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Review

Prevalence of mental health problems and sleep disturbances in nursing students during the COVID-19 pandemic: A systematic review and meta-analysis

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ABSTRACT

Aim: To identify the prevalence of mental health problems and sleep disturbances among nursing students during the COVID-19 pandemic.

Background: As a future professional workforce, nursing students are expected to play a role in controlling the COVID-19 pandemic; however, physical and mental health problems may hinder their willingness to stay in the nursing profession. Evidence of the prevalence of the health problems among nursing students related to COVID-19 may allow educators to manage their students' health problems and make them feel more positive about their future careers.

Design: Systematic review and meta-analysis. This study was prospectively registered with PROSPERO.

Data sources: Databases, including CINAHL, Embase, PubMed and Web of Science, were searched for all related journal articles, from database inception to June 29, 2021, published between 2020 and 2021.

Methods: This review was conducted following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines using a PICOS search strategy. A DerSimonian-Laird random-effects model was used to estimate the prevalence and potential heterogeneity among the selected studies using the Cochran Q statistic and I-square test. Publication bias was assessed using the Egger intercept test.

Results: Seventeen studies were included in the meta-analysis, representing 13,247 nursing students. During the COVID-19 pandemic, the prevalence of four health problems and sleep disturbances were identified. The health problem with the highest prevalence in nursing students was depression (52%). Other COVID-19-related health problems were fear (41%), anxiety (32%) and stress (30%) and sleep disturbances (27%).

Conclusions: The findings from this study showed that strategies are necessary to manage nursing students' teaching and learning during the COVID-19 pandemic or similar future situations. Our results suggest that preparing modified distance learning might reduce the prevalence of health problems related to the educational process. In addition, providing regular mental health assessments or online mental health services to students may improve their mental health and increase their well-being. Nursing education policies regarding clinical practice remain to be formulated to ensure the achievement of competencies to support future careers while considering the mental readiness and safety of students.

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1. Introduction

The coronavirus disease 2019 (COVID-19) has caused devastating effects by spreading rapidly throughout society worldwide since it was identified at the end of December 2019 in Wuhan City, China (Zhu et al., 2020). As of June 25, 2021, COVID-19 had been diagnosed in at least 179,686,071 individuals globally and was associated with 3899,172 deaths (World Health Organization, 2021) and this number is increasing every day in most countries, with some even reaching their second or third wave of rising cases. As a result, nurses in the healthcare workforce face heavy workloads and high psychological stress due to the many cases and deaths. Furthermore, the negative psychological effects experienced by nurses may affect the mentality of nursing students (Heilferty et al., 2021; Swift et al., 2020).

Several policies were adopted to control the COVID-19 pandemic. Generally, to prevent and reduce the spread of COVID-19, a comprehensive approach was implemented in the early phase of the pandemic; this approach entailed limiting community activities and requiring home isolation, regional quarantine, social distancing, postponing of planned social and public events, restrictions on mass transit and travel restrictions (Atalan, 2020; Meo et al., 2020; Usher et al., 2020). Academic institutions' concern about the COVID-19 pandemic led most universities worldwide to postpone or cancel all campus events, such as face-to-face teaching, workshops or conferences, sports and clinical practice (O'Flynn-Magee et al., 2021; Sahu, 2020; Viner et al., 2020). Furthermore, students have expressed concern that the interruption of their education would interfere with their competence and future career achievements (Dewart et al., 2020; O'Flynn-Magee et al., 2021). In addition to the impact of the COVID-19 pandemic itself, policies and measures aimed at preventing large gatherings of people, both in general and in academic settings, need to be considered in terms of their impact on mental health.

Nursing students across the world have experienced mental health problems as a result of the COVID-19 pandemic. The impact of COVID-19 goes beyond the most fundamental aspects of daily life, such as sleep patterns (Brouwer et al., 2021; Gol and Erkin, 2021). For example, a study from Turkey found that nursing students reported high levels of anxiety and fear due to COVID-19. Their anxiety levels increased because of the strict implementation of lockdowns and having family members or relatives who tested positive for COVID-19 (Alici and Copur, 2021). In addition, a study from the Philippines explained that nursing students who feared COVID-19 experienced poor sleep quality and developed the intention to leave nursing school. The fear of COVID-19 that the students experienced was due to the current high-risk environment, which requires high self-sacrifice in the nursing profession, whereas the intention to quit nursing school was caused by a lack of basic knowledge, skills in nursing and a lack of maturity in professional values (De Los Santos et al., 2021). Moreover, a study from the USA found that during a lockdown, nursing students reported higher stress, anxiety and depression (Kim et al., 2021).

The sequelae from the COVID-19 pandemic affected nursing students' mental health problems and sleep, putting them at high risk of contracting COVID-19, especially during clinical practice and altering their academic achievements (Okwuikpo et al., 2021; Tomietto et al., 2020). Nursing schools adopted various regulations to reduce these issues. Some institutions temporarily closed the university and delayed clinical practicums (Joob and Wiwanitkit, 2020; O'Flynn-Magee et al., 2021; Rothstein and Olympia, 2020). However, such regulations were found to have additional impacts on student achievements. According to a survey from the International Council of Nurses (ICN), the delay in clinical practice has affected nursing students' academic achievements and delayed their graduations (ICN, 2021). Other challenges arise when clinical practices reopen. For instance, previous studies reported that the implementation of clinical practice during the COVID-19 period experienced many challenges because the current situation required nurses' energy and thoughts to be devoted to dealing with COVID-19, which

burdened them and prevented them from guiding students properly (Franzoi and Cauduro, 2020; ICN, 2021; Okwuikpo et al., 2021). Therefore, it is necessary to carefully mitigate the potential risk of nursing students contracting COVID-19 during their clinical practicum (Alshutwi, 2021; Dewart et al., 2020; Swift et al., 2020).

Although, in general, all nurses are experiencing the same COVID-related stresses, evidence suggests that the youngest nurses have more difficulty coping with this situation (Sherman, 2021). Younger nurses represent the future workforce of nursing professionals, especially those who belong to Generation Z, defined as individuals born between 1995 and 2010 (Seemiller and Grace, 2017) and studies suggest that they have experienced difficulties during the COVID-19 pandemic (Sherman, 2021). Younger nurses self-reported high levels of stress, anxiety and depression during the COVID-19 pandemic (Czeisler et al., 2020; Kim et al., 2021), which may be associated with a lack of experience with adversity and a general aversion to risks and adverse events. Furthermore, Generation Z students have been found to have lower resilience compared with other generations (Ang et al., 2021). Building the resilience of nursing students is important to maintain their mental and psychological health during the COVID-19 pandemic (Labrague, 2021).

As mental health problems and sleep disturbances have been identified in previous studies, the prevalence of these problems may be of interest to educators. Understanding these issues is necessary because nursing students are expected to play a larger role in the current crisis than laypeople by volunteering, educating the public and increasing awareness of the COVID-19 pandemic (Mustafa et al., 2020; Sun et al., 2020). Previous research from before the COVID-19 pandemic reported that the prevalence of depression among nursing students was 34.0% (Tung et al., 2018). Another meta-analysis of university students during the COVID-19 pandemic found that the prevalence of anxiety was 31% and depression was 34% (Chang et al., 2021), but these results are likely different in the case of nursing students during COVID-19. Therefore, systematically synthesizing all the available evidence to estimate its prevalence is warranted. Thus, this systematic meta-analysis aimed to identify the prevalence of mental health problems and sleep disturbances among nursing students during the COVID-19 pandemic.

2. Methods

2.1. Design

This study was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). The study was registered with the International Prospective Register of Systematic Reviews (PROSPERO: CRDxxxxxxxxxx).

2.2. Eligibility criteria

The inclusion criteria were determined according to the PICOS method (population, issue of interest, comparison, outcome and study design) (Amir-Behghadami and Janati, 2020). The population (P) was nursing students; the issue of interest (I) was the COVID-19 pandemic; the outcomes (O) were the prevalence of mental health problems and sleep disturbances; and the study designs (S) were cohort studies, case-control studies, or cross-sectional studies. Additional inclusion criteria applied were study participants were nursing students, studies reported the number (%) of cases, full-text articles were available and articles were published in the English or Indonesian language. Studies were excluded if the study population comprised a mix of nursing students and other health professional students (Table 1).

2.3. Search strategy

To identify relevant studies, four databases were accessed through various vendors (EBSCO: CINAHL, Elsevier: Embase, National Institute of Health [NIH]: PubMed and Clarivate Analytics: Web of Science) and

Table 1
Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Participants consisting of only nursing students.	Participants do not consist of nursing students but comprised a mix of nursing students and other health professional students.
The study designs were cohort studies, case-control studies, or cross-sectional studies.	Other types of studies such as experimental study.
Studies that reported the number (%) of cases.	Studies that not reported number (%) of cases, such as mean, median.
Full text articles	Articles that were not peer-reviewed, such as theses.
Published in English or Indonesian language	Articles that were not in English or Indonesian.

searched from June 23 to June 29, 2021. This literature search was performed with the aid of a librarian and included studies published between 1 January 2020 and 29 June 2021. The search strategies, including all identified keywords (nursing students, mental health problems, fear, depression, anxiety, post-traumatic stress disorder (PTSD), sleep disturbances and COVID-19) and index terms, were adapted for each database. The detailed search strategy is described in.

2.4. Study screening and selection

All studies identified by the search strategy were imported into Endnote X9 to identify and remove duplicate studies. Two reviewers (MM and SIT) screened all titles and abstracts of the remaining studies and assessed the full-text articles for eligibility criteria. Any

disagreements were discussed and resolved by a third reviewer (BOL).

The initial search of the four databases yielded 241 articles. After importing all studies into EndNote X9 software, 75 studies were identified as duplicates and excluded. The titles and abstracts of 166 articles were screened and 134 articles were excluded for various reasons: 82 articles were excluded because the population was not nursing students, 50 studies did not report mental health problems or sleep disturbances and two studies were literature reviews. After the initial title and abstract screening, a total of 32 full-text articles were screened for eligibility. During eligibility screening, 15 articles were removed: seven articles were removed because they did not include the population of interest, two articles were not open-access, five articles did not provide N (%) and one study was not published in English or Indonesian. Thus, 17 articles were included in our final analysis (Fig. 1).

2.5. Data abstraction and quality appraisal

Two reviewers (MM, SIT) performed comprehensive data extraction from each study based on the inclusion criteria. Prevalence was defined as the total number of nursing students with mental health problems and sleep disturbances during the COVID-19 pandemic divided by the total population (Spronk et al., 2019). The extracted data included the author, year of the study, the country where the study was conducted, study design, total population, age, sex, students' degree, time of data collection, fear cases, depression cases, anxiety cases, stress cases, PTSD cases, sleep disturbance cases and measurements. All discrepancies during the data extraction process were discussed and the final decision was made by the third reviewer.

Two reviewers (MM, SIT) independently performed quality

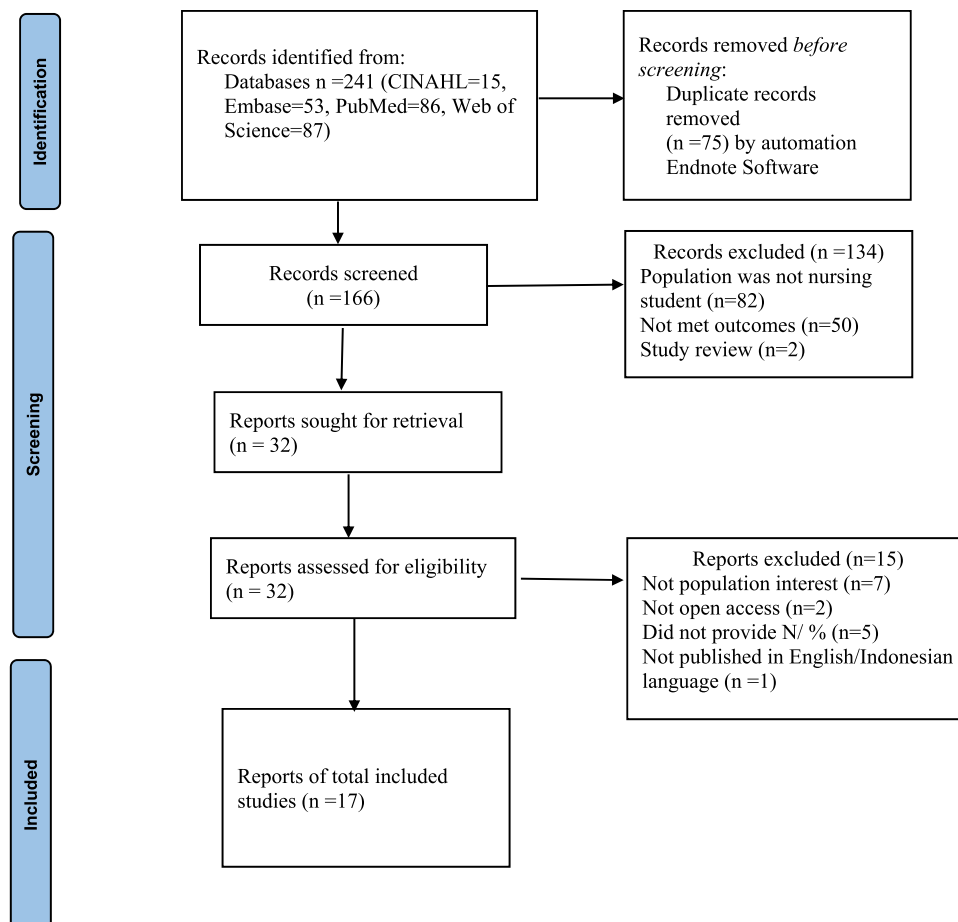


Fig. 1. PRISMA Diagram – process of study selection.

appraisals using the tool developed by the Joanna Briggs Institute (JBI) (The Joanna Briggs Institute, 2017). This study applied the eight-question JBI tool for cross-sectional studies. Each item was scored between 0 (high risk of bias) and 1 (low risk of bias) and a score of ≤ 4 was categorized as low quality, whereas a score of > 4 indicated high quality (Table 3). All differences of opinion were resolved by deliberation until consensus was reached or resolved by the decision of a third reviewer. The results of the discussion were used as the final results for the quality appraisal of the included studies.

2.6. Statistical analysis

Comprehensive Meta-Analysis® Software Version 3.3 was used for all analyses (Biostat, Englewood, NJ, USA). The DerSimonian–Laird random-effects model was used to estimate the prevalence of mental health and sleep disturbances among nursing students with a 95% confidence interval (CI) (Borenstein et al., 2010). The potential heterogeneity among the selected studies was assessed using Cochran Q statistic and I-square (I^2) test. Considerable heterogeneity was considered to be present if the Cochran Q and I^2 values were < 0.05 and at least 50%, respectively (Borenstein et al., 2017). To assess the robustness of the initial results, sensitivity analyses were carried out by removing the study with the greatest weighting in the pooled analysis. Publication

bias was assessed by the Egger intercept test and a p -value of < 0.05 indicated statistically significant publication bias (Sterne and Egger, 2001; Sterne et al., 2000).

3. Results

3.1. Study characteristics

Studies were published between 2020 and 2021 and a total of 17 studies had cross-sectional designs. Five studies were conducted in Turkey (Cici and Yilmazel, 2021; Dalcali et al., 2021; Gol and Erkin, 2021; Kalkan Uğurlu et al., 2021; Turan et al., 2021), three studies were conducted in China (D. Li et al., 2021b; Sun et al., 2020; Zhu et al., 2021), three studies were conducted in Indonesia (Kusuma et al., 2021; Mundakir et al., 2021; Santoso et al., 2020), two studies were conducted in the USA (Fitzgerald and Konrad, 2021; Rosenthal et al., 2021), one study was conducted in Israel (Savitsky et al., 2021), one study was conducted in Italy (Vitale et al., 2020), one study was conducted in Nepal (Deo et al., 2020) and one study was conducted in both India and Australia (Kochuvilayil et al., 2021).

A total of 13,247 nursing students were enrolled across the 17 studies, 80.90% of whom were women. The various mental health problems and sleep disturbances among nursing students across studies

Table 2
Summary of selected studies on mental health problems, and sleep disturbances in nursing students during COVID-19 pandemic.

Author, Year/Country	Sample size	Age	Female N (%)	Data collection (as of Deo 2019)	Mental health problems & Sleep disturbances (N/%)						Measurement
					Fear N/%	Anxiety N/%	Stress N/%	Depression N/%	PTSD N/%	Sleep Disturbances N/%	
Cici and Yilmazel (2021)/Turkey	233	20.8	178/76.4	<3 Month	203/63.04						The survey questions
Dalcali et al. (2021)/Turkey	283	20.39	232/82.0	3–6 Month	33/11.7	147/51.9				80/28.26	The survey questions, STAI, VAS
Deo et al. (2020)/Nepal	184	20–22	NA	3–6 Month		52/28.26	12/6.52	41/22.28		97/52.71	DASS,ISI
Fitzgerald and Konrad (2021)/USA	50	18–21	42/84	≥ 6 Month	30/70					16/32	The survey questions
Gol and Erkin (2021)/Turkey	2.630	21.30	2.159/82.1	3–6 Month						450/17.1	The survey questions
Kalkan Uğurlu et al. (2021)/Turkey	411	20.60	326/79.3	3–6 Month		209/50.85	262/63.74	228/55.47			DASS 42
Kochuvilayil et al. (2021)/Australia (A)&India (I)	A: 99 I: 113	A: 20.01 I: 20.2	191/90	–						A:45 (46.4) I: 5 (4.4)	The survey questions
Kusuma et al. (2021)/Indonesia	235	NA	209/88.9	–				166/70.63			The PHQ-9
Li et al. (2021a), (2021b)/China	6.348	NA	5.737/90.37	<3 Month		2.220/34.97		2.553/40.22	950/14.97		The GAD-7, The PHQ-9, The PCL-C
Mundakir et al. (2021)/Indonesia	619	20–60	510/82.4	–		37/6.0					The survey questions
Rosenthal et al. (2021)/USA	222	NA	NA	3–6 Month		63/28.37	83/37.38	82/36.93			The DASS-21
Santoso et al. (2020)/Indonesia	148	18–20	NA	–				70/47.29			The BDI II
Savitsky et al. (2021)/Israel	215	NA	NA	<3 Month		92/42.8%					The GAD-7
Sun et al. (2020)/China	474	20–22	402/84.8	<3 Month		59/12.44					The SAS
Turan et al. (2021)/Turkey	456	21.09	366/80.3	3–6 Month		197/43.2					The Anxiety Scale.
Vitale et al. (2020)/Italy	285	21–30	245/85.97	<3 Month				232/81.40			The PHQ-9
Zhu et al. (2021)/China	342	20.73	297/86.8	<3 Month		188/54.97		193/56.43			The GAD-7, The PHQ-9

Visual Analog Sleep (VAS) Scale, State-trait anxiety inventory (STAI), Depression Anxiety and Stress Scale (DASS), Generalized Anxiety Disorder 7-Item Scale (GAD-7), Patient Health Questionnaire 9-Item Scale (PHQ-9), Post Traumatic Stress Disorder Check List – Civilian version (PCL-C), Self-rating Anxiety Scale (SAS), Patient Health Questionnaire-9, (PHQ-9), Depression, anxiety, and stress scale (DASS-21), Insomnia Severity Index (ISI), Beck Depression Inventory-II (BDI-II)

Table 3
Quality assessment of cross-sectional studies.

No	JB1 checklist question	Cici and Yilmazel (2021)	Dalcali et al. (2021)	Deo et al. (2020)	Fitzgerald and Konrad (2021)	Gol and Erkin (2021)	Kalkan Ugurlu et al. (2021)	Kochuvilayil et al. (2021)
1	Were the criteria for inclusion in the sample clearly defined?	Y	N	Y	Y	Y	Y	Y
2	Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	Y
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y
4	Were objective standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y
5	Were confounding factors identified?	N	N	N	N	N	N	N
6	Were strategies to deal with confounding factors stated?	N	N	N	N	N	N	N
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y
8	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y
Overall Appraisal		Include: 6 Exclude: 2	Include: 5 Exclude: 3	Include: 6 Exclude: 2	Include: 6 Exclude: 2	Include: 6 Exclude: 2	Include: 6 Exclude: 2	Include: 6 Exclude: 2
Level of evidence		4.c case series	4.c case series	4.c case series	4.c case series	4.c case series	4.c case series	4.c case series
No	JB1 checklist question	Kusuma et al. (2021)	Li et al. (2021a), (2021b)	Mundakir et al. (2021)	Rosenthal et al. (2021)	Santoso et al. (2020)	Savitsky et al. (2021)	Sun et al. (2020)
1	Were the criteria for inclusion in the sample clearly defined?	N	Y	Y	N	N	N	Y
2	Were the study subjects and the setting described in detail?	Y	Y	Y	Y	Y	Y	Y
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y
4	Were objective standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y
5	Were confounding factors identified?	N	Y	N	N	N	Y	Y
6	Were strategies to deal with confounding factors stated?	N	N	N	N	N	Y	Y
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y	Y	Y	Y	Y
8	Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y
Overall Appraisal		Include: 5 Exclude: 3	Include: 7 Exclude: 1	Include: 6 Exclude: 2	Include: 5 Exclude: 3	Include: 5 Exclude: 3	Include: 7 Exclude: 1	Include: 8 Exclude: 0
Level of evidence		4.c case series	4.c case series	4.c case series	4.c case series	4.c case series	4.c case series	4.c case series
No	JB1 checklist question	Turan et al. (2021)	Vitale et al. (2020)	Zhu et al. (2021)				
1	Were the criteria for inclusion in the sample clearly defined?	N	Y	N				
2	Were the study subjects and the setting described in detail?	Y	Y	Y				
3	Was the exposure measured in a valid and reliable way?	Y	Y	Y				
4	Were objective standard criteria used for measurement of the condition?	Y	Y	Y				
5	Were confounding factors identified?	N	N	Y				
6	Were strategies to deal with confounding factors stated?	N	N	Y				
7	Were the outcomes measured in a valid and reliable way?	Y	Y	Y				
8	Was appropriate statistical analysis used?	Y	Y	Y				
Overall Appraisal		Include: 5 Exclude: 3	Include: 6 Exclude: 2	Include: 7 Exclude: 1				
Level of evidence		4.c case series	4.c case series	4.c case series				

Yes: 1, No= 0

were as follows: 10 studies reported anxiety, eight studies reported depression, three studies reported stress, three studies reported fear, one study reported PTSD and five studies reported sleep disturbances. The ranges of the prevalence of mental health problems were as follows: anxiety, 6–54.97%; depression, 22.28–81.40%; stress, 6.52–63.74%, fear, 11.7–70%; and sleep disturbances, 4.4–52.71%. The included studies are summarized in Table 2.

3.2. Risk of bias

The assessment of studies' risk of bias using the JBI tool for cross-sectional studies reported a score of 8 out of 8 in one study (Sun et al., 2020), 7 out of 8 in three studies (D. Li et al., 2021b; Savitsky et al.,

2021; Zhu et al., 2021), 6 out of 8 in eight studies (Cici and Yilmazel, 2021; Deo et al., 2020; Fitzgerald and Konrad, 2021; Gol and Erkin, 2021; Kalkan Uğurlu et al., 2021; Kochuvilayil et al., 2021; Mundakir et al., 2021; Vitale et al., 2020) and 5 out of 8 in five studies (Dalcali et al., 2021; Kusuma et al., 2021; Rosenthal et al., 2021; Santoso et al., 2020; Turan et al., 2021). All scores in this study were > 4 points, which indicated a low risk of bias. In general, all included studies had a low risk of bias, although we identified some concerns for risk of bias due to identified confounding factors and strategies to deal with confounding factors (Table 3).

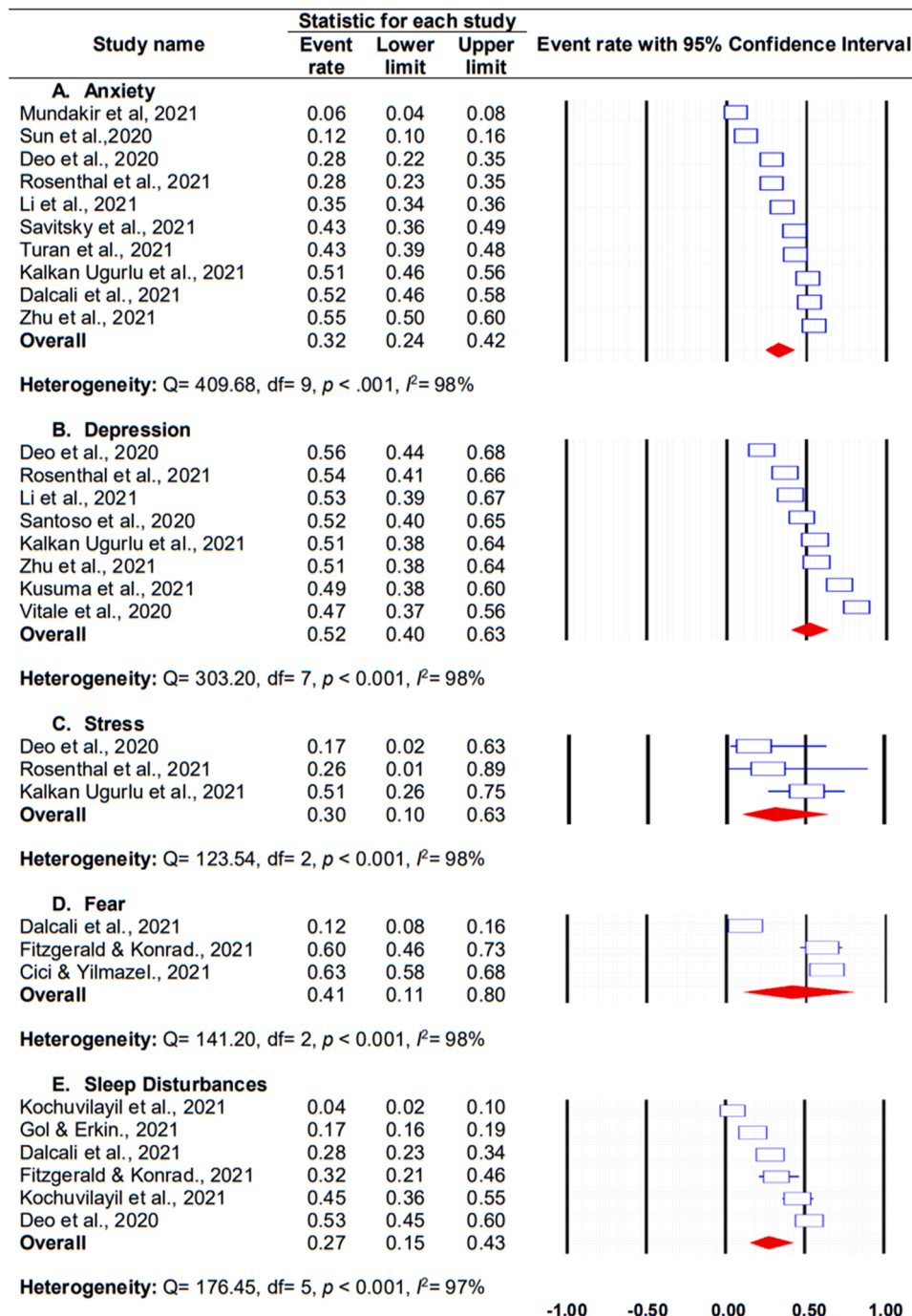


Fig. 2. Proportion of anxiety, depression, stress, fear, and sleep disturbances in nursing students during COVID-19 pandemic.

3.3. Prevalence and types of mental health problems and sleep disturbances

3.3.1. Anxiety

Ten studies involving 9554 students were included to estimate the prevalence of anxiety during the COVID-19 pandemic. The studies were assessed using the State-Trait Anxiety Inventory (STAI), the Depression Anxiety and Stress Scale (DASS), the Generalized Anxiety Disturbances 7-Item Scale (GAD-7), the Self-Rating Anxiety Scale (SAS), the Self-Developed Anxiety Scale and survey questions. The pooled prevalence of anxiety determined by the random-effects model was 32% (95% CI: 0.24–0.42) and there was considerable heterogeneity ($Q = 409.68$, degrees of freedom (df) = 9, $p < 0.001$, $I^2 = 98\%$) (Fig. 2). This result reveals that approximately one-third of the nursing students enrolled in the included studies experienced anxiety during the COVID-19 pandemic.

3.3.2. Depression

Eight studies enrolling 8175 students were assessed to estimate the prevalence of depression during the COVID-19 pandemic. The studies were assessed using the DASS, the Patient Health Questionnaire-9 (PHQ-9) and the Beck Depression Inventory-II (BDI-II). The pooled prevalence of depression determined by the random-effects model was 52% (95% CI: 0.40–0.63) and there was considerable heterogeneity ($Q = 303.20$, $df = 7$, $p < 0.001$, $I^2 = 98\%$) (Fig. 2). This result indicates that half of the nursing students in the included studies developed depression during the COVID-19 pandemic.

3.3.3. Stress

Three studies involving 817 students were included to estimate the prevalence of stress during the COVID-19 pandemic. All three studies assessed used the DASS. The pooled prevalence of stress determined by the random-effects model was 30% (95% CI: 0.10–0.63) and there was a considerable heterogeneity ($Q = 123.54$, $df = 2$, $p < 0.001$, $I^2 = 98\%$) (Fig. 2). This result suggests that one-third of the nursing students in the included studies experienced stress during the COVID-19 pandemic.

3.3.4. Fear

Three studies involving 817 students were included to estimate the prevalence of stress during the COVID-19 pandemic. All three studies assessed used survey questions. The pooled prevalence of stress determined by the random-effects model was 41% (95% CI: 0.11–0.80) and there was considerable heterogeneity ($Q = 141.20$, $df = 2$, $p < 0.001$, $I^2 = 98\%$) (Fig. 2). This result demonstrates that almost half of the nursing students in the included studies experienced fear during the COVID-19 pandemic.

3.3.5. Post-traumatic stress disorder

Only one study reported the prevalence of PTSD among nursing students during the COVID-19 pandemic. This study assessed PTSD using the Post-Traumatic Stress Disorder Checklist—Civilian Version (PCL-C). Since only one study reporting this outcome was identified, the pooled prevalence could not be calculated. Instead, the prevalence of PTSD was narratively reported. This study, which included 6348 nursing students, reported that 15% (95% CI: 0.14–0.16) developed PTSD during the COVID-19 pandemic.

3.3.6. Sleep disturbances

Six studies that included a total of 3359 students were included to estimate the prevalence of sleep disturbances during the COVID-19 pandemic. The studies assessed the Visual Analog Sleep (VAS) Scale, the Insomnia Severity Index (ISI) and survey questions. The pooled prevalence of sleep disturbances determined by the random-effects model was 27% (95% CI: 0.15–0.43) and there was considerable heterogeneity ($Q = 176.45$, $df = 5$, $p < 0.001$, $I^2 = 97\%$) (Fig. 2). This result indicates that approximately a quarter of the nursing students in the

included studies developed sleep disturbances during the COVID-19 pandemic.

3.3.7. Publication bias

The assessment of publication bias using Egger's regression intercept test indicated no significant publication bias for anxiety (intercept = -0.97 , $t = 0.27$, $p = 0.79$), depression (intercept = 4.89 , $t = 1.58$, $p = 0.16$), stress (intercept = -17.13 , $t = 3.79$, $p = 0.16$), fear (intercept = -7.79 , $t = 0.42$, $p = 0.74$), or sleep disturbances (intercept = 4.40 , $t = 1.14$, $p = 0.31$).

3.3.8. Sensitivity analysis

The robustness of principal findings was confirmed by removing the study with the highest weight. The pooled prevalence of anxiety was decreased to 32% (95% CI: 0.21–0.46) when the study by Li et al. (2021a), (2021b) was removed. When the study by Deo et al. (2020) was excluded, the pooled prevalence of sleep disturbances was elevated to 23% (95% CI: 0.14–0.36). In sum, removing the study with the highest weight did not significantly impact the overall results.

4. Discussion

This study aimed to identify the prevalence of mental health problems and sleep disturbances among nursing students during the COVID-19 pandemic. The pooled prevalences for anxiety, depression, stress, fear and sleep disturbances were 32%, 52%, 30%, 41% and 27%, respectively. Although most data collection was conducted six months after the initial outbreak of COVID-19, many countries are still struggling against the disease. Mental health problems during the COVID-19 pandemic can reduce motivation and concentration, introduce difficulties in the learning process, reduce learning quality and reduce student academic achievement (Alici and Copur, 2021; Lovrić et al., 2020). In addition to having an impact on educational performance, mental health issues can affect an individual's clinical practice and subsequent quality of life (Mohamed Sanad, 2019). Nevertheless, the findings from this study should encourage nursing schools to provide approaches that improve mental health and sleep quality and mitigate the students' vulnerability to these health problems.

Educational stakeholders may need to focus on increasing the availability of software and computer equipment and associated distanced learning policies to help nursing students cope with the consequences of COVID-19. First, educational adaptations during the COVID-19 pandemic have included a shift from face-to-face learning to online or flexible learning paradigms (O'Flynn-Magee et al., 2021; Pokhrel and Chhetri, 2021; Sahu, 2020). Studies have found that students face additional learning challenges when adjusting to these different learning modalities (Dewart et al., 2020; Majrashi et al., 2021; Wallace et al., 2021), including internet problems, technological issues, the absence of experimental/practical classes and reduced interactions with peers and educators (W. Li et al., 2021a; Thapa et al., 2021). Faculty members required more time to prepare for online classes and were forced to learn how to navigate and deliver the course content online (Agu et al., 2021; Almahasees et al., 2021). A lack of interactions between nursing educators and students added to the difficulties administering online courses and holding students' attention, resulting in variable outcomes for classroom management and students' learning (Agu et al., 2021; Almahasees et al., 2021; Lynn and Ward-Smith, 2021). Educational stakeholders may require collaborations with the government to improve the online teaching infrastructure, support student readiness to learn and provide technology training for educators in how to effectively deliver online education (Almahasees et al., 2021; Farsi et al., 2021; Pokhrel and Chhetri, 2021).

Second, online learning cannot replace clinical practice placements, which are necessary for skills development (Agu et al., 2021; Aslan and Pekince, 2021). Policies regarding the replacement of clinical experience with simulations have been trialed in developing countries,

tailored to help nursing students cope, adapt and recover as quickly as possible in times of crisis (Agu et al., 2021). The use of simulations is also viewed positively by the newer generation of students, who have expressed a preference for using technology-based simulations as a learning component (Mulyadi et al., 2021; Palancia Esposito and Sullivan, 2020; Shea and Rovera, 2021). Stakeholders involved in nursing education should develop policies related to multiple pedagogies, including online teaching and clinical practice placements.

When implementing clinical practice during a pandemic, some essential aspects should be considered, such as the mental resilience of nursing students and the ability to protect their health through available vaccines and protective equipment, in addition to potential changes in the teaching methods used by educators (Kregar Velikonja et al., 2021; Labrague, 2021; Manning et al., 2021). Coordination with stakeholders in the field of practice is also essential, including their readiness to accept students, their ability to provide a healthy learning environment and the readiness of human resources to guide the practice of nursing students (Hernández-Martínez et al., 2021; Okwuikpo et al., 2021). The results of the current review are important and can influence policy-making by both academic institutions and stakeholders regarding the delivery of nursing education and clinical practice.

The pooled prevalence from ten studies indicated that approximately one-third (32%) of nursing students experienced anxiety during the COVID-19 pandemic. This percentage was higher than that determined by a previous meta-analysis of medical students, which reported an anxiety prevalence of 28% based on eight studies (Lasheras et al., 2020). Anxiety among nursing students was related to several factors, including the changing situations and living conditions during the COVID-19 pandemic, social isolation, economic instability, risk of infection, the incidence of COVID-19 infection in students' families or friends and challenges related to technical problems of distance learning (Alici and Copur, 2021; Savitsky et al., 2020). Another factor related to anxiety in terms of academic achievement is the clinical practicum. Clinical practicum requires nursing students to be in direct contact with patients and because students expressed concerns about the transmission of the COVID-19 virus and the unpredictable situation of the COVID-19 pandemic, this condition endangers their mental health (Kim et al., 2021). Furthermore, a study reported that higher anxiety levels during COVID-19 tend to be reported by students who perceive the nursing profession as a high-risk profession (Turan et al., 2021). Thus, understanding student anxiety, providing assistance and encouraging students to continue to pursue the nursing profession is vital because the profession will always need nurses during critical situations, such as disasters, epidemics, or pandemics (Al Harthi et al., 2020; Turan et al., 2021). This implies that nursing students should learn appropriate coping skills and educators should prepare quality online education to meet student needs and implement strategies to improve students' mental health (Alici and Copur, 2021; Bdair, 2021; Li et al., 2021a).

The results drawn from eight studies indicated that approximately half (52%) of nursing students developed depression during the COVID-19 pandemic. This prevalence was higher than that of a previous study, which found a 34% prevalence of depression among nursing students before the COVID-19 pandemic (Tung et al., 2018). Before the COVID-19 pandemic, the mental health problems of nursing students were triggered by a competitive educational environment among students, along with expectations from parents and the students themselves for educational achievement. During the COVID-19 pandemic, nursing students' depression was triggered by disruption of study plans, restrictions on student activities and sudden changes in learning methods (Zhu et al., 2021). Existing evidence has noted that depressive thoughts during COVID-19 occur because of temporary restrictions on individual freedom, increased social distancing, social isolation, lack of exercise and spending large amounts of time at home (Kalkan Uğurlu et al., 2021; Li et al., 2021b; Qiu et al., 2020). Furthermore, individuals who are separated from their families and social lives tend to have higher depression scores (Ustun, 2021), whereas depression decreases when

people are around (Kalkan Uğurlu et al., 2021). Because of the nature of nursing school, nursing students may not live with their families; instead, they may live in boarding houses and are thus prone to depression. Therefore, the role of nursing schools is crucial in recognizing the risk of depression and preparing appropriate psychological interventions for students who experience social restrictions, regardless of whether they are isolated at home or in boarding houses (Li et al., 2021b).

Approximately one-third (30%) of nursing students experience stress during the COVID-19 pandemic. This prevalence is lower than that of a previous study, which reported a stress prevalence of 48.1% among Chinese people (Bareeqa et al., 2021). A possible explanation for the lower prevalence observed in the present study may be that several studies in our meta-analysis were conducted in other countries, whereas China previously experienced a major impact from the COVID-19 outbreak. However, stress among nursing students remains a concern because it can have an impact on students' health and future careers (Huang et al., 2020). Some findings from this study may be valuable and warrant discussion. First, Deo et al. (2020) found that approximately 6.52% of students experienced increased stress when hearing the news or reading information related to increased COVID-19 cases. In addition, other studies found that younger nursing students reported higher stress levels (Aslan and Pekince, 2021), which represents a particular concern among students belonging to Generation Z, who are known to be social media enthusiasts (Vizcaya-Moreno and Pérez-Cañaveras, 2020). Effective supervision and sharing suitable information sources regarding COVID-19 through social media are also expected to reduce stress. Second, Kalkan Uğurlu et al. (2021) argued that 63.74% of students felt mild to moderate stress because of the data collection conducted in the first five months of the pandemic and under temporary quarantine. Third, this study focused on the academic field, where the COVID-19 pandemic resulted in the inability to continue with the clinical experience required for students to graduate on time (Rosenthal et al., 2021). Thus, early recognition of mental health problems among nursing students is crucial because these health problems may worsen during the pandemic.

This study suggested that almost half of nursing students (41%) experienced fear during the COVID-19 pandemic. The explanation for this may be that the COVID-19 pandemic is perceived to be a prominent source of fear among students because of its rapid transmission, the growing number of infected people, deaths from COVID-19, distrust of the health system and disinformation about COVID-19 (Muller et al., 2021; Rodriguez-Hidalgo et al., 2020). In this review, three included studies found that nursing students were afraid of being infected with COVID-19 (Cici and Yilmazel, 2021; Dalcali et al., 2021; Fitzgerald and Konrad, 2021); however, all studies used survey questionnaires that may have been brief and yielded biased responses. Furthermore, some conditions, such as financial instability, the health of nursing students' friends and family and the death of a friend due to COVID-19, can increase students' fears (Fitzgerald and Konrad, 2021). Thus, nursing educators must be aware of students' needs for mental assessment; providing appropriate information about COVID-19 and facilitating mental services are highly recommended.

Only one study assessed PTSD and revealed a prevalence of 14.97% among nursing students. Despite the relatively small number of studies, potential trauma in nursing students may be due to students' concern for themselves and their families, along with their future careers, in light of the COVID-19 pandemic (Fowler and Wholeben, 2020). Therefore, nursing educators play a key role in maximizing individual student coping and preparing psychological interventions to reduce the risk of PTSD.

Another adverse psychological impact on nursing students was sleep disturbances. Approximately a quarter (27%) of nursing students suffered from sleep disturbances during COVID-19. The present study revealed a lower prevalence of sleep disturbances than a previous meta-analysis of healthcare professionals, which reported a sleep disturbance

prevalence of 31% and a higher prevalence than a general population study, which reported a prevalence of 18% (Alimoradi et al., 2021). Sleep problems cannot be ignored because persistent sleep problems may have serious consequences (Shaffique et al., 2020; Sher, 2020). A study reported that sleep disturbances were correlated with mental health problems, such as anxiety, stress and depression (Xiao et al., 2020); furthermore, increased sleep difficulties were found in people with more mental health problems (Cellini et al., 2020). Given that nursing students are at high risk for mental problems and sleep disturbances, further exploration to develop appropriate psychological support services may be warranted.

This review is the first to assess the mental health problems and sleep disturbances during the COVID-19 pandemic among nursing students to the best of the authors' knowledge. Furthermore, this meta-analysis provides a complete picture of the prevalence of health problems in nursing students, namely fear, anxiety, stress, depression and sleep disturbances. Although the mental health problems in this study were assessed using standardized tools, they were not clinically diagnosed. However, as the COVID-19 pandemic is ongoing in several countries, these results can be used for decision-making or policy-making in nursing education. The results of this study implied that nursing students are prone to mental health problems and sleep disturbances. Considering their future careers and public expectations, the health problems of nursing students must be recognized early and adequately managed through academic and non-academic approaches. For example, modifications to distanced learning can be implemented to increase students' engagement and simulation-based learning methods can be used to replace delayed clinical practice. In addition, non-academic approaches may include regular mental health assessments, making online mental health services available, or providing individual counseling. Policies must be developed for the implementation of clinical practice, with various considerations, such as the mental readiness and resilience of studies; physical resilience through vaccination and protective equipment; and the readiness of the practice area to provide student guidance methods during the COVID-19 adaptation period.

4.1. Limitations

This study has several limitations. First, the literature search only searched four major databases, which may limit the scope of the search. Second, this review only included research papers published in English and Indonesian, potentially overlooking valuable studies published in other languages. Third, some of the outcomes examined involved a small number of articles. For example, the prevalence of PTSD was reported narratively because only one study reporting PTSD outcomes was identified. In addition, the pooled prevalences for fear and stress were each obtained from only three studies. The small number of studies may affect the generalizability of the pooled results. Fourth, not all studies reported complete student characteristics, such as the students' degrees or places of residence, limiting the ability to conduct subgroup analyses or meta-regression to examine detailed conclusions from these results.

5. Conclusions

This study provides evidence that nursing students have experienced numerous mental health problems and suffered from sleep disturbances during the COVID-19 pandemic. Therefore, effective strategies for managing nursing students' education and implementing mental health services during the COVID-19 pandemic and similar future situations remain necessary. Additional data on the prevalence of mental health problems and sleep disturbances is crucial for policy development regarding both classroom-based education and clinical practice. The nursing profession requires that students obtain hands-on experience caring for patients; therefore, adequate preparation of the clinical practice environment, with considerations for mental resilience, physical preparation and practice area readiness, is necessary to allow nurses

to safely obtain clinical experience. Future studies should assess the specific factors associated with mental health problems and sleep disturbances among nursing students during the COVID-19 pandemic.

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Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.nepr.2021.103228](https://doi.org/10.1016/j.nepr.2021.103228).

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