version, and asked about symptoms in response to a specific stressful experience which was COVID-19. We have also added COVID-19 aspect to each of the items. Therefore, we have not explored a general PTSD, but a specific stressful event-related PTSD. The Cronbach's α in the total sample in this study was 0.94.

2.5. Statistical Analysis

The statistical analysis included descriptive statistics: mean (M), standard deviation (SD), 95% of confidence interval (CI) with lower limit (LL) and upper limit (UL). The analysis was conducted in SPSS27. To verifying the first hypothesis regarding the change in exposure to COVID-19, we have utilized the Pearson χ^2 independence test for each country and each aspect of exposure to COVID-19 separately using a 2×2 contingency table. Phi (ϕ) value was used to assess the effect size. The effect size equal 0.1 is considered to be a small effect, 0.3 a medium effect, and 0.5 a large effect. We have showed the prevalence rate for coronavirus-related PTSD. The following step was to verify whether the various aspects of the COVID-19 pandemic exposure are associated with coronavirus-related PTSD in university students. We conducted the multivariate logistic regression analysis for the coronavirus-related PTSD risk among the international student sample from the six countries. All predictors were entered into the model simultaneously. The multiple regression models reveal risk factors in their simultaneous effect on mental health. Therefore, the multivariate regression model is closer to actual psychological complexity than bivariate model, where the particular factors independently predict mental health issues.

3. Results

The Person's χ^2 independence test showed a significant difference between measurement during W1 (May–June 2021) and W2 (mid-October–November) in each of the six countries regarding the various aspects of self-reported exposure to COVID-19 and its consequences. The ϕ coefficient value allowed for the assessment of the effect size.

3.1. Comparison Proportions of Self-Reported Exposure to the COVID-19 Pandemic

A significantly higher proportion of students experienced symptoms of coronavirus infection during the second wave in the total international sample of university students. However, the effect size was small. Similarly, in Poland, Russia, Slovenia, and Turkey, the proportion of students experiencing COVID-19 symptoms was significantly higher in W2, although the effect size was small. A significant medium effect size was noted in Ukraine. Therefore, the most pronounced increase in the proportion of students experiencing the COVID-19 symptoms during the second wave was observed in Ukraine. However, the one country where there was no significant effect was Germany. Therefore, the university students in Germany did not experience higher exposure to the infection in the second wave, unlike all other students from the five countries.

However, a significant medium effect sized was observed in German students regarding testing for coronavirus. In all other countries and the total sample, the effect was also significant but small. Therefore, all university students reported a higher number of tests in W2, but the difference was the highest in Germany.

The exposure to being hospitalized for coronavirus was relatively small. Only 5 participants (0.30%) in W1 and 21 (1.21%) answered Yes to this question in the total sample. However, the difference was significant. A significantly higher proportion of students was hospitalized in Poland and Turkey during W2, although the effect size was small. In Germany, Russia, Slovenia, and Ukraine, the difference was insignificant.

A higher proportion of students experienced being in a strict quarantine during W2 than W1 in Poland, Turkey, Ukraine, and the total sample. However, in Germany, Russia, and Slovenia, the differences were trivial.

In all countries and the total international sample, the exposure to friends or relatives infected with the COVID-19 was higher during W2 than W1. A large significant effect was observed in Turkey, a medium effect in Ukraine and the total sample, while a small effect in Germany, Poland, Russia, and Slovenia.

Similarly, the proportion of students who experienced a loss of friends or relatives due to the COVID-19 has significantly increased during W2 compared to W1. The medium

effect was observed in Turkey while the small effect in all other countries and the international sample.

The proportion of students who experienced losing a job due to the COVID-19 pandemic was lower during W2 than W1 in the international sample and Ukraine. However, in other countries, the effect size was small. There was no significant drop in Germany, Poland, Russia, and Turkey.

Mixed results were observed regarding the self-reported deterioration of the economic status due to the pandemic. In the total sample, the difference between W1 and W2 was trivial. However, an increase in the proportion of students declaring that their economic status has worsened was observed in Poland. On the other hand, there was a significant drop in the proportion of students claiming worse economic status during W2 in Russia. All effects were small regarding this aspect of exposure. There were no significant differences in Germany, Slovenia, Turkey, and Ukraine. The results of the comparison are shown in Table 2.

Table 2. Comparison proportions of university students experienced exposure to Coronavirus pandemic at the first wave W1 (May–June 2020) and the second wave W2 (October–December 2020) of the COVID-19 pandemic.

Exposure Item		Self-Reported Exposure				Pearson's				
		No		Yes		N	$\chi^2(1)$	p	ϕ	
Sample	Wave	n	%	n	%					
1. Experiencing symptoms of coronavirus infection										
Total	W1	1486	88.24	198	11.76	1684	162.29	<0.001	0.22	
	W2	1229	70.59	512	29.41	1741				
Germany	W1	218	80.74	52	19.26	270	3.27	0.071	0.08	
	W2	205	74.28	71	25.72	276				
Poland	W1	274	91.33	26	8.67	300	22.13	<0.001	0.19	
	W2	265	77.71	76	22.29	341				
Russia	W1	237	83.16	48	16.84	285	21.66	<0.001	0.20	
	W2	181	66.06	93	33.94	274				
Slovenia	W1	181	86.60	28	13.40	209	10.75	0.001	0.16	
	W2	152	73.79	54	26.21	206				
Turkey	W1	288	92.90	22	7.10	310	53.22	<0.001	0.29	
	W2	219	70.19	93	29.81	312				
Ukraine	W1	288	92.90	22	7.10	310	84.77	<0.001	0.36	
	W2	207	62.35	125	37.65	332				
2. Testing for Coronavirus										
Total	W1	1611	95.67	73	4.33	1684	176.23	<0.001	0.23	
	W2	1411	81.05	330	18.95	1741				
Germany	W1	259	95.93	11	4.07	270	51.31	<0.001	0.31	
	W2	204	73.91	72	26.09	276				
Poland	W1	296	98.67	4	1.33	300	18.61	<0.001	0.17	
	W2	310	90.91	31	9.09	341				
Russia	W1	253	88.77	32	11.23	285	23.52	<0.001	0.21	
	W2	199	72.63	75	27.37	274				
Slovenia	W1	200	95.69	9	4.31	209	6.86	0.009	0.13	
	W2	183	88.83	23	11.17	206				
Turkey	W1	299	96.45	11	3.55	310	48.97	<0.001	0.28	
	W2	242	77.56	70	22.44	312				
Ukraine	W1	304	98.06	6	1.94	310	44.18	<0.001	0.26	
	W2	273	82.23	59	17.77	332				
3. Hospitalizing for Coronavirus										

Total	W1	1679	99.70	5	0.30	1684	9.40	<0.001	0.05
	W2	1719	98.79	21	1.21	1741			
Germany	W1	270	100.00	0	0.00	270	1.96	0.161	0.06
	W2	274	99.28	2	0.72	276			
Poland	W1	300	100.00	0	0.00	300	6.23	0.013	0.10
	W2	334	97.95	7	2.05	341			
Russia	W1	283	99.30	2	0.70	285	1.92	0.166	-0.06
	W2	273	100.00	0	0.00	273			
Slovenia	W1	209	100.00	0	0.00	209	0.00	1.00	0.00
	W2	206	100.00	0	0.00	206			
Turkey	W1	309	99.68	1	0.32	310	4.52	0.034	0.09
	W2	305	97.76	7	2.24	312			
Ukraine	W1	308	99.35	2	0.65	310	1.10	0.294	0.04
	W2	327	98.49	5	1.51	332			
4. Being in a strict quarantine for at least 14 days									
Total	W1	1575	93.53	109	6.47	1684	18.82	<0.001	0.07
	W2	1556	89.37	185	10.63	1741			
Germany	W1	246	91.11	24	8.89	270	1.46	0.227	-0.05
	W2	259	93.84	17	6.16	276			
Poland	W1	294	98.00	6	2.00	300	9.86	0.002	0.12
	W2	316	92.67	25	7.33	341			
Russia	W1	254	89.12	31	10.88	285	1.44	0.230	0.05
	W2	235	85.77	39	14.23	273			
Slovenia	W1	203	97.13	6	2.87	209	1.61	0.205	0.06
	W2	195	94.66	11	5.34	206			
Turkey	W1	293	94.52	17	5.48	310	13.84	<0.001	0.15
	W2	267	85.58	45	14.42	312			
Ukraine	W1	285	91.94	25	8.06	310	6.50	0.011	0.10
	W2	284	85.54	48	14.46	332			
5. Friends or relatives were infected									
Total	W1	1441	85.57	243	14.43	1684	516.36	<0.001	0.39
	W2	854	49.05	887	50.95	1741			
Germany	W1	207	76.67	63	23.33	270	4.59	0.032	0.09
	W2	189	68.48	87	31.52	276			
Poland	W1	277	92.33	23	7.67	300	166.08	<0.001	0.51
	W2	151	44.28	190	55.72	341			
Russia	W1	225	78.95	60	21.05	285	67.61	<0.001	0.35
	W2	124	45.26	150	54.74	273			
Slovenia	W1	195	93.30	14	6.70	209	32.17	<0.001	0.28
	W2	149	72.33	57	27.67	206			
Turkey	W1	242	78.06	68	21.94	310	199.20	<0.001	0.57
	W2	67	21.47	245	78.53	312			
Ukraine	W1	295	95.16	15	4.84	310	148.84	<0.001	0.48
	W2	174	52.41	158	47.59	332			
6. Friends or relatives died of Coronavirus									
Total	W1	1643	97.57	41	2.43	1684	131.47	<0.001	0.19
	W2	1516	87.08	225	12.92	1741			
Germany	W1	266	98.52	4	1.48	270	7.20	0.007	0.11
	W2	260	94.20	16	5.80	276			
Poland	W1	300	100.00	0	0.00	300	19.10	<0.001	0.17
	W2	320	93.84	21	6.16	341			

Russia	W1	269	94.39	16	5.61	285	13.34	<0.001	0.15
	W2	233	85.04	41	14.96	273			
Slovenia	W1	207	99.04	2	0.96	209	6.57	0.007	0.13
	W2	195	94.66	11	5.34	206			
Turkey	W1	292	94.19	18	5.81	310	82.52	<0.001	0.36
	W2	202	64.74	110	35.26	312			
Ukraine	W1	309	99.68	1	0.32	310	22.44	<0.001	0.19
	W2	306	92.17	26	7.83	332			
7. Losing job because of the Coronavirus									
Total	W1	1157	68.71	527	31.29	1684	8.09	0.004	-0.05
	W2	1273	73.12	468	26.88	1741			
Germany	W1	208	77.04	62	22.96	270	0.57	0.452	0.03
	W2	205	74.28	71	25.72	276			
Poland	W1	217	72.33	83	27.67	300	0.00	0.977	0.00
	W2	247	72.43	94	27.57	341			
Russia	W1	227	79.65	58	20.35	285	0.73	0.393	-0.04
	W2	226	82.48	48	17.52	273			
Slovenia	W1	160	76.56	49	23.44	209	0.01	0.935	0.00
	W2	157	76.21	49	23.79	206			
Turkey	W1	162	52.26	148	47.74	310	3.12	0.077	-0.07
	W2	185	59.29	127	40.71	312			
Ukraine	W1	183	59.03	127	40.97	310	21.70	<0.001	-0.18
	W2	253	76.20	79	23.80	332			
8. The economic status worsened due to the pandemic									
Total	W1	747	44.36	937	55.64	1684	0.02	0.885	0.00
	W2	768	44.11	973	55.89	1741			
Germany	W1	202	74.81	68	25.19	270	1.19	0.275	0.05
	W2	195	70.65	81	29.35	276			
Poland	W1	120	40.00	180	60.00	300	10.55	0.001	0.13
	W2	95	27.86	246	72.14	341			
Russia	W1	124	43.51	161	56.49	285	11.78	<0.001	-0.15
	W2	159	58.03	115	41.97	273			
Slovenia	W1	104	49.76	105	50.24	209	0.30	0.587	-0.03
	W2	108	52.43	98	47.57	206			
Turkey	W1	109	35.16	201	64.84	310	0.08	0.783	-0.01
	W2	113	36.22	199	63.78	312			
Ukraine	W1	88	28.39	222	71.61	310	0.10	0.752	-0.01
	W2	98	29.52	234	70.48	332			

3.2. Descriptive Statistics and Prevalence of Coronavirus-Related PTSD

The descriptive statistics showed that the mean value of coronavirus-related PTSD was 38.08 (SD = 15.49) among students from Germany, Poland, Russia, Slovenia, Turkey, and Ukraine during W2. Detailed description is presented in Table 3.

Table 3. Descriptive statistics for coronavirus-related PTSD risk among university students in six countries during the second wave (October-December 2020) of the COVID-19 pandemic.

Sample	N	Range	M	95% CI		SD	Skewness	Kurtosis	Cronbach's α
				LL	UL				
Total	1741	17–85	38.08	37.36	38.81	15.49	0.73	-0.29	0.94

Note. M = mean; CI = confidence interval; LL – lower limit; UL = upper limit; SD – standard deviation.

The prevalence of coronavirus-related PTSD risk was presented at three cutoff points, align with presented literature [35,36]. The proportion of students with coronavirus-related PTSD risk at three cutoff scores (25, 44, and 50) is presented in Table 4.

Table 4. Prevalence of coronavirus-related PTSD risk among university students in six countries during the second wave (October–December 2020) of the COVID-19 pandemic (N = 1741).

Variable	No risk		Risk	
	<i>n</i>	%	<i>n</i>	%
Moderate risk (cutoff point 25)	380	21.80	1361	78.20
High risk (cutoff point 44)	1171	67.30	570	32.70
Very high risk (cutoff point 50)	1339	76.90	402	23.10

3.3. Logistic Regression for Coronavirus-Related PTSD Risk

The multivariate logistic regression for coronavirus-related PTSD risk during the second pandemic wave showed significant models for a moderate, high, and very high risk of PTSD among an international sample of university students from Germany, Poland, Russia, Slovenia, Turkey, and Ukraine. The predictors were eight different aspects of self-reported exposure to COVID-19 and its consequences. All predictors were included simultaneously.

The model of moderate risk of coronavirus-related PTSD (cutoff point 25) revealed only three predictors to be relevant: experiencing the COVID-19 symptoms, COVID-19 among friends and family, and deterioration of the economic status due to the pandemic. Students who experienced the COVID-19 symptoms and whose family or friends were infected had 1.5 times higher odds of moderate risk of PTSD. Those who reported worsening economic status due to the pandemic were almost three times more frequently in the moderate PTSD risk group.

However, the regression models for high and very high risk of PTSD revealed a different set of predictors. In those two models, the significant predictors were the same with similar adjusted odds. Students who reported the COVID-19 symptoms had 1.3 times higher odds to be at a high/risk of coronavirus-related PTSD. Additionally, students who experienced a loss in the family or friends due to COVID-19 were twice as more likely to be in a PTSD-risk group. Also, students who were exposed to the COVID-19 pandemic in the aspect of losing a job (own or in the family) and worsening of the economic status were 1.6 times and twice more likely to be in a very/high coronavirus-related PTSD-risk group, respectively.

Table 2. Results of logistic regression for coronavirus-related PTSD risk among university students during the second wave of the COVID-19 pandemic (W2) (N = 1741).

Exposure Item	Model 1: Moderate Risk (PCL Cutoff Point = 25)				Model 2: High Risk (PCL Cutoff Point = 44)				Model 3: Very High Risk (PCL Cutoff Point = 50)			
	B	SE B	Wald's X ² (1)	AOR	B	SE B	Wald's X ² (1)	AOR	B	SE B	Wald's X ² (1)	AOR
1. Experiencing symptoms of coronavirus infection	0.48	0.15	9.63 **	1.61	0.25	0.12	4.25 *	1.29	0.3	0.14	4.85 *	1.35
2. Testing for Coronavirus	-0.27	0.17	2.74	0.76	-0.06	0.15	0.16	0.94	-0.02	0.17	0.01	0.98
3. Hospitalizing for Coronavirus	0.35	0.67	0.28	1.42	-0.52	0.51	1.06	0.59	-0.57	0.56	1.04	0.57
4. Being in a strict quarantine for at least 14 days	-0.25	0.23	1.19	0.78	0.03	0.19	0.03	1.04	-0.08	0.21	0.14	0.93
5. Friends or relatives were infected	0.33	0.13	6.47 *	1.39	0.05	0.11	0.17	1.05	-0.05	0.13	0.15	0.95
6. Friends or relatives died of Coronavirus	0.27	0.21	1.67	1.31	0.64	0.16	16.10 ***	1.9	0.74	0.17	19.52 ***	2.1
7. Losing job because of the Coronavirus	0.26	0.16	2.87	1.3	0.45	0.12	14.35 ***	1.57	0.59	0.13	21.12 ***	1.8
8. The economic status worsened due to the pandemic	1.04	0.13	66.29 ***	2.82	0.84	0.11	53.96 ***	2.32	0.84	0.13	40.56 ***	2.31
Constant	0.48	0.1	23.60 ***	1.61	-1.53	0.11	200.50 ***	0.22	-2.07	0.13	267.15 ***	0.13

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussion

Our study revealed the differences in exposure to COVID-19 and its consequences among university students in Germany, Poland, Russia, Slovenia, Ukraine, and Turkey during W1 (April–May 2020) and W2 (October–December 2020). The prevalence of coronavirus-related PTSD risk for 25, 44, and 50 cutoff scores was 78.20%, 32.70%, and 23.10%, respectively, during W2. We have also verified the prediction models of coronavirus-related PTSD risk for each cutoff score in the international sample of university students during W2.

We expected that in countries like Russia, where the restrictions were significantly waved during W2, the worsening of the economic status and losing a job due to the COVID-19 pandemic would significantly decrease. The mean stringency of restrictions in the six countries was lower during W2 compared to W1. However, the ratio of students in the international sample who have lost a job during W2 was significantly lower compared to W1. In contrast, the ratio of students whose economic status worsened due to the pandemic was not significantly different during W2. Therefore, the most significant experience of losing job by a student or a family member was more evident during W1 (31%) than W2 (25%). However, the deterioration of the economic status was still on the rise even during W2 (although insignificant) and concerned over half of the international student sample (55%). The lowest proportion of students exposed to worsening economic during W2 was noted in Germany (29.92%), while the highest (over 50%) in Poland, Ukraine, and Turkey, at 72.14%, 70.41%, and 63.78%, respectively. In contrast, the proportion of French students who reported a loss of income was significantly lower and reached only 18.30% in June–July 2020 [28]. In accordance with our expectations, the rate of students who experience worsening economic status due to the pandemic was significantly lower in Russia during W2 due to the significant wave of the restrictions, whereas higher in Poland, where the restrictions were stringer.

In congruence with our hypothesis 2, the exposure to COVID-19 among the total sample of students has risen. A higher proportion of students during W2 in all countries reported experiencing symptoms of COVID-19 compared to W1, except Germany. Even though the number of new cases daily was almost 20 times higher during W2 ($n = 7762$) than during W1 ($n = 392$) in the general German population. On the other hand, the difference in the testing to COVID-19 frequency was the largest in the German sample. Therefore, although the ratio of German students who experienced having infected friends/family or losing a loved one was higher during W2, the portion of German students who experienced COVID-19 has not increased. It might be due to the significant increase in testing among German students.

There was a significant growth of the percentage of hospitalized students in strict quarantine in Poland and Turkey. Also, in Ukraine, the ratio of students in a compulsory 14-day quarantine was elevated during W2. In congruence with the numbers in the general population, the percentage of students who experience losing a family member or friends due to COVID-19, was higher in all countries. However, the largest increase of daily coronavirus-related deaths was among Polish and Russian general population. In contrast, among student population, the highest increase was declared in Turkey. Similarly to previous research among Turkish students [37] it would seem that the student sample was overexposed to the bereavement experience. However, there were concerns regarding the reliability of COVID-19 data in Turkey, as it appeared that the prevalence of the disease (particularly total deaths) might be underreported [38,39].

The mean for the coronavirus-related PTSD risk in the international sample of students from six countries (38) has exceeded the lowest cutoff score (25), which is used for screening reasons [35]. The prevalence at this cutoff point was very high and indicated that over 78.20% of students are at coronavirus-related PTSD risk in this study. Every third student (32.70%) is at high PTSD risk (cutoff point 44), and almost every fourth student (23.10%) is at a very high PTSD risk (cutoff point 50). The high cutoffs are used to minimize false positives or for diagnosis [36]. The prevalence of PTSD risk in general

population in the USA [40] and China [41] with the use of PCL-C was 32% (cutoff point 44) and 14% (cutoff point 38), respectively. Research with the use of the PCL-5 at 32 cutoff point in the general population, showed 7% of posttraumatic stress symptoms in Chinese sample (January/February, cutoff score 33) [42] and 13% in five western countries [22]. However, the Italian general sample with the use of a modified 19-item PCL-5-based-PTSD questionnaire revealed 29% PTSD symptomatology [43]. The highest prevalence (67% of high PTSD level) was in a Chinese sample, with a different measurement (IES-R) [44]. Various measurements and cutoff scores hinder the comparison to our sample. Additionally, the presented studies were conducted during the first wave of the pandemic. However, referring to the specific cutoff score (44), the prevalence of coronavirus-related PTSD risk was similar in the student sample in our study (33%) during the second wave of the pandemic to the general sample (32%) [40]. On the other hand, the used PCL-C version was general and did not refer to COVID-19 as a specific stressful event [40] as in our study. In contrast, the single-arm meta-analysis [44] of 478 papers and 12 studies showed that the prevalence of PTSD in the general population during the COVID-19 pandemic was 15%; therefore, significantly lower than among students in this study.

The prevalence of PTSD risk is also various in student samples. In the French university students one month after the COVID-19 lockdown, the prevalence of PTSD risk measured by PCL-5 (cutoff score 32) was 19.50% [25]. Among Chinese college students, with the use of the abbreviated PCL, conducted in February 2020, the prevalence was 31% [24]. The smallest prevalence reaching 2.7%, was noted in Chinese university students [26]. The measurement in this study was PCL-C, with the cutoff score of 38. The repeated cross-sectional research among French students revealed that 16.40% students developed probable PTSD in the second measurement. The increase in the second measurement [26] can explain the high prevalence at a screening level (cutoff point 25) in our sample (78.20%).

The prediction models of coronavirus-related PTSD risk differed due to the severity of risk regarding the exposure to infected friends or family members. In the prediction model of moderate PTSD risk (cutoff point 25), it was an important factor, while in the more severe PTSD risk models (cutoff point 44 and 50), this factor was irrelevant. The following significant predictors for the more severe PTSD risk models were experiencing symptoms of COVID-19, losing a family member or friends because of COVID-19, losing job (by a participant or the family member), and worsening the economic status due to the COVID-19 pandemic. However, experiencing the loss of a friend or family member and losing job, were not relevant predictors for moderate coronavirus-related PTSD risk. Testing and hospitalizing for COVID-19, as well as being in strict 14-days quarantine, were not significantly associated with coronavirus-related PTSD risk in any model. The results are similar to research among Chinese students [26], where longer home-quarantine was not found to be associated with PTSD. However, in the French university sample, having lived through quarantine alone was a significant factor associated with the probable PTSD [25]. The lack of association of quarantine experience with the PTSD risk in this study can be due to the low proportion of exposed students (11%).

5. Conclusions

This study shows that besides exposure to COVID-19 symptoms and loss of relatives because of the COVID-19, the economic aspect of pandemic plays a vital role in susceptibility to coronavirus-related PTSD high risk. Even though the proportion of students who have experienced worsening economic status has not increased during W2, it still considered over half of the student sample from six countries in this study. Therefore, additional financial support for students could mitigate the coronavirus-related PTSD risk, particularly in Poland, Ukraine, and Turkey.

The analysis of the federal restrictions' stringency shed light on an increase of worsening economic status in Poland (where the restrictions were stringer) and a decrease in Russia where the restrictions were waved despite a high number of new daily cases.

The German case shows the importance of frequent testing; however, this research was conducted before open public access to the COVID-19 vaccine.

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