Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Journal of Affective Disorders 319 (2022) 638–645

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Review article

Post-pandemic stress of COVID-19 among high-risk groups: A systematic review and meta-analysis

Razyeh Bajoulvand [a], Shima Hashemi [b], Elaheh Askari [c], Rasool Mohammadi [d], Masoud Behzadifar [e], Mohammad-Hasan Imani-Nasab [e,*]

[a] Student Research Committee, Iran University of Medical Sciences, Tehran, Iran
[b] Student Research Committee, Ilam University of Medical Sciences, Ilam, Iran
[c] Nutritional Health Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran
[d] Mehr Psychiatric Hospital, Lorestan University of Medical Sciences, Khorramabad, Iran
[e] Social Determinants of Health Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran

ARTICLE INFO

Keywords:
Prevalence
Post-Traumatic Stress Disorder (PTSD)
Post-traumatic stress symptoms
Mental disorders
COVID-19
High-risk groups
Systematic review and meta-analysis

ABSTRACT

Background: Post-Traumatic Stress Disorder (PTSD) is considered as a prevalent outcome of the COVID-19 pandemic. This study aimed to present a global picture of the prevalence of PTSD in high-risk groups for COVID-19 (HRGs-COVID19) and determine its risk factors.

Methods: Cross-sectional studies published between March 11, 2020, and October 11, 2021, in English, were searched in seven databases on the prevalence of PTSD in HRGs-COVID19. After screening the retrieved records, their quality was assessed, and the required data were extracted. R-4.1.3 software and random effect model with 95 % confidence interval (CI) were used to synthesize and analyze the data.

Results: The pooled prevalence of PTSD in HRGs-COVID19 was 30 % (95 % CI: 21–39 %). The pooled prevalence of PTSD was significantly different in terms of the variables of data collection during the lockdown, gender, and data collection season ($P < 0.05$). Subgroup analyses could not identify sources of heterogeneity.

Limitations: The included studies did not cover all HRGs-COVID19 such as smokers and the elderly.

Conclusion: Considering the higher pooled prevalence of PTSD in HRGs-COVID19 than the general population, COVID-19 patients, and health care workers, prioritizing this subgroup for prevention and treatment of psychological outcomes is highly recommended. Predicting and implementing psychological interventions early in the pandemic is more critical when applying restrictive measures and among HRGs-COVID19 women.

1. Introduction

Post-Traumatic Stress Disorder (PTSD) is a common mental disorder in the general population that can follow a traumatic event. PTSD includes spontaneous and repetitive reminding traumatic events, attempt to avoid situations, activities, and people that are reminiscent of the event, and excessive psychological irritability that can result from direct or indirect exposure to life-threatening events such as war, natural disasters, and epidemics (De Micco et al., 2021; Edition, 2013; Shalev et al., 2017). More than two-thirds of adults worldwide may experience a traumatic event throughout their lives (Galea et al., 2005). In the world mental health survey (2017), the global lifetime prevalence of PTSD in the general population was estimated at 3.9–5.6 % (Koenen et al., 2017). The prevalence of PTSD due to the epidemics of infectious disease among the general population has been reported at 24.20 % (95 % CI: 18.54–30.53 %) (Qiu et al., 2021a).

The COVID-19 pandemic has spread rapidly worldwide since late 2019, with 288,631,129 confirmed cases reported worldwide by the beginning of 2022, of which 5,458,545 died (WHO, 2021). High prevalence of morbidity and mortality, unknown and unpredictable nature of the disease, lack of effective medical treatment, contradictory news, stigma, home quarantine, restriction of travel and contact with friends and relatives, widespread lockdown, financial losses, and fear of infecting oneself and relatives, are essential sources of psychological stress associated with COVID-19 and predisposing to PTSD among the general population, especially high-risk groups (Bareeqa et al., 2021; Bueno-Notivol et al., 2021; Forte et al., 2020; Huremović, 2019).

There is evidence that high-risk groups such as older adults, obese

* Corresponding author at: School of Health and Nutrition, Gholdasht Sharghi Avenue, Khorramabad 89741-68197, Iran.
E-mail address: imaninasab.m@lums.ac.ir (M.-H. Imani-Nasab).

https://doi.org/10.1016/j.jad.2022.09.053
Received 7 April 2022; Received in revised form 31 July 2022; Accepted 20 September 2022
Available online 27 September 2022

individuals, smokers, pregnant women, HIV^{+}, and patients with comorbidities including cardiovascular, pulmonary, renal, rheumatoid, hormonal diseases, and a variety of cancers, are more likely to develop PTSD as a result of COVID-19 (Delle Donne et al., 2021; Durcan et al., 2021; Gandhi et al., 2020; Hocaoglu et al., 2020; Jelly et al., 2021; Juanjuan et al., 2020; Torales et al., 2020; Yang et al., 2020). Predictive factors for PTSD include a history of individual and family psychiatric disorders, gender, socioeconomic status, personality (introversion/extroversion), level of education, race, perceived life threat, previous trauma, the severity of trauma, and perceived social support (Bisson, 2007).

The pooled prevalence of PTSD in the COVID-19 pandemic has been reported among the general population between 12 and 27.13 %, among COVID-19 survivors between 15.45 and 36.3 %, and among Health Care Workers (HCWs) between 17.23 and 29.22 % in several Systematic Reviews and Meta-Analyses (SR-MAs) (Qiu et al., 2021b; Salehi et al., 2021; Yunitri et al., 2022). An accurate estimate of the prevalence of PTSD among different subgroups, especially high-risk groups for COVID-19 (HRGs-COVID19), is necessitated to take effective measures for reduction of the psychological outcomes of COVID-19. High-risk groups are more likely to develop COVID-19 and its severe complications including disability and death, due to their specific physiological, physical, and psychological conditions. Therefore, PTSD seems to be higher among high-risk groups than other subgroups of the community, even HCWs and COVID-19 survivors during the COVID-19 pandemic period. The use of different assessment tools for PTSD has been a source of heterogeneity in previous meta-analyses (Qiu et al., 2021a). Therefore, the present study was developed to estimate a more accurate pooled prevalence of PTSD among HRGs-COVID19 using the most common PTSD assessment tool, the Revised Impact of Event Scale (IES-R), by identifying the possible causes of heterogeneity and analyzing subgroups. However, according to our knowledge, no SR-MA study has been published to estimate the pooled prevalence of PTSD among HRGs-COVID19; therefore, this study aimed to present a global picture of the prevalence of PTSD among HRGS-COVID19 and to determine the risk factors associated with it. The results of this study can help health policymakers prioritize population subgroups to prevent and treat the psychological outcomes of COVID-19 (Table 1).

2. Methods

This study was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis protocols (PRISMA). The protocol of this study is registered in PROSPERO with the code CRD42021228454.

2.1. Search strategy and selection of studies

English cross-sectional studies published between March 11, 2020, and October 11, 2021, on the prevalence of PTSD in HRGs-COVID19 were searched. Searching was done independently by two researchers (BR, HSh). The following databases, including Web of Science, PubMed, Scopus, Embase, Psycinfo, PsyArxiv, ResearchGate, and Google Scholar, were searched for pre-print, published, and related gray literature records. To determine keywords, the list of HRGs-COVID19 was taken from the WHO and Centers for Disease Control and Prevention (CDC) websites. The main terms of Medical Subject Headings (MeSH) and Emtree Thesaurus along with other synonyms were used to develop the search strategy. The included keywords were:

(PTSD OR "post-traumatic stress" OR "posttraumatic stress" OR "post traumatic stress" OR "revised impact of event scale" OR IES-R) AND (COVID19 OR COVID-19 OR SARS-COV-2 OR 2019-nCOV OR "Wuhan coronavirus" OR "coronavirus disease19") AND (high-risk OR "high risk" OR "higher risk" OR at-risk OR vulnerable OR "underlying health condition*" OR "underlying medical condition*" OR "underlying condition*" OR "underlying disease*" OR "underlying illness*" OR "pre-

Table 1
Characteristic of the included studies.

Author	Country	Population	Participants	PTSD (%)	Female (%)	Daily mortality rate[a]	Daily morbidity rate[a]	Lockdown	Quality assessment (%)
(Tutnjević and Lakić, 2020)	Bosnia and Herzegovina and Serbia	Pregnant women	152	44.1	100	753	5075	Yes	51.6
(Romito et al., 2020)	Italy	Lymphoproliferative neoplasm	77	18	49.4	5	179	Yes	58.1
(Deledda et al., 2021)	Italy	Chronic disease	506	40.3	74.8	19	321	Yes	45.2
(Delle Donne et al., 2021)	Italy	People living with HIV	98	25.5	24.5	55	333	Yes	45.16
(Durcan et al., 2021)	Turkey	Acromegaly	217	24.9	55.3	12	302	Yes	51.6
(Saccone et al., 2020)	Italy	Pregnant women	100	61	100	18	573	No	77.4
(Hocaoglu et al., 2020)	Turkey	Pregnant women	283	55.4	100	49	327	Yes	51.6
(Seyahi et al., 2020)	Turkey	Rheumatic patients	771	28.4	69	57	360	Yes	45.2
(Addis et al., 2021)	Ethiopia	Chronic disease	413	7.8	52.1	83	5967	No	58.1
(Durcan et al., 2021)	Turkey	Cushing patients	127	24.4	78.7	2	76	No	61.3
(Yang et al., 2021)	China	Hemodialysis patients	273	12.45	41	0.01	0.2	Yes	48.39
(Wang et al., 2020)	China	Cancer patients	6213	9.3	47.2	0.2	9	Yes	71
(Jelly et al., 2021)	India	Pregnant women	333	8.1	NR	0.2	9	Yes	71
(Cui et al., 2020)	China	Breast cancer	207	35.3	100	1	2	No	58.6
(Juanjuan et al., 2020)	China	Breast cancer	658	52.3	100	1	1	No	64.5

[a] Daily mortality rate and Daily morbidity rate are reported per 10^{7}.

existing condition*" OR "health condition*" OR "medical condition*" OR "chronic disease*" OR "chronic illness*" OR aged OR "older adults" OR elderly OR pregnan* OR smok* OR obes* OR "fat people" OR overweight OR hypertension OR "high blood pressure" OR diabet* OR "cardiovascular disease*" OR "coronary disease*" OR "coronary heart disease*" OR HIV OR HIV/AIDS OR aids OR "hemoglobin disorder*" OR "sickle cell" OR "immune compromised" OR immunocompromised OR "weakened immune system*" OR neoplas* OR cancer OR tumor OR malignan* OR chemotherapy OR radiotherapy OR "pulmonary disease*" OR "respiratory disease*" OR "lung disease*" OR asthma OR "chronic obstructive pulmonary disease" OR COPD OR bronchitis OR tuberculosis OR emphysema OR "kidney disease*" OR "renal disease*" OR "liver disease*" OR "liver illness*" OR "liver dysfunction*" OR cirrhosis OR "cerebrovascular accident" OR "cerebrovascular disorder*" OR "cerebrovascular disease*" OR stroke OR rheumati* OR thalassemia OR leukemia OR lymphoma OR neurologic* OR MS OR "multiple sclerosis" OR *"Parkinson disease" OR epilepsy OR dementia OR "Alzheimer* disease*" OR lupus OR corticosteroid).

The search strategy changed according to the guidelines of each database.

2.2. Screening studies

After searching and retrieving records from databases, two researchers (BR, HSh) independently screened records based on the title and abstract then deleted duplicate and irrelevant items. In the next step, the two researchers studied the full text of the records and screened them based on inclusion and exclusion criteria. At each step, disagreements were resolved through discussion and consensus, or ultimately the judgment of a third researcher (IM).

2.3. Data extraction

Two researchers (BR, HSh) independently extracted the following data from the final records: first author name, year of publication, country, time of the study (lockdown/peak), publication status (peer review/gray), statistical population, sampling method, sample size, participants, response rate, prevalence PTSD (95 % CI), mean ± standard deviation (SD) of PTSD score, mean ± SD of PTSD subscales (intrusion, avoidance, hyper-arousal), mean ± SD of age, gender, and marital status.

The inclusion criteria were cross-sectional studies on HRGs-COVID19 in English full-text that measured the prevalence of PTDS based on IES-R. Exclusion criteria included people infected with COVID-19 or mental illness and disorders. Children and adolescents were not announced as a high-risk group for COVID-19 by WHO. They seem to be less skilled at recognizing their PTSD symptoms. Data on the morbidity, mortality, and waves of COVID-19 epidemics were extracted from the World Health Organization (WHO) website.

2.4. Assessing the quality of studies

Two researchers (BR, HSh) independently evaluated the quality of records using the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) Checklist. Scores of included records using the Strobe checklist were calculated as percentages. The range of scores was divided into three equal parts and interpreted as follows: 45.16–55.90: weak, 55.91–66.65: moderate, 66.66–77.41: good. Disagreements were resolved through discussion and consensus, or ultimately the judgment of a third researcher (AE).

2.5. Statistical synthesis and analysis

Forest plots in the random effect model with 95 % CI were used to calculate the pooled prevalence. For this purpose, the metaprop command of meta-package version 5.1–1 was used in R software version 4.1.3. Heterogeneity between studies was assessed using Cochran's Q, I^2 statistic. The I^2 statistic is between 0 and 100 %, and values of 50 % or higher were considered heterogeneous. To evaluate the sources of heterogeneity, subgroup analysis was performed in terms of gender, data collection season, lockdown, morbidity and mortality rate, epidemic wave, high-risk group, data collection method, and quality of records. In the end, sensitivity analysis was performed for HRGs-COVID19. A significance level of $P < 0.05$ was considered in all statistical analyses.

3. Results

The mean (SD) age of participants of included studies was 46.31 (12) years old which, 71 % of whom were women. The distribution of records in terms of the continent in Asia, Europe, and Africa was 60 %, 33 %, and 7 %, respectively. 93 % of the records were published, and one study was gray literature. The studied population of 27 % of the records was pregnant women, 27 % were cancer patients, and the rest were other chronic diseases such as hemodialysis, Cushing, acromegaly, and HIV^+. The in-person technique was used to collect data in 47 % of records, and the online technique was used in 53 % of them. The average response rate of all records was 78.43 %. The average response rate in records whose data were collected online or in-person was 66.8 % and 90.0 %, respectively. The sampling method of 26 % of records was non-random, 13 % random, 20 % census, and 40 % of records did not report the sampling method.

Out of 10'428 participants, 2948 had PTSD.The mean (SD) of PTSD reported in the records was 23.64(14.01), which was normal (Creamer et al., 2003; Kawamura et al., 2001; Larsson, 2000; Morina et al., 2013). The prevalence of PTSD in HRGs-COVID19 varied between 7.8 % and 61 %. The mean (SD) scores of PTSD subscales were: avoidance 8.49 (5), intrusion 6.5 (4.9), and hyper-arousal 4.7 (4.2). The average number of deaths and daily morbidities of COVID-19 during the data collection period per 10 million was 70 and 902, respectively. Data on 67 % of records were collected during the lockdown. The quality of 21 % of the records was good, 29 % was moderate, and the rest was weak. The process of identifying and screening records is shown in Fig. 1.

The pooled prevalence of PTSD in HRGs-COVID19 was 30 % (95 % CI: 21–39 %). Fig. 2-A shows the pooled prevalence of PTSD in HRGs-COVID19. The pooled prevalence of PTSD in studies with a statistical population of women was significantly higher than studies in both genders ($\chi^2 = 6.05$, $p = 0.01$) (Fig. 2-B). In three records, the prevalence of PTSD varied in terms of participants' gender; The PTSD of women was significantly higher than men (Addis et al., 2021; Romito et al., 2020; Seyahi et al., 2020). The pooled prevalence of PTSD in HRGs-COVID19 decreased in terms of the data collection season from winter 2019 to summer 2020, which was statistically significant ($\chi^2 = 44.24$, $p < 0.01$) (Fig. 3-A). The pooled prevalence of PTSD in records whose data were collected during the lockdown was significantly higher records whose data was collected in an otherwise situation ($\chi^2 = 17.11$, $p < 0.01$) (Fig. 3-B). None of the records examined the difference in the prevalence of PTSD regarding whether or not lockdown was applied.

The pooled prevalence of PTSD in records that their data were collected at the time of morbidity rate $>300 \times 10^7$ (person/day/country) was higher than other records with a lower morbidity rate (34 % vs. 23 %), but this difference was not statistically significant ($\chi^2 = 1.68$, $p = 0.19$). The pooled prevalence of PTSD in records that their data were collected at the time of mortality rate $>12 \times 10^7$ (death/day/country) was higher than other records with a lower mortality rate (37 % vs. 23 %), but this difference was not statistically significant ($\chi^2 = 2.61$, $p = 0.11$). The pooled prevalence of PTSD in records collected simultaneously with the first wave of COVID-19 was higher than in records whose data were collected before the onset of this wave (33 % vs. 23 %), but this difference was statistically insignificant ($\chi^2 = 0.86$, $p = 0.35$).

The pooled prevalence of PTSD was higher in pregnant women than in cancer patients (42 % vs. 29 %), but this difference was not statistically significant ($\chi^2 = 1.04$, $p = 0.59$). The pooled prevalence of PTSD

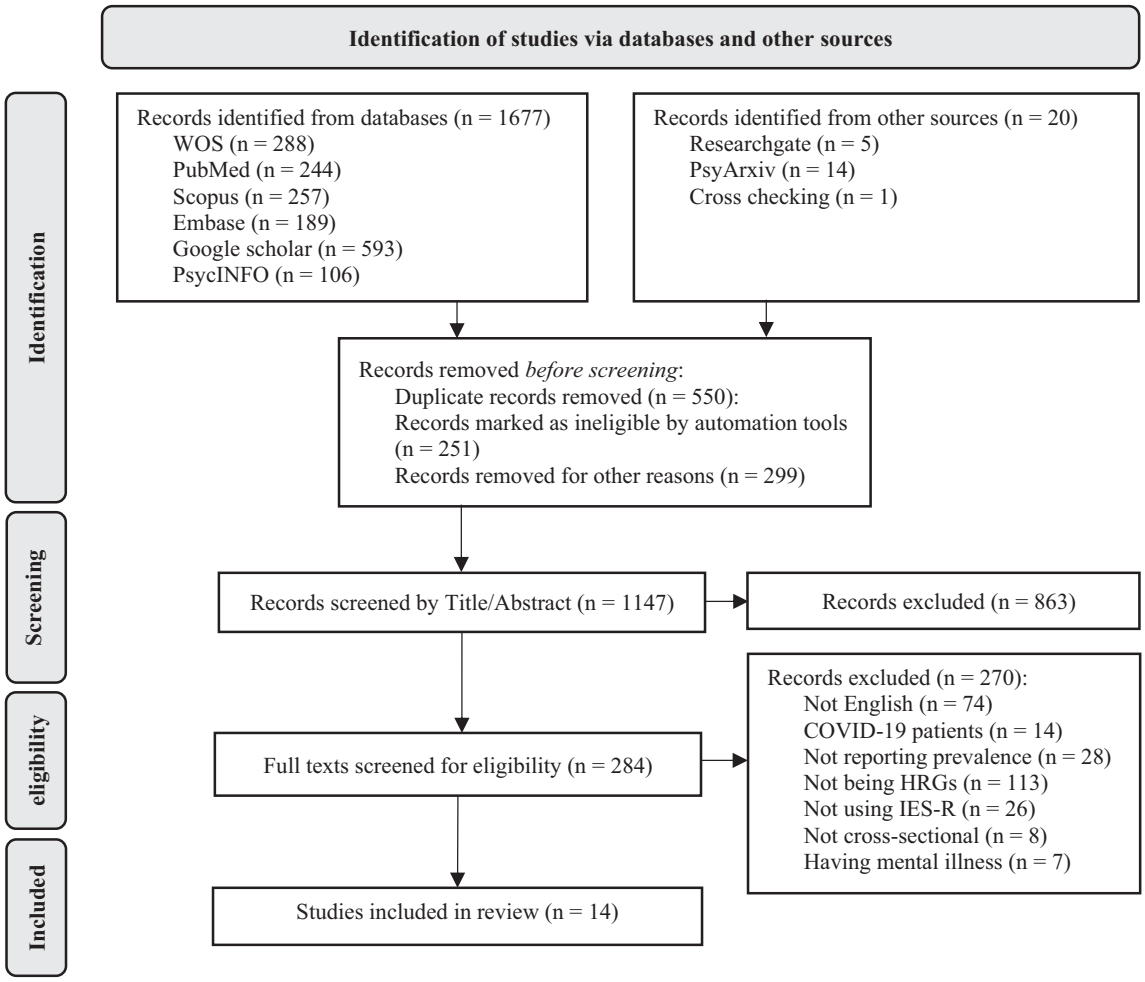

Fig. 1. PRISMA flow diagram for post-pandemic stress of COVID-19 among high-risk groups.

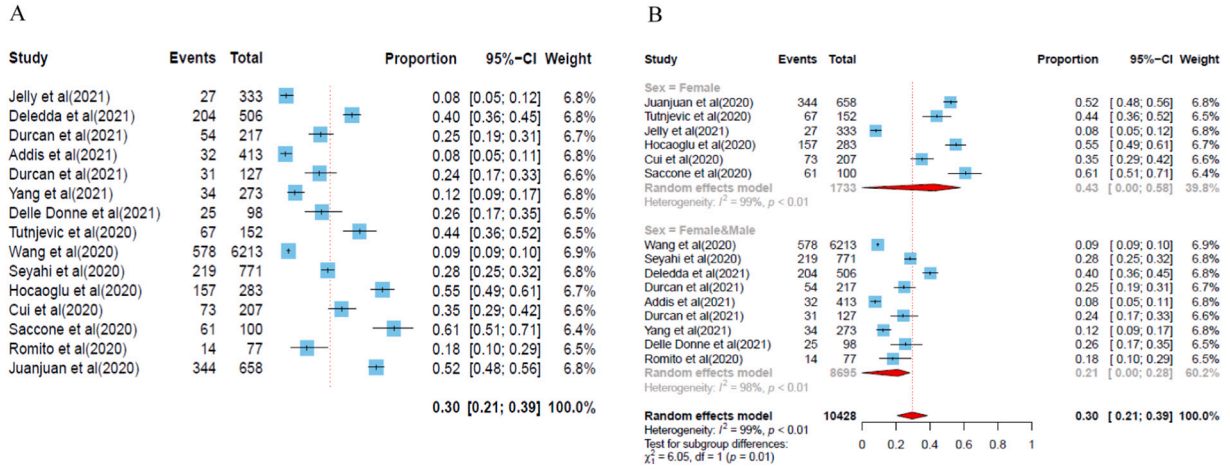

Fig. 2. Forest plot of (A) pooled estimate of PTSD prevalence among high-risk groups (B) by sex of participant.

was approximately equal in terms of data collection technique (in-person/online) (29 % and 30 %, respectively), while the response rate varied. The pooled prevalence of PTSD in weak quality records was higher than good and moderate records (39 %, 27 %, and 27 %, respectively), but this difference was not statistically significant (χ^2 = 2.7, p = 0.26). Heterogeneity of pooled prevalence of PTSD was significantly high (I^2 = 99 %, p < 0.01). Sensitivity analysis did not change the pooled prevalence of PTSD after excluding records related to cancer patients (30 %).

4. Discussion

High-risk groups are more susceptible to develop COVID-19, its severe complications, and a higher risk of PTSD due to their specific

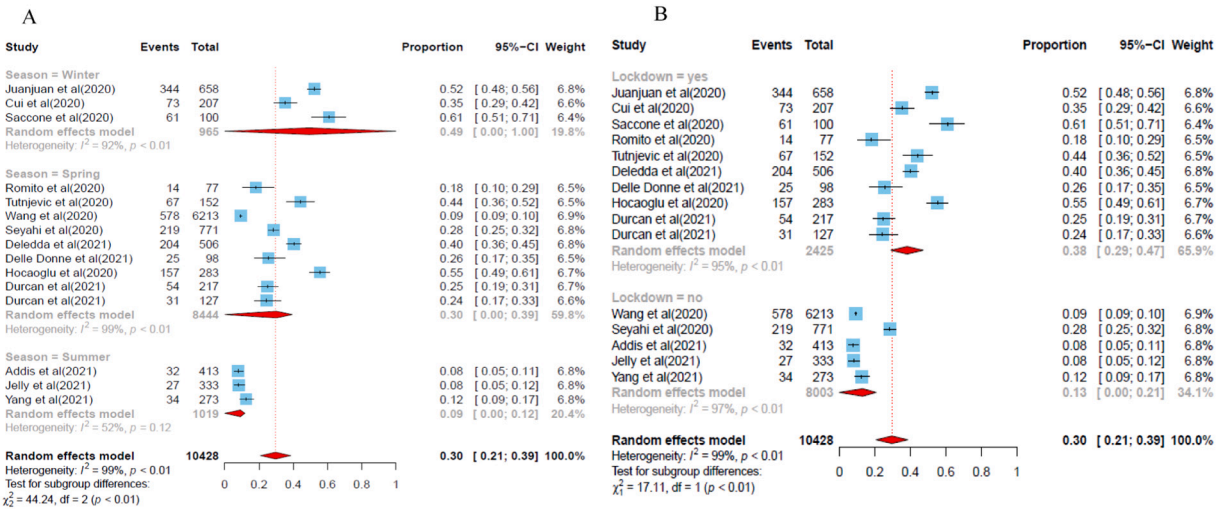

Fig. 3. Forest plot of PTSD prevalence among high-risk groups (A) by the season of data collection (B) in terms of lockdown at the time of data collection.

conditions than other subgroups of the community. Therefore, in order to prioritize interventions to reduce the psychological consequences of the COVID-19 period, it is necessary to provide a global picture of the pooled prevalence of PTSD among this subgroup and determine its risk factors.

The pooled prevalence of PTSD in HRGs-COVID19 was 7.5 times the prevalence in the general population under normal conditions in 2017 (Liu et al., 2017). The mean pooled prevalence of PTSD in the COVID-19 pandemic period in published SR-MAs among different populations in descending order was: COVID-19 patients (25.88 %), suspected COVID-19 patients (24.47 %), HCWs (19.82 %), general population (19.67 %), and patients with severe COVID-19 (16 %) (Qiu et al., 2021b; Krishnamoorthy et al., 2020; Yunitri et al., 2022; Cooke et al., 2020; Zhang et al., 2021; Nagarajan et al., 2022). The prevalence of PTSD appears to vary depending on whether the exposure to COVID-19 is direct or indirect. Another factor that can affect the prevalence of PTSD is the degree of vulnerability of individuals. The high pooled prevalence of PTSD in HRGs-COVID19 compared to the other populations mentioned above and the high mean score of the avoidance subscale compared to the other two subscales in the present study provide evidence to support the recent hypothesis. Therefore, arguably, vulnerability is a more determining factor for the prevalence of PTSD than the type of exposure. Although the exposure of HCWs with COVID-19 is higher than the general population, the average pooled prevalence of PTSD in these two populations was similar, providing evidence regarding the effect of exposure duration, as prolonged exposure to traumatic events seems to increase people's resilience to trauma and thus reduce PTSD. The lower pooled prevalence of PTSD among cancer patients than pregnant women in the present study also provides evidence of previous adaptation of cancer patients to the outcomes of their disease and consequently less PTSD in the COVID-19 pandemic period. The increase in PTSD seems to have a threshold in proportion to the severity of the trauma, so that by crossing it, the PTSD decreases unexpectedly. The lower prevalence of pooled PTSD among patients with severe COVID-19 than confirmed and suspected cases of COVID-19 supports the abovementioned hypothesis (a miss is as good as a mile). Therefore, it can be concluded that the amount and severity of exposure, degree of vulnerability, the resiliency of people, and duration of exposure are the determinants of the amount of PTSD. It is recommended that the above hypotheses be tested in future studies. Given the importance of vulnerability in PTSD, it is advised that HRGs-COVID19 benefit from self-isolation such as telecommuting and vulnerability leave.

In an SR-MA (2020), psychological outcomes among the general population, HCWs, and COVID-19 patients in descending order were as follows: PTSD (33 %), anxiety (28 %), stress (27 %), and depression (22 %) (Arora et al., 2020); on the other hand, the descending order of psychological outcomes in similar populations in other SR-MA (2021) were: stress and distress (34 %), PTSD (27 %) and anxiety and depression (26 %) (Krishnamoorthy et al., 2020). It can be argued that the COVID-19 pandemic has been accompanied by a significant increase in most of the psychological outcomes in the mentioned populations (Liu et al., 2017). Thus, similar estimates can be expected for other psychological outcomes among HRGs-COVID19. It is recommended that high-risk groups be assessed for various psychological outcomes of the COVID-19 pandemic and have their access to mental health services facilitated.

Heterogeneity of pooled prevalence of PTSD in the present study was significantly high; however, subgroup analysis failed to identify sources of heterogeneity. Heterogeneity in estimating the pooled prevalence of PTSD in the COVID-19 pandemic period in seven studies of eight published SR-MAs was also higher than 99 %. Subgroup analysis and meta-regression in these above seven studies were also unable to explain the heterogeneity (Arora et al., 2020; Cénat et al., 2021; Cooke et al., 2020; Krishnamoorthy et al., 2020; Nagarajan et al., 2022; Qiu et al., 2021b; Zhang et al., 2021). In one study, age and continent variables significantly explained the heterogeneity of the pooled prevalence of PTSD in the general population (Yunitri et al., 2022). It is proposed that the potential risk factors for PTSD in high-risk groups such as race, personality (introversion/extroversion), perceived economic threat, lockdown, history of mental health care utilization, history of personal and family mental illnesses and disorders, emotional support, access to personal protective equipment, epidemic wave, morbidity and mortality rate attributed to COVID-19, vaccination coverage, and previous traumatic events, be measured, and their association with PTSD be tested in future studies.

The high pooled prevalence of PTSD in the present study can be attributed to the fact that the majority of the records' population were women, and more than half of their data were collected during lockdown. The results of the two SR-MAs showed that the pooled prevalence of PTSD in the records that used the IES-R questionnaire was higher than DSM-5 and PCL-C, but this difference was not significant (Nagarajan et al., 2022; Qiu et al., 2021b). In another SR-MA (2022), the pooled prevalence of PTSD estimated by the DSM-5 questionnaire was significantly higher than the studies using the IES-R (Yunitri et al., 2022). Despite the discrepancy in the findings of the above studies, the higher prevalence in the present study might be related to the used questionnaire (IES-R) compared to similar studies.

In the early months of the COVID-19 pandemic, the unpredictable

nature of the disease and its high infection rate, conflicting news, fear of infection, and restrictions imposed by governments, resulted in a higher prevalence of PTSD in HRGs-COVID19. It seems that after several months from the onset of the pandemic, with the identification of methods of transmission and supply of personal protective equipment, the introduction of specialized diagnostic kits, and the psychological acceptance of individuals over time, the prevalence of PTSD decreased. It can be inferred that public panic, social isolation, and financial losses from lockdown have led to differences in the prevalence of PTSD. The chain mediation model on COVID-19 symptoms and mental health outcomes emphasizes the importance of the mediating role of health information on the prevalence of PTSD, rapid COVID-19 diagnostic testing, and implementation of general mental health interventions to minimize adverse psychological outcomes during the COID-19 pandemic (Wang et al., 2021).

PTSD of different traumatic events can occur immediately after an event to decades later (Galea et al., 2005). Although the difference in the pooled prevalence of PTSD in terms of morbidity, mortality, and waves of COVID-19 epidemic at the time of data collection was not statistically significant; Nevertheless, PTSD of COVID-19 seems to be one of those events that occurred within a short time of infection, death, and its waves. It is inferred that PTSD among the general population (unaffected) increased during the COVID-19 pandemic period with the onset of its waves and decreased with its end. Still, PTSD has persisted among people with Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS) years after their end (Ahmed et al., 2020; Hong et al., 2009; Lee et al., 2019). Therefore, it can be concluded that the presence or absence of COVID-19 infection can be directly related to the persistence of PTSD. To better understand the psychological outcomes of COVID-19, it is recommended that studies among patients and non-patients continue after the end of the pandemic. An SR-MA (2022) among the general population, COVID-19 patients, and HCWs also attributed the higher prevalence of PTSD during the COVID-19 pandemic period than previous coronavirus epidemics (SARS, MERS) to the higher transmission rate of COVID-19 (Yunitri et al., 2022). However, the non-statistical significance of the PTSD difference in terms of the morbidity rate in the present study does not provide evidence for the validity of the above hypothesis.

The pooled prevalence of PTSD was almost equal in the different data collection techniques (in-person/online). In an SR-MA (2021), the pooled prevalence of anxiety did not show a significant difference in terms of data collection technique (in-person/online), but the pooled prevalence of depression in the online technique was significantly higher (Krishnamoorthy et al., 2020); Whereas in another SR-MA (2022), the pooled prevalence of PTSD in studies that collected their data online was higher than the offline and telephone techniques (Nagarajan et al., 2022). Despite the higher estimate of the prevalence of psychological outcomes in the online technique, it seems that the data collection technique (in-person/online) does not make a statistically significant difference in estimating the prevalence of psychological outcomes.

There was no statistically significant difference between the pooled prevalence of PTSD in terms of quality records in the present study. The pooled prevalence of PTSD in an SR-MA (2021) in the general population, HCWs, and COVID-19 patients confirmed the pre-mentioned finding (Qiu et al., 2021b). However, in another SR-MA (2020), the pooled prevalence of psychological outcomes in the general population, HCWs, and COVID-19 patients in weak quality studies was significantly higher than in good and moderate studies (Arora et al., 2020). Novice researchers may tend to magnify health problems by thinking of gaining more chances to publish or conceal the weak methodological quality of their studies. Therefore, a deeper investigation of the recent hypothesis by research methodologists is recommended.

The present study had some limitations. Search for records was limited in English. There was a high degree of heterogeneity whose sources remained unknown even after the subgroup analysis. Not reporting the sampling methods, employing non-random methods, or the weak quality of some records limit the generalizability of the results. Due to the different prevalence of PTSD in previous epidemics in different countries and social contexts, the present study's findings may not be generalizable to other continents (America and Oceania). Using a self-report tool to measure PTSD across all records can estimate the prevalence of PTSD more or less than the actual value. However, self-report PTSD based on IES-R has shown high validity and reliability (Blevins et al., 2015; Weathers et al., 2018). As the records do not cover all HRGs-COVID19, it is recommended that other high-risk groups, such as smokers and the elderly, be included in future studies. The advantages of the present study are the specificity of the studied population, the measurement tool, the psychological outcome, and the extraction of data on morbidity, mortality, and waves of COVID-19 epidemics from the WHO website and testing the statistical differences in PTSD prevalence among HRGs-COVID19.

Considering the existence of >10,000 mental health self-assessment online apps, it is recommended HRGs-COVID19 be encouraged to use those applications that report the result of self-assessment as the need to help-seeking from mental health professionals or not (Marshall et al., 2019). Then, depending on the mental health status, the possibility of online screening by HCWs should be provided for users to refer them to mental health professionals if they need clinical counseling. Other services such as teaching methods to prevent mental disorders at the time of traumatic events and suggesting simple interventions that can be performed by users depending on the type and severity of the disorder can be implemented in such online apps. One of the most cost-effective treatments for coping with the psychological outcomes of traumatic events is internet-delivered Cognitive Behavior Therapy (iCBT), considering the restrictions of the infectious diseases' pandemics including Covid-19, is especially recommendable for HRGs-COVID19 (Zhang and Ho, 2017; Ho et al., 2020; Soh et al., 2020).

The present study results can help policymakers and managers of health systems in estimating the sources of needed mental health services during infectious diseases epidemics. Because of the imbalance of specialized human resources (psychiatrist, psychologist) with the increasing mental health care needs during infectious diseases epidemics, including the COVID-19 pandemic, it is recommended to compensate for the shortage of specialized human resources, HCWs be trained for secondary screening mental disorders and providing primary mental health care. Considering the higher pooled prevalence of PTSD among HRGs-COVID19 than the general population, COVID-19 patients, and HCWs, it is recommended that this subgroup be prioritized for prevention and treatment of psychological outcomes. Predicting and implementing these interventions has a higher priority in the early pandemic, the time of implementing restrictive measures, and among women in high-risk groups.

CRediT authorship contribution statement

I.M., B.M., B.R., and H.Sh. conceptualized and designed the study and developed search strategies. A.E., B.R., and H.Sh. designed the data extraction sheet, extracted data, and interpreted data. M.R. analyzed the data. I.M., A.E., and B.R. drafted the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

Conflict of interest

None.

Acknowledgement

This study was the result of research project No. 1397-1-99-2371 approved by Lorestan University of Medical Sciences.

Funding

This research received grant from Lorestan University of Medical Sciences, Iran.

Ethical approval

IR.LUMS.REC.1400.307.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2022.09.053.

References

Addis, S.G., Nega, A.D., Miretu, D.G., 2021. Psychological impact of COVID-19 pandemic on chronic disease patients in Dessie town government and private hospitals, Northeast Ethiopia. Diabetes Metab. Syndr. Clin. Res. Rev. 15 (1), 129–135.
Ahmed, H., Patel, K., Greenwood, D., Halpin, S., Lewthwaite, P., Salawu, A., Eyre, L., Breen, A., O'Connor, R., Jones, A., 2020. Long-term Clinical Outcomes in Survivors of Coronavirus Outbreaks After Hospitalisation or ICU Admission: A Systematic Review and Meta-analysis of Follow-up Studies. medrxiv.
Arora, T., Grey, I., Östlundh, L., Lam, K.B.H., Omar, O.M., Arnone, D., 2020. The prevalence of psychological consequences of COVID-19: a systematic review and meta-analysis of observational studies. J. Health Psychol. 27 (4), 805–824.
Bareeqa, S.B., Ahmed, S.I., Samar, S.S., Yasin, W., Zehra, S., Monese, G.M., Gouthro, R. V., 2021. Prevalence of depression, anxiety and stress in China during COVID-19 pandemic: a systematic review with meta-analysis. Int. J. Psychiatry Med. 56 (4), 210–227.
Bisson, J.I., 2007. Post-traumatic stress disorder. BMJ 334 (7597), 789–793.
Blevins, C.A., Weathers, F.W., Davis, M.T., Witte, T.K., Domino, J.L., 2015. The posttraumatic stress disorder checklist for DSM-5 (PCL-5): development and initial psychometric evaluation. J. Trauma. Stress. 28 (6), 489–498.
Bueno-Notivol, J., Gracia-García, P., Olaya, B., Lasheras, I., López-Antón, R., Santabárbara, J., 2021. Prevalence of depression during the COVID-19 outbreak: a meta-analysis of community-based studies. Int. J. Clin. Health Psychol. 21 (1), 100196.
Cénat, J.M., Blais-Rochette, C., Kokou-Kpolou, C.K., Noorishad, P.-G., Mukunzi, J.N., McIntee, S.-E., Dalexis, R.D., Goulet, M.-A., Labelle, P.R., 2021. Prevalence of symptoms of depression, anxiety, insomnia, posttraumatic stress disorder, and psychological distress among populations affected by the COVID-19 pandemic: a systematic review and meta-analysis. Psychiatry Res. 295, 113599.
Centers for Disease Control and Prevention, 2020. People with certain medical conditions. Retrieved 12–31-2021 from. https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html.
Cooke, J.E., Eirich, R., Racine, N., Madigan, S., 2020. Prevalence of posttraumatic and general psychological stress during COVID-19: a rapid review and meta-analysis. Psychiatry Res. 292, 113347.
Creamer, M., Bell, R., Failla, S., 2003. Psychometric properties of the impact of event scale—revised. Behav. Res. Ther. 41 (12), 1489–1496.
Cui, Q., Cai, Z., Li, J., Liu, Z., Sun, S., Chen, C., Wang, G.J.F.i.p, 2020. In: The Psychological Pressures of Breast Cancer Patients During the COVID-19 Outbreak in China—A Comparison With Frontline Female Nurses, p. 1462.
De Micco, R., Siciliano, M., Sant'Elia, V., Giordano, A., Russo, A., Tedeschi, G., Tessitore, A., 2021. Correlates of psychological distress in patients with Parkinson's disease during the COVID-19 outbreak. Mov. Disord. Clin. Pract. 8 (1), 60–68.
Deledda, G., Riccardi, N., Gori, S., Poli, S., Giansante, M., Geccherle, E., Mazzi, C., Silva, R., Desantis, N., Giovannetti, A.M., 2021. The impact of the SARS-CoV-2 outbreak on the psychological flexibility and behaviour of cancelling medical appointments of italian patients with pre-existing medical condition: the "ImpACT-COVID-19 for patients" multi-centre observational study. Int. J. Environ. Res. Public Health 18 (1), 340.
Delle Donne, V., Ciccarelli, N., Massaroni, V., Lombardi, F., Lamonica, S., Borghetti, A., Fabbiani, M., Cauda, R., Di Giambenedetto, S., 2021. Psychological distress during the initial stage of the COVID-19 pandemic in an Italian population living with HIV: an online survey. Infez. Med. 54–64.
Durcan, E., Turan, S., Sahin, S., Sulu, C., Taze, S.S., Kavla, Y., Ozkaya, H.M., Kadioglu, P., 2021. Psychosocial effects and clinic reflections of the COVID-19 outbreak in patients with acromegaly and Cushing's disease. Pituitary 1–11.
Edition, F., 2013. Diagnostic and statistical manual of mental disorders. Am. Psychiatr. Assoc. 21.
Forte, G., Favieri, F., Tambelli, R., Casagrande, M., 2020. COVID-19 pandemic in the italian population: validation of a post-traumatic stress disorder questionnaire and prevalence of PTSD symptomatology. Int. J. Environ. Res. Public Health 17 (11), 4151.
Galea, S., Nandi, A., Vlahov, D., 2005. The epidemiology of post-traumatic stress disorder after disasters. Epidemiol. Rev. 27 (1), 78–91.
Gandhi, R.T., Lynch, J.B., Del Rio, C., 2020. Mild or moderate Covid-19. N. Engl. J. Med. 383 (18), 1757–1766.
Ho, C.S., Chee, C.Y., Ho, R.C., 2020. Mental health strategies to combat the psychological impact of COVID-19 beyond paranoia and panic. Ann. Acad. Med. Singap. 49 (1), 1–3.
Hocaoglu, M., Ayaz, R., Gunay, T., Akin, E., Turgut, A., Karateke, A., 2020. Anxiety and post-traumatic stress disorder symptoms in pregnant women during the COVID-19 PANDEMIC'S delay phase. Psychiatr. Danub. 32 (3–4), 521–526.
Hong, X., Currier, G.W., Zhao, X., Jiang, Y., Zhou, W., Wei, J., 2009. Posttraumatic stress disorder in convalescent severe acute respiratory syndrome patients: a 4-year follow-up study. Gen. Hosp. Psychiatry 31 (6), 546–554.
Huremović, D., 2019. Social distancing, quarantine, and isolation. In: Psychiatry of Pandemics. Springer, pp. 85–94.
Jelly, P., Chadha, L., Kaur, N., Sharma, S., Sharma, R., Stephen, S., Rohilla, J., 2021. Impact of COVID-19 pandemic on the psychological status of pregnant women. Cureus 13 (1).
Juanjuan, L., Santa-Maria, C.A., Hongfang, F., Lingcheng, W., Pengcheng, Z., Yuanbing, X., Yuyan, T., Zhongchun, L., Bo, D., Meng, L., 2020. Patient-reported outcomes of patients with breast cancer during the COVID-19 outbreak in the epicenter of China: a cross-sectional survey study. Clin. Breast Cancer 20 (5), e651–e662.
Kawamura, N., Kim, Y., Asukai, N., 2001. Suppression of cellular immunity in men with a past history of posttraumatic stress disorder. Am. J. Psychiatr. 158 (3), 484–486.
Koenen, K., Ratanatharathorn, A., Ng, L., McLaughlin, K., Bromet, E., Stein, D., Karam, E., Ruscio, A.M., Benjet, C., Scott, K., 2017. Posttraumatic stress disorder in the world mental health surveys. Psychol. Med. 47 (13), 2260–2274.
Krishnamoorthy, Y., Nagarajan, R., Saya, G.K., Menon, V., 2020. Prevalence of psychological morbidities among general population, healthcare workers and COVID-19 patients amidst the COVID-19 pandemic: a systematic review and meta-analysis. Psychiatry Res. 293, 113382.
Larsson, G., 2000. Dimensional analysis of the impact of event scale using structural equation modeling. J. Trauma. Stress. 13 (2), 193–204.
Lee, S.H., Shin, H.-S., Park, H.Y., Kim, J.L., Lee, J.J., Lee, H., Won, S.-D., Han, W., 2019. Depression as a mediator of chronic fatigue and post-traumatic stress symptoms in Middle East respiratory syndrome survivors. Psychiatry Investig. 16 (1), 59.
Liu, H., Petukhova, M.V., Sampson, N.A., Aguilar-Gaxiola, S., Alonso, J., Andrade, L.H., Bromet, E.J., De Girolamo, G., Haro, J.M., Hinkov, H., 2017. Association of DSM-IV posttraumatic stress disorder with traumatic experience type and history in the World Health Organization world mental health surveys. JAMA Psychiatry 74 (3), 270–281.
Marshall, J.M., Dunstan, D.A., Bartik, W., 2019. The digital psychiatrist: in search of evidence-based apps for anxiety and depression. Front. Psychiatry 10, 831.
Morina, N., Ehring, T., Priebe, S., 2013. Diagnostic utility of the impact of event scale–revised in two samples of survivors of war. PLoS One 8 (12), e83916.
Nagarajan, R., Krishnamoorthy, Y., Basavarachar, V., Dakshinamoorthy, R., 2022. Prevalence of post-traumatic stress disorder among survivors of severe COVID-19 infections: a systematic review and meta-analysis. J. Affect. Disord. 299, 52–59.
Qiu, D., Li, Y., Li, L., He, J., Ouyang, F., Xiao, S., 2021a. Infectious disease outbreak and post-traumatic stress symptoms: a systematic review and meta-analysis. Front. Psychol. 12, 668784.
Qiu, D., Li, Y., Li, L., He, J., Ouyang, F., Xiao, S., 2021b. Prevalence of post-traumatic stress symptoms among people influenced by COVID-19 outbreak: a meta-analysis. Eur. Psychiatry 1–42.
Romito, F., Dellino, M., Loseto, G., Opinto, G., Silvestris, E., Cormio, C., Guarini, A., Minoia, C., 2020. Psychological distress in outpatients with lymphoma during the COVID-19 pandemic. Front. Oncol. 10, 1270.
Saccone, G., Florio, A., Aiello, F., Venturella, R., De Angelis, M.C., Locci, M., Bifulco, G., Zullo, F., Sardo, A.D.S., 2020. Psychological impact of coronavirus disease 2019 in pregnant women. Am. J. Obstet. Gynecol. 223 (2), 293–295.
Salehi, M., Amanat, M., Mohammadi, M., Salmanian, M., Rezaei, N., Saghazadeh, A., Garakani, A., 2021. The prevalence of post-traumatic stress disorder related symptoms in coronavirus outbreaks: a systematic-review and meta-analysis. J. Affect. Disord. 282, 527–538.
Seyahi, E., Poyraz, B.C., Sut, N., Akdogan, S., Hamuryudan, V., 2020. The psychological state and changes in the routine of the patients with rheumatic diseases during the coronavirus disease (COVID-19) outbreak in Turkey: a web-based cross-sectional survey. Rheumatol. Int. 40 (8), 1229–1238.
Shalev, A., Liberzon, I., Marmar, C., 2017. Post-traumatic stress disorder. N. Engl. J. Med. 376 (25), 2459–2469.
Soh, H.L., Ho, R.C., Ho, C.S., Tam, W.W., 2020. Efficacy of digital cognitive behavioural therapy for insomnia: a meta-analysis of randomised controlled trials. Sleep Med. 75, 315–325.
Torales, J., O'Higgins, M., Castaldelli-Maia, J.M., Ventriglio, A., 2020. The outbreak of COVID-19 coronavirus and its impact on global mental health. Int. J. Soc. Psychiatry 66 (4), 317–320.
Tutnjević, S., Lakić, S., 2020. Psychological Impact of the COVID-19 Pandemic on Pregnant Women in Bosnia and Herzegovina and Serbia.
Wang, C., Chudzicka-Czupała, A., Tee, M.L., Núñez, M.I.L., Tripp, C., Fardin, M.A., Habib, H.A., Tran, B.X., Adamus, K., Anlacan, J., García, M.E.A., 2021. A chain mediation model on COVID-19 symptoms and mental health outcomes in Americans. Asians and Europeans. Sci. Rep. 11 (1), 1–12.
Wang, Y., Duan, Z., Ma, Z., Mao, Y., Li, X., Wilson, A., Qin, H., Ou, J., Peng, K., Zhou, F.J. T.p., 2020. In: Epidemiology of Mental Health Problems Among Patients With Cancer During COVID-19 Pandemic, 10, pp. 1–10 (1).
Weathers, F.W., Bovin, M.J., Lee, D.J., Sloan, D.M., Schnurr, P.P., Kaloupek, D.G., Keane, T.M., Marx, B.P., 2018. The clinician-administered PTSD scale for DSM–5 (CAPS-5): development and initial psychometric evaluation in military veterans. Psychol. Assess. 30 (3), 383.

World Health Organization, 2021. WHO Coronavirus (COVID-19) Dashboard. Retrieved 12-31-2021 from. https://covid19.who.int/.
World Health Organization, 2020. COVID-19: vulnerable and high risk groups. Retrieved 12-31-2021 from. https://www.who.int/westernpacific/emergencies/covid-19/information/high-risk-groups.
Yang, J., Zheng, Y., Gou, X., Pu, K., Chen, Z., Guo, Q., Ji, R., Wang, H., Wang, Y., Zhou, Y., 2020. Prevalence of comorbidities in the novel Wuhan coronavirus (COVID-19) infection: a systematic review and meta-analysis. Int. J. Infect. Dis. 10 (10.1016).
Yang, Z.H., Pan, X.T., Chen, Y., Wang, L., Chen, Q.X., Zhu, Y., Zhu, Y.J., Chen, Y.X., Chen, X.N., 2021. Psychological profiles of Chinese patients with hemodialysis during the panic of coronavirus disease 2019. Front. Psychiatry 12, 1–8.
Yunitri, N., Chu, H., Kang, X.L., Jen, H.-J., Pien, L.-C., Tsai, H.-T., Kamil, A.R., Chou, K.-R., 2022. Global prevalence and associated risk factors of posttraumatic stress disorder during COVID-19 pandemic: a meta-analysis. Int. J. Nurs. Stud. 126, 104136.
Zhang, L., Pan, R., Cai, Y., Pan, J., 2021. The prevalence of post-traumatic stress disorder in the general population during the COVID-19 pandemic: a systematic review and single-arm meta-analysis. Psychiatry Investig. 18 (5), 426.
Zhang, M.W., Ho, R., 2017. Moodle: the cost effective solution for internet cognitive behavioral therapy (I-CBT) interventions. Technol. Health Care 25 (1), 163–165.