Tehran University of Medical Sciences

Nursing Practice Today

2024; Volume 11, No 1, pp. 22-33

Review Article

Sleep disorders among healthcare workers during the COVID-19 pandemic: An umbrella review and meta-analysis

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ARTICLE INFO

Received 10 September 2023
Accepted 08 November 2023

Available online at:
http://npt.tums.ac.ir

Keywords:
sleep disorders;
COVID-19;
sleep quality;
healthcare workers;
meta-analysis

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DOI: 10.18502/npt.v11i1.14939

ABSTRACT

Background & Aim: Healthcare workers are at the forefront of the fight against COVID-19 and are exposed to numerous risks and health consequences, including sleep disturbance. The present study aimed to investigate the prevalence of sleep disorders among HCWs during the COVID-19 pandemic using an umbrella review of meta-analyses.

Methods & Materials: Based on the guidance of PRISMA, literature was searched on the Web of Science, PubMed, Embase, Science Direct, Scopus, and Google Scholar (from the beginning of January 2020 to the end of March 2022). The random effects model was used for meta-analysis, and the I2 index was employed to ascertain heterogeneity among studies. Publication bias was investigated using the Begg test. Data were analyzed using STATA software version 14.

Results: Initially, 561 studies were found after the primary literature search in the data resources, of which 27 eligible studies were selected for quality assessment and data extraction. The results showed that the prevalence of sleep disorders among HCWs during the COVID-19 pandemic was 38.27% (95% CI: 35.20-41.01, I^2= 74.2%, P= 0.008).

Conclusion: Based on the results of this review, the prevalence of sleep disorders among HCWs during the COVID-19 pandemic was relatively high. Therefore, these individuals should undergo routine screening for sleep quality and other mental health disorders.

Introduction

The COVID-19 disease has affected all countries around the globe and challenged the healthcare system (1). In parallel, the COVID-19 outbreak has affected the lifestyle of all members of society, bringing numerous mental health consequences, including depression, anxiety, and panic disorder (2, 3). Healthcare workers (HCWs), via providing patient care services, play a crucial role in terminating the COVID-19 pandemic (4) and are at the forefront of the fight against COVID-19, exposing them to risks such as contraction of the pathogen, long working hours, psychological distress, fatigue, burnout, and physical and psychological violence (5-10). During this pandemic, HCWs experienced a significant rise in their working hours (i.e., increased working shifts) (11). Therefore, these factors can predispose HCWs to devastating psychological and physical health consequences, including sleep disorders (12-15) that mostly present as sleep deprivation, circadian rhythm disorders, and insomnia. On the other hand, there is a possibility of an

Please cite this article as: Tahernejad S, Ghaffari S, Farahmandnia H, Farahi-Ashtiani I, Sahebi A, Tahernejd A. Sleep disorders among health care workers during the COVID-19 pandemic: An umbrella review and meta-analysis. Nursing Practice Today. 2024; 11(1):22-33

upsurge in these disorders during the COVID-19 pandemic (16-19).

Hospital personnel are considered to be at risk of sleep problems (20) due to working hours that cause non-standard sleep and wakefulness times, leading to conflict between the imposed sleep-wake cycle and the person's circadian system (21). The results of a study showed that HCWs at the forefront of the fight against COVID-19 were 1.5 times more likely to develop anxiety, stress, and insomnia compared to their peers working in other wards and departments (22). The results of another study showed that 31.5% of HCWs experienced poor-moderate sleep quality during the COVID-19 pandemic (23).

Some epidemiological studies have confirmed the relationship between sleep disorders and adverse health consequences (cardiovascular problems, metabolic disorders, and mortality) (24-27). On the other hand, disturbances in sleep and wakefulness patterns can disrupt job activities and mental processes, contributing to physical and mental problems (28). The results of studies have shown that insomnia can cause HCWs to spend less time providing direct care to patients during the COVID-19 pandemic (29). In addition, fatigue, as the most common and permanent outcome of insomnia, causes daytime exhaustion, medical and psychiatric disorders, and reduced immune response among HCWs (30).

A comprehensive review showed that several systematic reviews and meta-analysis studies had addressed sleep disorders among HCWs during the COVID-19 pandemic, but no study has been conducted, to sum up and report the findings of these studies comprehensively. Therefore, the present umbrella review of meta-analyses was conducted to determine the prevalence of sleep disorders among HCWs during the COVID-19 pandemic. We hope the results of this study can help health policymakers in future planning.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guideline was used to conduct this study (31). This review protocol was also registered at the International Prospective Register of Systematic Reviews (PROSPERO) database under the code CRD42022327002.

Data resources and search strategy

The data resources of Web of Science, PubMed, Embase, Science Direct, Scopus, and Google Scholar were used for literature searches.

Valid keywords and phrases used for the search included "Sleep disorder", "Sleep disturbance", "sleep problem", "Sleep quality", "Sleep duration*", "Sleep pattern", "Circadian Rhythm", "sleep function," Dyssomnia, Insomnia, COVID 19, "SARS CoV 2 Infection", "2019 Novel Coronavirus Disease", "2019 Novel Coronavirus Infection", "2019-nCoV Disease", "COVID-19 Virus Infection", "Coronavirus Disease 2019", "Coronavirus Disease-19", "Coronavirus Disease 19", "Severe Acute Respiratory Syndrome Coronavirus 2 Infection", "SARS Coronavirus 2 Infection", "COVID-19 Virus Disease", "2019-nCoV Infection", COVID19, "COVID-19 Pandemic", "COVID 19 Pandemic", "SARS-CoV- 2 Infection", "Health Personnel", "Healthcare Provider", "Healthcare Worker", "Health Care Professional", "healthcare personnel", "health care personnel", "Medical Staff", "Medical worker", and "Health Care Provider". The search timespan encompassed the beginning of January 2020 to the end of March 2022.

Initially, a search strategy was formulated for PubMed using the keywords, operators, and search fields, based on which a search strategy was then developed for other databases. The search strategies used have been listed in Table 1.

Study eligibility criteria

Meta-analysis studies reporting the prevalence of various sleep disorders among HCWs during the COVID-19 pandemic were included in the study. On the other hand, narrative reviews, systematic literature reviews, scoping reviews, rapid reviews, literature reviews, and interventional studies were excluded.

Table 1. The search strategies used in various databases

Database	Search strategy
PubMed	(“Sleep disorder*” OR “sleep problem*” OR “Sleep disturbance*” OR “Sleep quality*” OR “Sleep duration*” OR “Sleep pattern*” OR “Circadian Rhythm*” OR “sleep function*” OR Dyssomnia* OR Insomnia*) AND (COVID 19 OR "SARS CoV 2 Infection*" OR "2019 Novel Coronavirus Disease" OR "2019 Novel Coronavirus Infection" OR "2019-nCoV Disease*" OR "COVID-19 Virus Infection*" OR "Coronavirus Disease 2019" OR "Coronavirus Disease-19" OR "Coronavirus Disease 19" OR "Severe Acute Respiratory Syndrome Coronavirus 2 Infection" OR "SARS Coronavirus 2 Infection" OR "COVID-19 Virus Disease*" OR "2019-nCoV Infection*" OR COVID19 OR "COVID-19 Pandemic*" OR "COVID 19 Pandemic" OR "SARS-CoV-2 Infection") AND ("Health Personnel" OR "Healthcare Provider*" OR "Healthcare Worker*" OR "Health Care Professional*" OR "healthcare personnel" OR "health care personnel" OR "Medical Staff" OR "Medical worker" OR "Health Care Provider*") AND ("Systematic review") AND ("meta-analysis" [tiab] OR "meta-analytic"))
Scopus	((ALL(“Sleep disorder*”) OR (“sleep problem*”) OR ALL(“Sleep disturbance*”) OR ALL(“Sleep quality *”) OR ALL(“Sleep duration*”) OR ALL(“Sleep pattern*”) OR ALL(“Circadian Rhythm*”) OR ALL(“sleep function*”) OR ALL(Dyssomnia*) OR ALL(“Insomnia*”)) AND (ALL(COVID 19) OR ALL(“SARS CoV 2 Infection*”) OR ALL(“2019 Novel Coronavirus Disease”) OR ALL(“2019 Novel Coronavirus Infection”) OR ALL(“2019-nCoV Disease*”) OR ALL(“COVID-19 Virus Infection*”) OR ALL(“Coronavirus Disease 2019”) OR ALL(“Coronavirus Disease-19”) OR ALL(“Coronavirus Disease 19”) OR ALL(“Severe Acute Respiratory Syndrome Coronavirus 2 Infection”) OR ALL(“SARS Coronavirus 2 Infection”) OR ALL(“COVID-19 Virus Disease*”) OR ALL(“2019-nCoV Infection*”) OR ALL(COVID19) OR ALL(“COVID-19 Pandemic*”) OR ALL(“COVID 19 Pandemic”) OR ALL(“SARS-CoV-2 Infection”)) AND (ALL(“Health Personnel”) OR ALL(“Healthcare Provider*”) OR ALL(“Healthcare Worker*”) OR ALL(“Health Care Professional*”) OR ALL("healthcare personnel") OR ALL("health care personnel") OR ALL(“Medical Staff”) OR ALL(“Medical worker”) OR ALL(“Health Care Provider*”)) AND (ALL(“Systematic review”)) AND (TITLE-ABS(“meta-analysis”) OR ALL(“meta-analytic”))
Web of Science	((TS= ("Sleep disorder*") OR TS=("sleep problem*") OR TS= ("Sleep disturbance*") OR TS= ("Sleep quality*") OR TS= ("Sleep duration*") OR TS= ("Sleep pattern*") OR TS= ("Circadian Rhythm*") OR TS= ("sleep function*") OR TS= (Dyssomnia*) OR TS= (Insomnia*)) AND (TS= (COVID 19) OR TS= ("SARS CoV 2 Infection*") OR TS= ("2019 Novel Coronavirus Disease") OR TS= ("2019 Novel Coronavirus Infection") OR TS= ("2019-nCoV Disease*") OR TS= ("COVID-19 Virus Infection*") OR TS= ("Coronavirus Disease 2019") OR TS= ("Coronavirus Disease-19") OR TS= ("Coronavirus Disease 19") OR TS= ("Severe Acute Respiratory Syndrome Coronavirus 2 Infection") OR TS= ("SARS Coronavirus 2 Infection") OR TS= ("COVID-19 Virus Disease*") OR TS= ("2019-nCoV Infection*") OR TS= (COVID19) OR TS= ("COVID-19 Pandemic*") OR TS= ("COVID 19 Pandemic") OR TS= ("SARS-CoV-2 Infection")) AND (TS= ("Health Personnel") OR TS= ("Healthcare Provider*") OR TS= ("Healthcare Worker*") OR TS= ("Health Care Professional*") OR TS= ("healthcare personnel") OR TS= ("health care personnel") OR TS= ("Medical Staff") OR TS= ("Medical worker") OR TS= ("Health Care Provider*")) AND TS =("Systematic review") AND TS = ("meta-analysis") OR TS = ("meta-analytic"))

Study eligibility criteria

Meta-analysis studies reporting the prevalence of various sleep disorders among HCWs during the COVID-19 pandemic were included in the study. On the other hand, narrative reviews, systematic literature reviews, scoping reviews, rapid reviews, literature reviews, and interventional studies were excluded.

Study selection

All studies obtained while searching the databases were initially inserted into EndNote X7 reference manager software. After removing duplicates, the titles and abstracts of 491 studies were screened, and then the full texts of 53 possibly related studies were independently reviewed by two researchers (AS and ST). Finally, 27 studies were selected for quality assessment.

Study qualification and data extraction

Two researchers (AS and ST) independently checked the quality of the 27 studies selected using the AMSTAR-2 (A Measurement Tool to Assess Systematic Reviews, version 2) tool(32). This tool includes 16 items, each of which the author answers as either yes, to some extent, or no. Based on this tool, the overall reliability of the results is classified into four levels: critically low, low, moderate, and high.

The two researchers (ST and AS) independently used a checklist prepared in Microsoft Word 2016 to collect the required data, including the first author's name, year of study conduction, study place, number of participants, number of studies reviewed, the study population, tools, publication bias, heterogeneity among studies, and the prevalence of sleep disorders (33).

Statistical analysis

In each study, the prevalence of sleep disorders, along with the confidence interval, were used for meta-analysis. The random effects model was used for the meta-analysis of the studies enrolled. The I^2 index was used to evaluate the heterogeneity among studies, with the indices of <25%, 25-50%, 50-75%, and >75% representing no heterogeneity, moderate, high, and very high heterogeneity, respectively (31). Sensitivity analysis was used to determine the impact of each study on the overall outcome, and publication bias was investigated using the Begg test. Data were analyzed using STATA software (version 14).

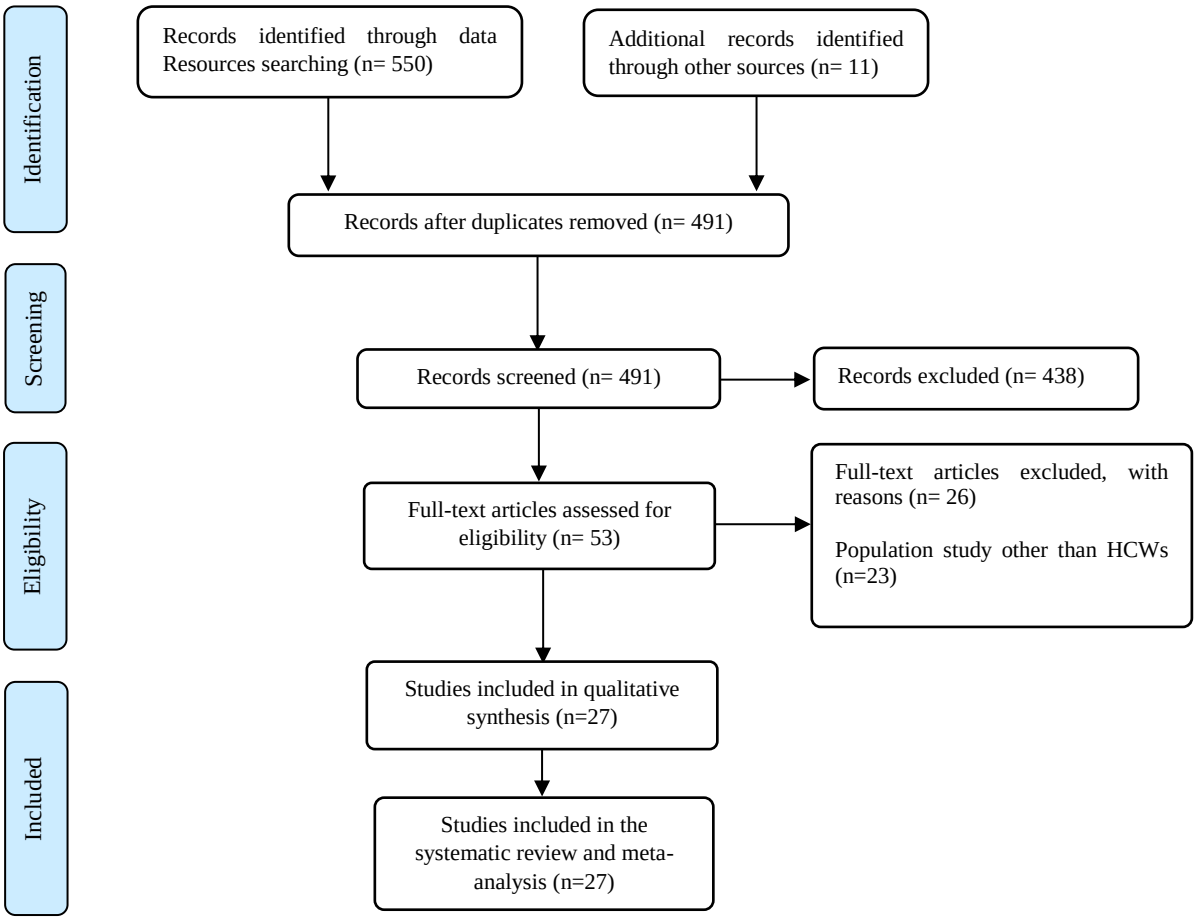

Figure 1. The flowchart of study selection based on PRISMA

Results

A comprehensive literature search resulted in 561 initial studies in the data resources. 11 meta-analyses were also found after checking the reference studies. After removing duplicates, the titles and abstracts of 491 studies were screened, and finally, after reviewing the full texts of 27 studies, all of them entered the quality assessment phase and then meta-analysis. Figure 1 shows the steps of the study selection process, and Table 2 demonstrates each study's features and data separately. In this study, the prevalence of sleep disorders among HCWs during COVID-19 was obtained as 38.27% (95% CI: 35.20–41.01, I^2= 74.2%, P= 0.008) (Figure 2).

According to the I^2 index, heterogeneity among the studies was high. Based on the results of Begg's test, publication bias in the present study was negligible (P= 0.886, Figure 3). The results of the sensitivity analysis test showed that the elimination of each of the studies had no significant impact on the overall outcome, indicating the rigor and robustness of the present study's findings (Figure 4).

Table 2. Specifications of studies included in the umbrella review

First author	Country (year)	Sample size	Prevalence of sleep disorders	Heterogeneity% I^2	Tool*	Group study	Publication bias	Number of studies
Salari (34)	Iran (2020)	3745	34.8% (95% CI:24.8-46.4)	97.4	ISI, PSQI	Nurses	Egger's (P= 0.618)	6
		2123	41.6% (95% CI:27.7-57)	97.3		Physician	Egger's (P=0.322)	5
Abdulla (35)	India (2021)	416	31.94% (95% CI: 21.38–42.49)	81%	PHQ-9, PSQI,	Health care professionals	Funnel plot	3
Busch (36)	Italy (2021)	75991	39.88% (95% CI: 27.70-52.72)	98.99%	NR**	Health care workers	NR	86
Dutta (37)	India (2021)	10411	36.6% (95% CI: 25.6-48.3)	99%	PHQ-9, PSQI, ISI, AIS	Health care workers	NR	11
Jahrami (38)	Bahrain (2021)	4854	36% (95% CI: 21.1-54.2)	99%	PHQ-9, PSQI, ISI, AIS, MOS-SS, MSQ, SCI, SD, SQS, SRSS, YSIS	Health care workers	NR	8
Xia (39)	China (2021)	12261	45.1% (95% CI: 37.2-53.1)	98.7%	PSQI, ISI, AIS	Health care workers	Funnel plot and Egger's (P=0.017)	15
Xiong (40)	Germany (2022)	64706	15% (95% CI: 7-23)	99.1%	NR	Health care workers	Funnel plot and Egger'S (P=0.366)	44
Jahrami (41)	Bahrain (2022)	63685	42.47% (95% CI: 37.95-47.12)	99.1%	ISI AIS PSQI, MSQ, SCI-02, MOS-SS, SRSS, SQS	Health care workers	Funnel plot and Egger'S (P=0.001)	NR
Zhang (19)	China (2022)	11758	34.5% (95% CI: 28-42)	98.3%	PHQ-9, PSQI	Health care workers	NR	8
Hu (42)	China (2022)	26937	40% (95% CI:0.34-0.47)	99%	NR	Medical staff	NR	25
Marvaldi (16)	France (2021)	12428	44.0% (95% CI: 24.568-64.4970)	99.81%	AIS, PHQ-9	Health care workers	NR	10
Al Maqbali (43)	Oman	10697	43% (95% CI: 36-50)	97%	AIS, ISI, PSQI, SRSS	Nurses	No publication bias	18
Alimoradi (44)	Taiwan (2021)	345270	43% (95% CI: 39-47)	99.29%	ISI, PSQI PHQ	Health care professionals	Begg's (P=0.12) and funnel plot	14
Aymerich (45)	Spain (2022)	37068	42% (95% CI: 36-48)	99.59%	ISI, SQS, AIS, PSQI	Healthcare workers	NR	55
Cénat (5)	Canada (2021)	6307	36.52% (95% CI: 32.99-40.20)	-	PSQI, ISI, AIS, ISI-7	Health care workers	NR	6
Chen (46)	Australia (2021)	4144	30% (95% CI: 2–71)	-	ISI, AIS, PHQ-9	Frontline healthcare workers	NR	-
			28% (95% CI: 13–45)	-		General healthcare workers		
Dragioti (47)	Korea (2022)	-	37% (95% CI: 31-44)	96%	PHQ-9, ISI	Health care workers	-	-
Hao (48)	China (2021)	3643	44.1% (95% CI: 31.3–57)	98%	PSQI, PHQ-9, ISI-7,	Healthcare workers	NR	5
Krishnamoorthy (49)	India	6308	37% (95%CI: 32-42)	92.6%	PHQ-9, ISI, PSQI, AIS,	Health care workers	NR	4
Zhang (50)	Australia (2022)	745	57% (95% CI: 47-66)	NR	PHQ-9, PSQI, ISI	Medical workers	NR	3

First author	Country (year)	Sample size	Prevalence of sleep disorders	Heterogeneity% I^2	Tool*	Group study	Publication bias	Number of studies
Wu (18)	China (2021)	13375	47.3% (95% CI: 38.8–55.8)	98.7%	NR	Physicians and nurses	Not significant (Egger test) and Funnel plot)	7
		1380	31.8% (95% CI: 27.2–36.5)	37.5%		Other medical staff		2
Varghese (51)	India (2021)	1714	38.3% (95% CI: 5.8-78.6)	98.56	PHQ-9, PSQI	Nurses	Funnel plot	2
Sun (52)	China (2021)	NR	32% (95% CI: 23-42)	99.5%	ISI, PSQI, AIS	Health care workers	NR	10
Pappa (53)	UK (2020)	8558	34.32% (95% CI: 27.45-41.54)	98%	PHQ-9, ISI, AIS	Health care workers	NR	5
GS (54)	UK (2020)	5067	37.9% (95%CI=30.9–45.5)	96.27%	NR	Health care workers	NR	6
Li (55)	China (2020)	33021	46.4% (95% CI: 40.3-52.5)	99.5%	ISI, AIS, PSQI, SRSS	Health care workers	Not significant (Funnel plot)	48
Yan (56)	China (2021)	7476	41% (95% CI: 33-50)	98%	PHQ-9, PSQI, ISI	Medical staff	NR	8

*****ISI: Insomnia Severity Index, PSQI: Pittsburgh Sleep Quality Index, PHQ-9: Patient Health Questionnaire-9, AIS: Athens Insomnia Scale, MOS-SS: Medical Outcomes Study Sleep Scale, MSQ: Mini Sleep Questionnaire, SCI: Sleep Condition Indicator, SD: Self-Developed, SQS: Sleep Quality Scale, SRSS: Self-Rating Scale of Sleep, YSIS: Youth Self-rating Insomnia Scale, SCI-02: Sleep condition indicator-02, PHQ: Patient Health Questionnaire, ISI-7: seven-item Insomnia Severity Index, **NR: Not Reported

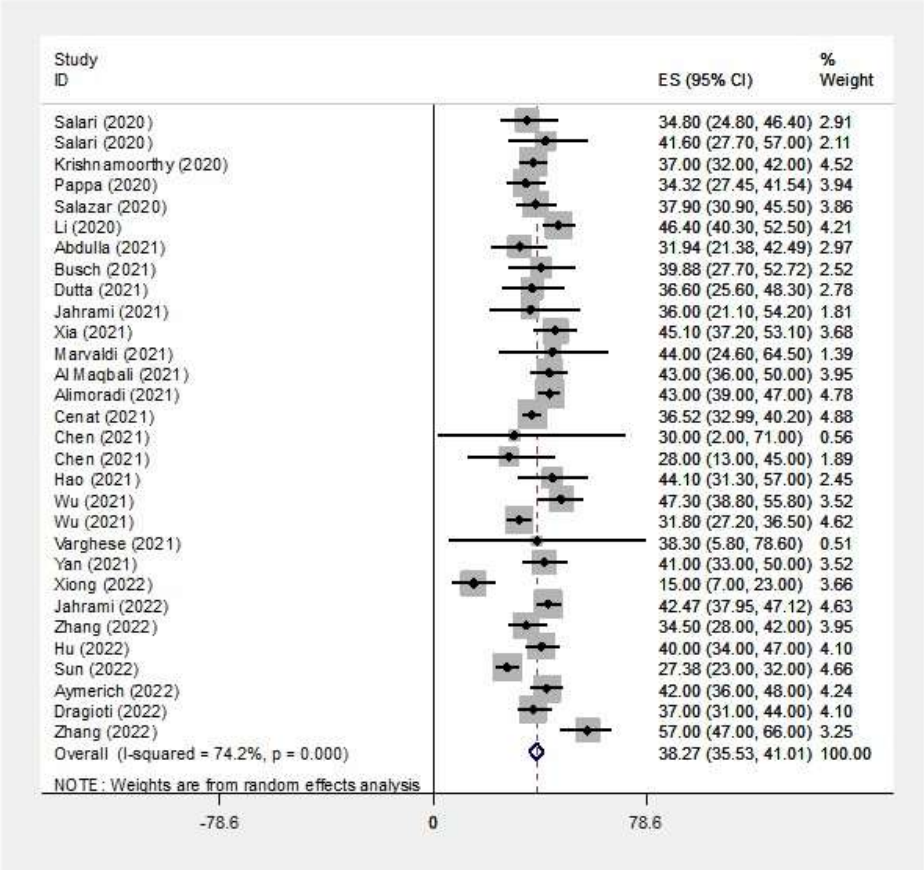

Figure 2. The Forest plot of overall and individual prevalence of sleep disorder in the studies with a 95% confidence interval

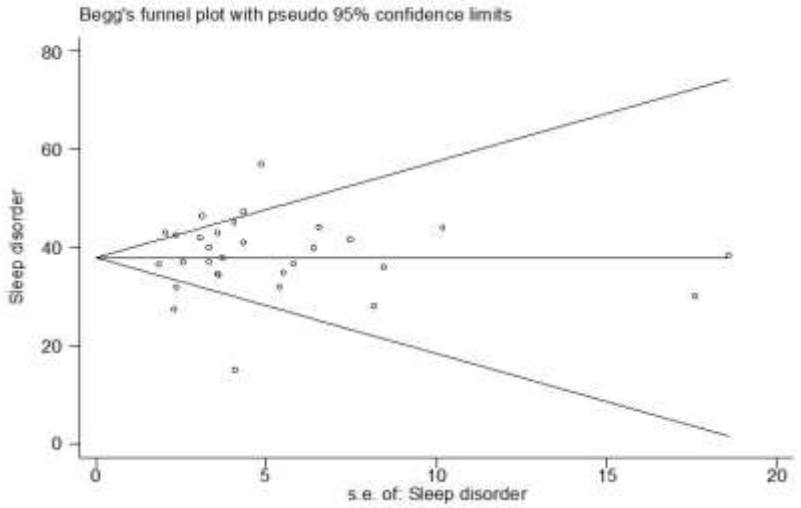

Figure 3. Publication bias based on Begg's test

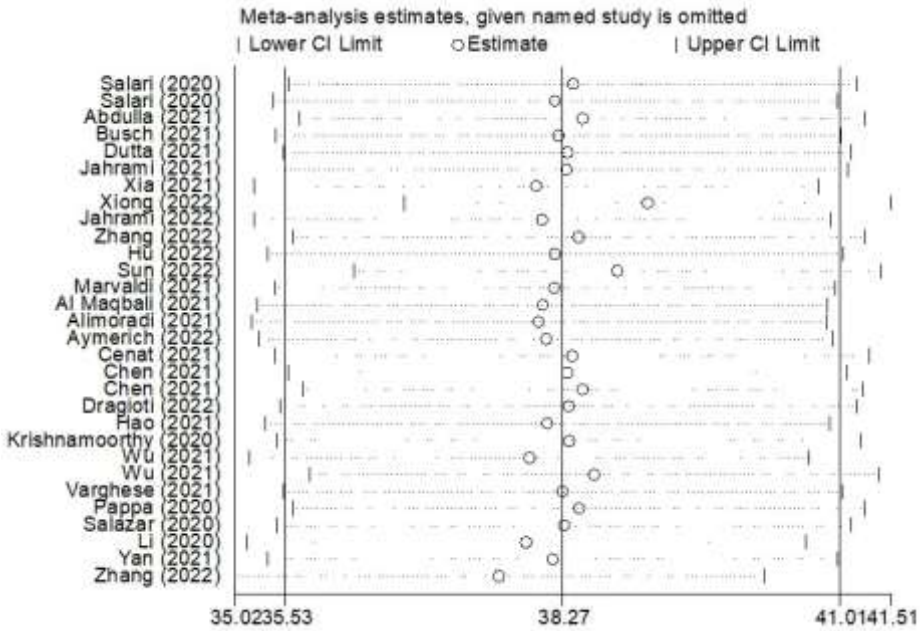

Figure 4. Sensitivity analysis for the sleep disorders in HCWs during COVID-19

Discussion

The results of the present study showed that the prevalence of sleep disorders among HCWs during the COVID-19 pandemic was 38.27%. The results of an umbrella review of meta-analyses conducted in 2021 showed that the prevalence of insomnia, a type of sleep disorder, among HCWs amid the COVID-19 pandemic was 36.36% (57). In a review by Hu *et al*. (2022), the prevalence of sleep disorders among medical students during the COVID-19 outbreak was reported as 40% (42). The results of a study by Jahromi *et al*. also disclosed that the prevalence of sleep disorders among HCWs during COVID-19 was higher compared to the general population (36% vs. 32.3%) (41). In another review, the prevalence of insomnia among COVID-19 patients was reported as 39% (13). The results of an umbrella review indicated a high prevalence of poor sleep quality and job-related stress among HCWs during the COVID-19 pandemic (58). The results of another umbrella review highlighted the deep effects of the COVID-19 pandemic on the mental health status of HCWs, contributing to high levels of depression and sleep disorders among them (59). On the other hand, according to studies, prolonged sleep deprivation can boost irritability and job burnout among HCWs,

which are known as threats to patient safety (60). A comparison between the results of other studies and those of the present study spotlights that HCWs, similar to other groups such as COVID-19 patients and medical students, experience a high prevalence of sleep disorders during the COVID-19 pandemic. Overall, the prevalence of sleep disorders among HCWs has been almost equal to that of other groups. Considering the fact these individuals are responsible for providing direct care to COVID-19 patients, sleep disorders are inevitable in them, which, of course, can adversely affect the quality of care and have dire consequences for themselves and patients. Therefore, priority should be granted by health policymakers to manage the occurrence of sleep disorders among HCWs.

According to the results of a study, the prevalence of sleep disorders among HCWs working at a hospital was reported as 11.3% during the non-COVID period (61). According to the findings of other studies, HCWs suffer from sleep disorders and poor sleep quality due to job-related stress, sleep deprivation, and frequent work shifts, leading to a deregulated circadian rhythm, immune system dysfunction, and increased propensity to infections (62). Research findings denote daytime sleepiness as a common problem among HCWs, followed by nighttime sleep problems (60). On the other hand, sleep disorders are closely related to medical, psychological, and social problems, and excessive stress can lead to long- and short-term impairments in various human organs (63, 64). Studies have also shown that sleep quality is linked with social support, and on the other hand, stress and anxiety have had negative impacts on HCWs' sleep quality during the COVID-19 pandemic. Thus, it is advisable to use family- and friend-oriented support to share exercises, maintain social relationships, reduce anxiety severity, and increase sleep quality (65). Generally, HCWs have already been at risk for sleep disorders due to shift-based working and high physical and mental workload. Besides, they have been at the forefront of the fight against the COVID-19 disease since the start of the pandemic, causing them to experience stressful work environments exaggerating their sleep problems. On the other hand, sleep disorders are accompanied by numerous physical and psychological consequences, so these people should be regularly screened for sleep disorders and other psychological problems, which should be a priority, particularly during the current pandemic. If necessary, HCWs should receive individual and group supportive measures to improve their conditions.

Conclusion

The results of the present umbrella review of meta-analyses showed that the prevalence of sleep disorders among HCWs was relatively high during the COVID-19 pandemic. Since sleep disorders can lead to many physical and psychological consequences and affect the quality of patient care and the quality of life of HCWs, they should be regularly screened in terms of sleep quality and other mental health problems during the COVID-19 pandemic. If these disorders are diagnosed, supportive measures and timely and effective treatments can prevent them from becoming chronic or progressing to other adverse psychological and physical outcomes.

Study limitations

Most studies included in this review had not reported the prevalence of sleep disorders based on age groups, sex, or type of sleep disorder. Also, some studies had not reported the tools used. Therefore, it was inapplicable to perform subgroup analysis to report the prevalence based on these categories and to reduce heterogeneity between the studies.

Conflict of interest

The authors have stated that there is no conflict of interest.

Acknowledgment

All authors thank the Health in Disasters and Emergencies Research Center at Kerman University of Medical Sciences. The research project from which this article was derived was supported by this research center.

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