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.

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Review article

The prevalence and risk factors of mental problems in medical students during COVID-19 pandemic: A systematic review and meta-analysis

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ABSTRACT

Background: This meta-analysis and systematic review aimed to evaluate the global prevalence and risk factors of mental problems (i.e., depression, anxiety, stress, sleep disorder, posttraumatic stress disorder (PTSD), burnout, psychological distress, and suicidal ideation) among medical students during the COVID-19 pandemic.

Method: We searched PubMed, Embase, Web of Science, psycARTICLES, PsycINFO, CNKI, and Wan Fang for studies on the prevalence of mental problems among medical students from January 1, 2020, to April 1, 2022. The pooled prevalence was calculated by random-effect models. We performed a narrative review to identify the risk factors.

Results: The meta-analysis included 201 studies (N = 198,000). The prevalence of depression (41 %, 95 % CI, 37–45 %,), anxiety (38 %,95 % CI, 34 %–42 %), stress (34 %, 95 % CI, 27 %–42 %), sleep disorder (52 %, 95 % CI, 44 %–60 %), psychological distress (58 %, 95 % CI, 51 %–65 %), PTSD (34 %, 95 % CI, 22 %–46 %), suicidal ideation (15 %, 95 % CI, 11 %–18 %) and burnout (38 %, 95 % CI, 25 %–50 %) was high. The major risk factors were being female, being junior or preclinical students, exposure to COVID-19, academic stress, psychiatric or physical disorders history, economic trouble, fear of education impairment, online learning trouble, fear of infection, loneliness, low physical activity, low social support, problematic internet or smartphone use, and young age.

Limitations: Most studies were cross-sectional. Few studies provided a reasonable response rate, suggesting potential selection bias.

Conclusions: The study demonstrated a high prevalence and risk factors for mental problems during COVID-19, calling for mental health services. Our findings are valuable for college and health authorities to identify high-risk students and provide targeted intervention.

1. Introduction

The outbreak of the coronavirus disease 2019 (COVID-19) has caused profound and long-lasting psychological harm (Kunzler et al., 2021; Prati and Mancini, 2021; Wu et al., 2021b). Medical students were found to be extremely vulnerable to the mental problems during the pandemic, which might result from the high risk of infection, significant lifestyle change, strict confinement, and disturbance in education program (Eleftheriou et al., 2021). Studies demonstrated a high prevalence of depression, anxiety, and sleep disorder among medical students worldwide during the pandemic (Cao et al., 2020; Chandratre, 2020; Eleftheriou et al., 2021; Kuman Tunçel et al., 2021; Leroy et al., 2021; Yuan et al., 2021). In addition, the common mental problems might lead to their attrition from the medicine learning (Deng et al., 2021a; Khalafallah et al., 2021; Peng et al., 2022; Wang et al., 2020; Yang et al., 2022b), suggesting the urgent need to screen mental problems and

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explore their risk factors among medical students.

To date, most of the studies among medical students were limited by small sample size and reported varied prevalence and possible associated factors. So far, only a few reviews on the mental health of medical students during this pandemic were available (Chandratre, 2020; Lasheras et al., 2020; Mittal et al., 2021; Vythilingam and Atiomo, 2021). Nevertheless, those reviews focused on certain mental problems (depression or anxiety) and most of the included studies were from the very early phase of the pandemic. More importantly, the risk factors of those symptoms were rarely reviewed. A more comprehensive review which assesses a broader range of mental problems and their risk factors in medical students shall provide more valuable insights for university, hospital, and health policymakers to identify at-risk students and to provide timely mental intervention.

Hence, we conducted the present systemic review and meta-analysis of the prevalence and risk factors of mental problems among medical students. Our study aims to evaluate the global prevalence and risk factors of several mental problems (i.e., depression symptoms, anxiety symptoms, burnout, sleep disorder, high perceived stress, PTSD, psychological distress, burnout, and suicidal ideation) among medical students during the COVID-19 pandemic.

2. Method

The systematic review and meta-analysis was performed according to Preferred Reporting Items For Systematic Reviews and Meta-analyses (PRISMA) guidelines (Moher et al., 2009), and the checklist could be found in Table S1. The study was registered in PROSPERO (CRD42022306025).

2.1. Search strategy

Two independent researchers, Qiuxia Wu and Pu Peng, searched the following database: PubMed, Embase, Web of Science, psycARTICLES, PsycINFO, CNKI, and Wan Fang. All the publications from 01 January 2020 to 01 April 2022 will be researched without country and language restrictions. We did the first search in Feb 2022, and updated them on 01 April 2022. Reference lists of all selected articles will independently be screened to identify additional studies left out in the initial search. Detailed search strategies were provided in Supplementary materials Table S2.

2.2. Selection criteria

All abstracts and full-text were independently reviewed by two researchers: Pu Peng and Qiuxia Wu. Any disagreement will be dissolved by discussion until reaching consensus or by consulting Tieqiao Liu.

To be included in the meta-analysis, the studies should (i) assess a group of medical students (ii) provide the prevalence of mental problems or the prevalence could be calculated according to the article; (iii) determine the prevalence of that mental problem using validated instruments and questionnaires, and (iv) be carried out at least 1 week after the onset of COVID-19 in the specific country where the study was conducted. Studies that included medical students as a subgroup will also be included when detailed information on the prevalence of mental problems of medical students was provided. The exclusion criteria were: (i) failed to provide any aggregate prevalence of mental problems in the medical students group; (ii) had included nursing, dentistry, or pharmacy students as part of the medical student group and did not provide enough data to calculate the prevalence of mental problems in medical students (iii) were not accessible for full review; (iv) all interventional studies, editorials, case reports, case series, meeting abstracts and commentaries; (v) were carried out before the breakout of COVID-19 or failed to provide the study setting, and (vi) the number of participants was <50.

For the narrative review of associated factors of mental problems, studies should meet the additional criteria that they performed appropriate statistical methods (i.e., multiple or single-factor regression model, chi-square test, Student's *t*-test, Pearson's/Spearman's correlation test, and Wilcoxon Rank-Sum test) to evaluate the possible associated factors. When the studies provided both multiple and single-factor regression, we only included the results of multiple regression.

2.3. Data extraction

Two authors (Pu Peng and Qiuxia Wu) did the literature search and quality assessment independently and completed a data extraction form: author, study design, geographic location; study time, sample characteristics (age, gender, size), study period (during the lockdown or out of the lockdown), measurement tools (the questionnaires and cutoff points, for example), reported prevalence estimates (the number of cases and the total participants), risk factors of that mental problems, and quality assessment. For studies assessing the prevalence of mental problems at multiple time points, only the latest data was extracted. When multiple studies were found reporting on the same population cohort, only the study reporting the most informative and complete data was chosen. We contacted the corresponding authors to gain the information when necessary.

2.4. Quality assessment

A modified version of the Newcastle-Ottawa Quality Assessment Scale (NOS) was used to evaluate the quality of literature (Rotenstein et al., 2016). Five dimensions include sample size, representativeness, response rate, valid assessment of mental problems, and strong statistic methods. Details of the scoring system could be found in Table S3. A score lower than three represented a high risk of bias.

2.5. Data synthesis and statistical analyses

We performed the statistical analyses on R foundation (Version 4.0.2). The main outcome was the pooled prevalence and 95 % confidence intervals (CI) of mental problems (depressive symptoms, anxiety symptoms, high stress, sleep disorder, burnout, psychological distress, suicidal ideation, and PTSD). Random effect models were performed due to the high heterogeneity between studies. The publication bias was evaluated by funnel plot and egger's test, with a $p > 0.05$ showing low public bias. We assessed the heterogeneity by I^2 statistic, and an $I^2 > 75$ % indicated a high heterogeneity. Subgroup analysis and meta-regression were performed to identify the source of heterogeneity including study time, COVID-19 period, study location, measurement tools, and study quality. Subgroup analysis was conducted when $k \geq 10$ with a cell size of $k > 3$ for each categorical comparison.

3. Result

As illustrated in the flow diagram (Fig. 1), 6273 records were screened after removing duplicates. 1021 studies were read in full text to include studies that met the inclusion criteria. 201 studies were included in the meta-analysis. The study reference, geographic location, study time, sample characteristics (age, gender, size), study period (during the lockdown or out of the lockdown), measurement tools, and prevalence of mental problems were provided in Table S2.

3.1. Study characters

A total of 201 studies regarding 198,000 medical students were included in this study. Of them, the prevalence of a wide range of mental problems was assessed including depression (in 116 studies), anxiety (in 125 studies), high perceived stress (in 43 studies), sleep problems (in 34 studies), psychological distress (in 25 studies), PTSD (in 13 studies), suicidal ideation (in 13 studies) and burnout (in 13 studies).

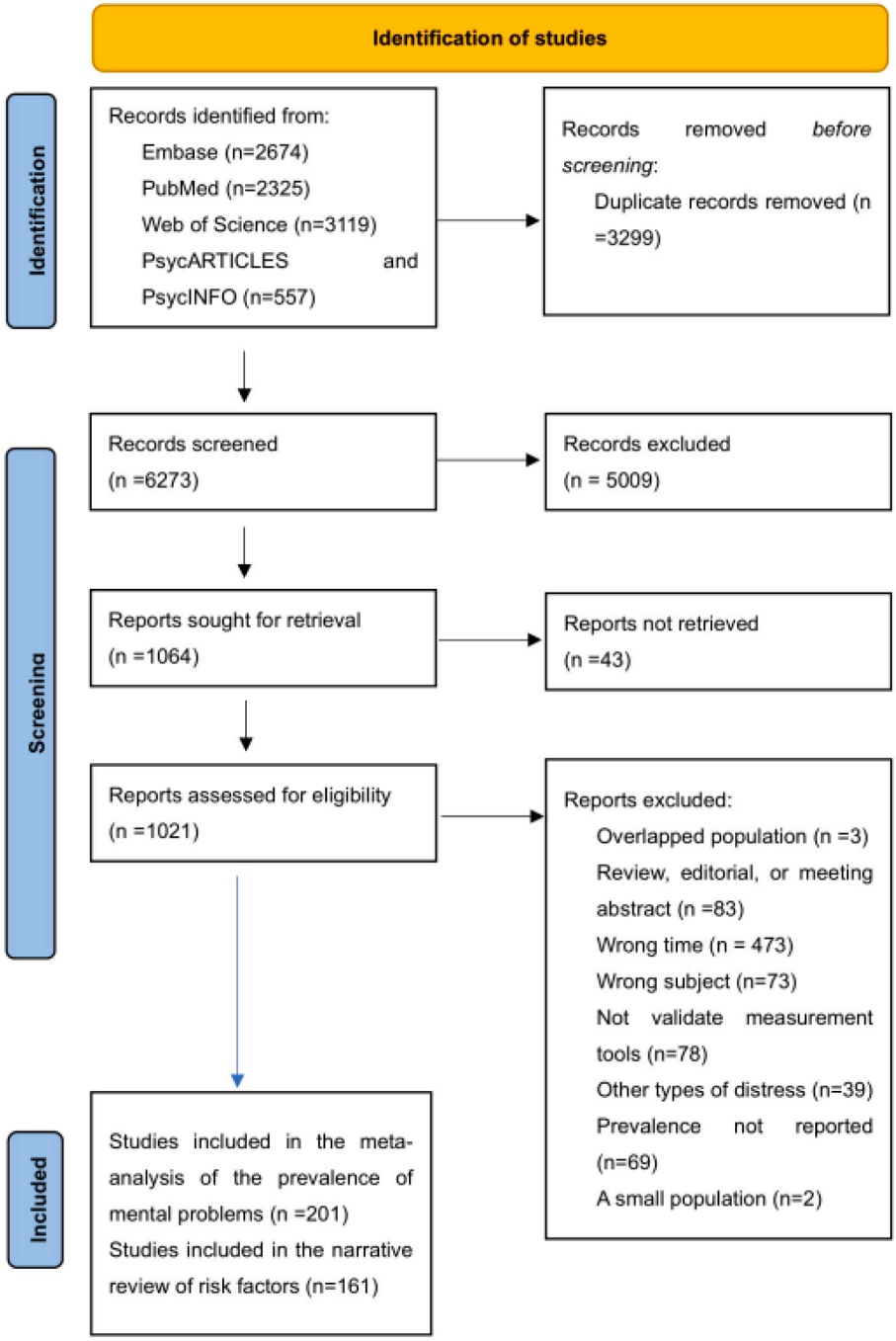

Fig. 1. PRISMA workflow of identification of studies.

Most of the studies were from Asia (72, 35.8 %) and East Asia (72, 35.8 %), followed by Europe (24, 11.9 %), South America (11, 5.4 %), North America (10, 5 %), and Africa (9, 4.4 %). Only one study was carried out in Australia and two studies recruited participants from diverse geographical regions. Nearly half of the studies were carried out during the nationwide COVID-19 lockdown, while 85 (42.3 %) studies were in the post-lockdown period. 24 studies were carried out before lockdown or did not report enough information to identify. 162 studies were carried out during 2020, and 24 studies were carried out in 2021. 15 studies did not report the exact time point. The majority of the studies (193 in 201) were cross-sectional, and 8 studies were longitudinal or repeat cross-sectional.

3.2. Pooled prevalence of mental health problems

The pooled prevalence of depression (41 %, 95 % CI, 37–45 %), anxiety (38 %,95 % CI, 34 %–42 %), stress (34 %, 95 % CI, 27 %–42 %), sleep disorder (52 %, 95 % CI, 44 %–60 %), psychological distress (58 %, 95 % CI, 51 %–65 %), PTSD (34 %, 95 % CI, 22 %–46 %), suicidal ideation (15 %, 95 % CI, 11 %–18 %) and burnout (38 %, 95 % CI, 25 %–50 %) are summarized in Table 1. 81 studies investigated the moderate or severe depression, yielding a pooled prevalence of 27 % (95 % CI, 22 %–31 %). The pooled prevalence of moderate or severe anxiety was 24 % (95 % CI, 20 %–29 %). There was high heterogeneity between studies, with I^2 ranging from 98.5 %–100 %. The forest plot of each mental health problem was found in Figs. S1–8.

Table 1
Pooled prevalence, heterogeneity, and publication bias.

Distress	Studies	Cases	N	Prevalence	95 % CI	I^2	p-Value[1]
Depression							
Overall depression	116	43,557	126,044	41 %	37 %–45 %	99.9 %	0.052
Mild and above	89	33,264	93,310	43 %	39 %–48 %	99.8 %	
Moderate and severe	81	19,735	82,418	27 %	22 %–31 %	99.9 %	
Anxiety							
Overall anxiety	125	46,755	155,291	38 %	34 %–42 %	100 %	<0.001
Mild and above	103	38,819	122,966	39 %	34 %–43 %	100 %	
Moderate and severe	89	18,488	107,648	24 %	20 %–29 %	100 %	
Stress	43	9102	34,231	34 %	27 %–42 %	99.9 %	0.932
Sleep disorder	34	10,945	20,661	52 %	44 %–60 %	99.7 %	0.002
PTSD	13	3231	17,622	34 %	22 %–46 %	99.5 %	0.001
Distress	25	8146	15,195	58 %	51 %–65 %	99.2 %	0.178
Suicidal ideation	13	3857	26,708	15 %	11 %–18 %	98.7 %	0.219
Burnout	13	8089	17,577	38 %	25 %–50 %	99.8 %	0.928

[1] p-Value for egger's test, with a $p > 0.05$ suggested no publication bias.

3.3. Publication bias

Egger's test indicated that there was no publication bias in the prevalence of depression, stress, psychological distress, suicidal ideation, and burnout (All $p > 0.05$). However, egger's test suggested a significant publication bias in anxiety, sleep disorder, and PTSD. The funnel plot of each mental health problem was provided in Fig. S9.

3.4. Meta-regression

Meta-regression suggested a rising prevalence of depression and anxiety symptoms over time. For every 1-month increase, a 1.14 % increase in the prevalence of depression (k = 108; rate = 0.0142, 95 % CI: 0.0032, 0.0206; $p = 0.0071$) and a 1.17 % increase in anxiety (k = 117; rate = 0.0117, 95 % CI: 0.0020, 0.0214; $p = 0.018$). The regression model bubble plot was available in Fig. S9. No association of study time with other mental health problems was found.

3.5. Subgroup analysis

We performed a subgroup analysis of the prevalence of mental symptoms based on lockdown period, study quality, study location, and measurement tools (Table 2). Subgroup difference between groups was only conducted in subgroups with a cell size of $k > 3$, and the full results could be found in Table S5. We found no association between the lockdown period and the prevalence of all mental health problems. Studies with a high risk of bias demonstrated a significantly higher prevalence of anxiety symptoms (44 % vs 34 %, $p = 0.033$) than studies with a low risk of bias, while such association did not exist in other mental health problems. The subgroup analysis revealed that study location was the major resource of heterogeneity of depression ($p < 0.001$), anxiety ($p < 0.001$), and distress ($p = 0.041$), with studies from East Asia demonstrating a lower prevalence. Moreover, a similar trend was observed in sleep disorder ($p = 0.204$) and stress ($p = 0.102$). Measurement tools were the main moderators of the prevalence of depression ($p = 0.016$), anxiety ($p < 0.001$), sleep disorder ($p < 0.001$), and PTSD ($p = 0.009$). However, we found no such relationship in the prevalence of stress ($p = 0.913$), and psychological distress ($p = 0.488$). The forest plot of each subgroup for mental health symptoms was available in Figs. S10–18.

3.6. Factors associated with mental health symptoms

161 studies were included in the narrative review of factors associated with mental health symptoms. We categorized these factors in terms of "Sociodemographic factor" (such as gender, age, and "household income") "Education factor" (such as education level, preclinical or clinical, academic performance, disruption of education, and online education), "COVID-19 factor" (such as fear of COVID-19 infection, relatives infected COVID-19, and lived in a high-epidemic COVID-19 area), "Physiological factor" (such as a history of mental disorder), "Lifestyle factor" (such as physical activity, internet addiction, and diet.), "Physiological and health factor" (such as a history of disease or current health status), "Relational factor" (such as family relationship, friendship, and loneliness) and "Predictors of response to trauma" based on the Furber's theory with some modification (Furber et al., 2017).

Table 3 summarized the most frequently reported associated factors. The major risk factors for mental symptoms were being female (in 62 studies), being preclinical students (in 31 studies), being in a high-epidemic COVID-19 area or having relatives infected with COVID-19 (in 26 studies), having low academic performance or heavy academic burden (in 19 studies), with psychiatric disorders history (in 18 studies), economic instability (in 14 studies), fear of education or career impairment (in 12 studies), difficulties with online learning (in 14 studies), fear of COVID-19 infection (in 12 studies), with physical illness or bad somatic health (in 11 studies), living alone or loneliness (in 12 studies), low physical activity (in 10 studies), low social support (in 10 studies), smartphone addiction or extreme screen time (in 10 studies), and young age (in 11 studies). However, there were inconsistent results across the literature. Nine studies demonstrated that male was more prone to mental problems than female. Six studies reported a positive association between age and the incidence of mental problems. Moreover, for the study period, seven studies showed that clinical students had a higher mental health burden than preclinical students.

4. Discussion

The present meta-analysis is composed of 201 studies. It assesses the global prevalence and risk factors of various mental symptoms among medical students during the COVID-19 pandemic, including depression, anxiety, high perceived stress, sleep disorder, psychological distress, PTSD, burnout, and suicidal ideation. This is the largest meta-analysis on that topic. Our study demonstrates a heavy mental burden among medical students worldwide during this period and highlights risk factors for mental symptoms at a variety of levels. Our findings are valuable for university and health policy makers to early detect and provide targeted interventions for mental problems in medical students.

Our study demonstrated the profound and long-lasting psychological impact of COVID-19 on medical students. There was an extreme high prevalence of depression (41 %, 95 % CI, 37–45 %,), anxiety (38 %, 95 % CI, 34 %–42 %), stress (34 %, 95 % CI, 27 %–42 %), sleep disorder (52 %, 95 % CI, 44 %–60 %), psychological distress (58 %, 95 % CI, 51 %–65 %), PTSD (34 %, 95 % CI, 22 %–46 %), suicidal ideation (15 %, 95 % CI, 11 %–18 %) and burnout (38 %, 95 % CI, 25 %–50 %) among medical students during the pandemic period. The prevalence of depression, anxiety, suicidal ideation, and psychological distress was higher than

Table 2
Subgroup analysis of mental health problems.

Symptom	Subgroup	k	Prevalence	LLCI	ULCI	I^2	p[1]
Depression	Lockdown						0.917
	After lockdown	47	0.41	0.35	0.47	1	
	Lockdown	59	0.41	0.35	0.47	1	
	Area						<0.001
	Africa	6	0.66	0.51	0.81	0.99	
	Asia	36	0.49	0.41	0.57	1	
	East Asia	47	0.29	0.24	0.33	1	
	Europe	12	0.43	0.31	0.54	1	
	North America	6	0.41	0.28	0.54	0.99	
	South America	7	0.54	0.4	0.68	0.99	
	Quality						0.511
	High risk of bias	34	0.39	0.32	0.46	1	
	Low risk of bias	82	0.42	0.37	0.47	1	
	Scale						0.016
	BDI or BDI-2	10	0.38	0.31	0.46	0.99	
	DASS-21	25	0.40	0.30	0.50	1	
	HADS	4	0.41	0.21	0.62	1	
	PHQ2	4	0.27	0.17	0.37	0.93	
	PHQ9 or PHQ8	55	0.46	0.40	0.52	1	
	SDS	13	0.32	0.22	0.41	0.99	
Anxiety	Lockdown						0.376
	After lockdown	44	0.39	0.33	0.46	1	
	Lockdown	71	0.36	0.30	0.41	1	
	Area						<0.001
	Africa	5	0.58	0.51	0.65	0.98	
	Asia	40	0.46	0.38	0.54	1	
	East Asia	53	0.23	0.19	0.27	0.99	
	Europe	11	0.42	0.30	0.55	0.99	
	North America	7	0.61	0.48	0.74	1	
	South America	8	0.54	0.45	0.63	0.94	
	Quality						0.033
	High risk of bias	42	0.44	0.36	0.52	1	
	Low risk of bias	83	0.34	0.30	0.39	1	
	Scale						<0.001
	BAI	4	0.40	0.27	0.53	0.98	
	DASS-21	26	0.39	0.30	0.48	1	
	GAD2	4	0.34	0.21	0.47	0.96	
	GAD7	64	0.42	0.36	0.48	1	
	HADS	5	0.50	0.34	0.65	0.99	
	SAS	16	0.16	0.10	0.22	0.99	
	STAI	5	0.40	0.19	0.60	0.98	
Stress	Lockdown						0.265
	After lockdown	14	0.32	0.19	0.45	0.99	
	Lockdown	25	0.37	0.27	0.48	1	
	Area						0.102
	Asia	19	0.35	0.23	0.47	1	
	East Asia	15	0.23	0.16	0.31	1	
	Europe	4	0.49	0.18	0.80	0.99	
	Quality						0.216
	High risk of bias	14	0.42	0.26	0.59	1	
	Low risk of bias	29	0.31	0.23	0.38	1	
	Scales						0.792
	DASS-21	24	0.32	0.21	0.43	1	
	PSS-10	13	0.38	0.23	0.52	0.99	
	PSS-14	6	0.37	0.28	0.45	0.98	
Sleep disorder	Lockdown						0.602
	After lockdown	18	0.55	0.45	0.65	1	
	Lockdown	14	0.51	0.39	0.63	1	
	Area						0.204
	Asia	14	0.53	0.44	0.61	0.98	
	East Asia	12	0.41	0.26	0.56	1	
	Quality						0.345
	High risk of bias	12	0.58	0.41	0.75	1	
	Low risk of bias	22	0.49	0.42	0.56	0.99	
	Scale						0.029
	ISI	5	0.38	0.24	0.52	0.99	
	PSQI	21	0.57	0.47	0.67	1	
Distress	Lockdown						0.625
	After lockdown	12	0.58	0.48	0.69	0.99	
	Lockdown	9	0.54	0.42	0.68	0.99	
	Area						0.041
	Asia	11	0.64	0.53	0.74	0.99	
	East Asia	4	0.38	0.16	0.60	0.98	
	Quality						0.849

(*continued on next page*)

Table 2 (*continued*)

Symptom	Subgroup	k	Prevalence	LLCI	ULCI	I^2	p[1]
	High risk of bias	6	0.60	0.43	0.76	0.98	
	Low risk of bias	19	0.58	0.50	0.66	0.99	
	Scale						0.417
	GHQ12	7	0.62	0.53	0.72	0.97	
	K10	9	0.64	0.51	0.77	0.99	
	K6	5	0.51	0.32	0.70	0.99	
	SQR20	4	0.48	0.28	0.68	0.98	
PTSD	Lockdown						0.887
	After lockdown	4	0.32	0.04	0.61	1	
	Lockdown	6	0.35	0.16	0.54	1	
	Quality						0.880
	High risk of bias	3	0.33	0.06	0.60	1	
	Low risk of bias	10	0.35	0.21	0.49	1	
	Scale						0.009
	IES-R	9	0.42	0.28	0.56	0.99	
	PCL-5	4	0.18	0.05	0.30	0.99	
	Quality						0.736
	High risk of bias	4	0.40	0.24	0.56	0.95	
	Low risk of bias	9	0.36	0.20	0.53	1	
	Area						0.055
	Asia	6	0.29	0.09	0.50	0.99	
	Europe	6	0.51	0.42	0.60	0.99	
Suicidal ideation	Lockdown						0.772
	After lockdown	8	0.15	0.11	0.20	0.96	
	Lockdown	4	0.14	0.06	0.21	0.99	
	Area						0.418
	East Asia	4	0.12	0.06	0.19	0.99	
	Europe	4	0.16	0.11	0.20	0.94	

Abbreviation: BAI Beck Anxiety Inventory, BDI Beck Depression Inventory, BDI(–II) Beck Depression Inventory(–II), DASS-21 Depression Anxiety Stress Scale-21, GAD-2(–7) Generalized Anxiety Disorder Scale-2(/–7), HADS Hospital Anxiety and Depression Scale, IES-R Impact of Event Scale-Revised, ISI Insomnia Severity Index, K-6 (/–10) Kessler Psychological Distress Scale-6(/–10), NA not available, PCL-5 Post-traumatic Stress Disorder Checklist-5, PHQ-2(/–8/–9) Patient Health Questionnaire-2(/–8/–9/), PSQI Pittsburgh Sleep Quality Index, PSS–10(–14) Perceived Stress Scale–10(–14), SAS Self-Rating Anxiety Scale, SDS Self-Rating Depression Scale, SRQ-20 20-item Self-Report Questionnaire, STAI-Y State Trait Anxiety Inventory-Y, GHQ12 General health questionnaire-12.

[1] $p<0.05$ indicated significant difference between the subrgoups.

that before the COVID-19 pandemic (Hope and Henderson, 2014; Quek et al., 2019; Rotenstein et al., 2016). However, the prevalence of sleep disorder or burnout was similar to that before the COVID-19 pandemic (Frajerman et al., 2019; Rao et al., 2020). Moreover, when compared with studies on the general public during the COVID-19 pandemic, our study demonstrated a much higher prevalence of depression, anxiety, distress, sleep disorder, and PTSD (de Sousa et al., 2021; Jahrami et al., 2022; Yunitri et al., 2022).

Based on the subgroup analysis and meta-regression, our study indicated a slight increase in the prevalence of all symptoms except stress and PTSD during the post-lockdown period. However, the changes were not significant. Besides, we found a positive association between the time of data collection and the prevalence of depression and anxiety. Those findings suggest that COVID-19 might be continuing to affect psychological health even long after the initial or peak point. This hypothesis was supported by numerous longitudinal studies which found increasing mental distress among the general population over time (Ausín et al., 2022; Kok et al., 2022; MacDonald et al., 2022). Taken together, our study suggested the mental problems might persist in the late stage of this pandemic. Therefore, it is critical that medical schools and hospitals screen medical students for common mental problems when medical students returned back.

In line with similar meta-analyses in other populations, our study found that studies in East Asia reported the lowest prevalence of mental symptoms (Deng et al., 2021b; Zhu et al., 2021), which might result from effective epidemic disease control. Various studies showed that the severity of the epidemic was positively associated with unhealthy mental status (Essangri et al., 2021; Lee et al., 2021; Lu et al., 2022). Most studies in East Asia were carried out in China, which was the very first country hit by COVID-19 but managed to control it in three months.

Our study has identified several high-risk groups that deserved more attention. Despite several inconsistent results, most studies found female medical students were at a higher risk for mental problems, which was in line with previous studies in different populations (Balakrishnan et al., 2022; Kunzler et al., 2021; Sheldon et al., 2021). There might be several explanations. First, epidemiological studies demonstrated that females could be more suspectable to mental distress even before the pandemic (Lim et al., 2018). The gender difference in mental distress might be maintained during the pandemic. Second, studies suggested that females might have severer health anxiety, which might lead to worse mental health during the pandemic (Bleichhardt and Hiller, 2007; Solomou and Constantinidou, 2020). Another important risk factor for mental problems was being preclinical or junior students. Interestingly, studies on non-medical students reported similar results, finding junior students were more prone to mental distress (Wathelet et al., 2020). Junior or preclinical students were at the early stage of their medical education. They might have difficulties in adjusting to the stressful medicine learning and the new online learning mode during the pandemic (Çimen et al., 2021). Several studies also suggest junior students might experience more academic stress than senior students during the pandemic (Hakami et al., 2021), which might result in mental problems. Our study also demonstrated low social support and bad family relationship were positively associated with mental distress, which might be explained by the lockdown policy. During the home quarantine, medical students had to live with their family members for a long time. Hence, low social support and bad family relationship might lead to conflicts, which caused mental problems (Wu et al., 2021a). Other important risk factors included economic trouble, pre-existing mental or physical illness, and COVID-19 infection or exposure, which was consistent with studies in other populations (Yuan et al., 2022). Further qualitative interviews in those high-risk students are needed to determine how these factors impacted the mental health of the medical students.

Moreover, our study indicated many modifiable risk factors for mental symptoms, hence targeted intervention could be applied. For example, fear of COVID-19 infection (Bilgi et al., 2021; Gruba et al., 2021; Kuman Tunçel et al., 2021; Safa et al., 2021; Saraswathi et al.,

Table 3
Most frequently reported risk factors for mental health symptoms[a].

Type	Details	Studies	Numbers
Sociodemographic factor	Female	(Abdulghani et al., 2020; AbuDujain et al., 2021; Aftab et al., 2021; AlJhani et al., 2021; Alkhamees et al., 2020; Alkwai, 2021; Allah et al., 2021; Alotiby et al., 2021; Alrashed et al., 2021; Alshammari et al., 2021; Biswas et al., 2021; Capdevila-Gaudens et al., 2021; Çimen et al., 2021; Cockburn et al., 2022; Domínguez-González et al., 2022; Duan et al., 2022; Eleftheriou et al., 2021; Esmat et al., 2021; Essadek et al., 2022; Essangri et al., 2021; Goweda et al., 2020; Gupta et al., 2021; Halperin et al., 2021; Hassnain et al., 2021; Huarcaya-Victoria et al., 2021; Khurram et al., 2020; Kuman Tunçel et al., 2021; Lee et al., 2021; Lingyu et al., 2021; Menon et al., 2021; Muhammad Alfareed Zafar et al., 2020; Nakhostin-Ansari et al., 2020; Natalia and Syakurah, 2021; Ni et al., 2021; Nihmath Nisha et al., 2020; Nikas et al., 2022; Pedraz-Petrozzi et al., 2021; Pelaccia et al., 2021; Pelissier et al., 2021; Perissotto et al., 2021; Puranachaikere et al., 2021; Roka et al., 2020; Rolland et al., 2022a, 2022b; Safarini et al., 2021; Saravia-Bartra et al., 2020; Seetan et al., 2021; Shrestha et al., 2021; Simic et al., 2021; Soltan et al., 2021; Teixeira et al., 2021; Toubasi et al., 2021; Vala et al., 2020; Wang et al., 2021; Xiao et al., 2020; Xie et al., 2020; Yuan et al., 2021; Tian et al., 2021; Jiang et al., 2020; Xing et al., 2020; Zheng et al., 2021b; Zheng et al., 2021c)	62
	Male	(Chang et al., 2021; Gao et al., 2021; Kumar et al., 2021; Xie et al., 2020, 2021; Feng et al., 2021; Zhang et al., 2020b; Jin et al., 2021; Ma et al., 2021)	9
	Be younger	(Abdulghani et al., 2020; AlJhani et al., 2021; Eid et al., 2021; Lee et al., 2021; Mishra et al., 2021; Muhammad Alfareed Zafar et al., 2020; Pedraz-Petrozzi et al., 2021; Rolland et al., 2022a; Seetan et al., 2021; Yang et al., 2021; Zhang et al., 2021c)	11
	Be older	(Allah et al., 2021; Kumar et al., 2021; Periasamy et al., 2021; Risal et al., 2020; Xie et al., 2021; Zheng et al., 2021a)	6
	Living in rural	(Cao et al., 2020; Gao et al., 2021; Liu et al., 2021a; Meng et al., 2021; Xiao et al., 2021; Zheng et al., 2021a; Zhang et al., 2020c; Wang et al., 2022; Jin et al., 2021)	9
	Economic instability	(Allah et al., 2021; Cao et al., 2020; Capdevila-Gaudens et al., 2021; Çimen et al., 2021; Huarcaya-Victoria et al., 2021; Khurram et al., 2020; Kumar et al., 2020; Nishimura et al., 2021; Puranachaikere et al., 2021; Rolland et al., 2022b; Simic et al., 2021; Xiao et al., 2021; Ye et al., 2020; Jiang et al., 2020)	14
	Not living home or housing stress	(Dahanayake et al., 2021; Elhadi et al., 2020; Nikas et al., 2022; Teixeira et al., 2021)	4
Physiological factor	Psychiatric disorders history or current psychiatric disorder	(Aftab et al., 2021; AlJhani et al., 2021; Chootong et al., 2022; Çimen et al., 2021; Crisol-Deza et al., 2022; Domínguez-González et al., 2022; Essangri et al., 2021; Forycka et al., 2022; Guo et al., 2021; Mishra et al., 2022; Nishimura et al., 2021; Pelissier et al., 2021; Puranachaikere et al., 2021; Risal et al., 2020; Soltan et al., 2021; Teixeira et al., 2021; Zhang et al., 2021c; Wang et al., 2022)	18
	Negative coping style	(Lu et al., 2022; Mishra et al., 2021; Saali et al., 2021; Yuan et al., 2021; Zhao et al., 2021; Xia et al.,	7

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Table 3 (*continued*)

Type	Details	Studies	Numbers
		2022; Zheng et al., 2021b)	
	Low resilience	(Forycka et al., 2022; Saali et al., 2021; Zhao et al., 2022, 2021; Xu et al., 2021)	5
Education factor	Junior student or preclinical students[b]	(Adhikari et al., 2021; Ali et al., 2020; AlJhani et al., 2021; Alshammari et al., 2021; Büssing et al., 2021; Capdevila-Gaudens et al., 2021; Chan et al., 2022; Chootong et al., 2022; Çimen et al., 2021; Essadek et al., 2022; Essangri et al., 2021; Goweda et al., 2020; Guse et al., 2021; Halperin et al., 2021; Huarcaya-Victoria et al., 2021; Ismail et al., 2021; Kolcu and Başer Kolcu, 2021; Kostina et al., 2021; Lee et al., 2021; Lingyu et al., 2021; Natalia and Syakurah, 2021; Perissotto et al., 2021; Romic et al., 2021; Saeed and Javed, 2021; Sandoval et al., 2021; Seetan et al., 2021; Shrestha et al., 2021; Simic et al., 2021; Teixeira et al., 2021; Zhao et al., 2021; Zhang et al., 2020c)	31
	Senior students or clinical students[c]	(Elhadi et al., 2020; Hassnain et al., 2021; Xiao et al., 2021; Xie et al., 2020; Zis et al., 2021; Xu et al., 2021; Jiang et al., 2020)	7
	3rd year student	(Abdulghani et al., 2020; Chang et al., 2021; Guo et al., 2021; Jin et al., 2021; Gao et al., 2020)	5
	Low academic performance or heavy academic burden	(AlJhani et al., 2021; Allah et al., 2021; Atta and Almilaibary, 2022; Bolatov et al., 2020; Capdevila-Gaudens et al., 2021; Cardoso et al., 2022; Chang et al., 2021; Esmat et al., 2021; Gao et al., 2021; Nakhostin-Ansari et al., 2020; Safa et al., 2021; Xiao et al., 2021; Yang et al., 2022a; Yuan et al., 2021; Zhong et al., 2021; Ren et al., 2021; Feng et al., 2021; Jiang et al., 2020; Chen et al., 2020)	19
	Decreased willingness in medicine learning	(Deng et al., 2021a; Khalafallah et al., 2021; Peng et al., 2022; Wang et al., 2020; Yang et al., 2022b; Tian et al., 2021; Zheng et al., 2021c)	7
	Being postgraduate[d]	(Duan et al., 2022; Meng et al., 2021; Wang et al., 2020; Xiao et al., 2020; Zhan et al., 2020; Liu et al., 2020; Liu et al., 2021b)	7
	Fear of education or career impairment	(Bilgi et al., 2021; Cao et al., 2020; Gruba et al., 2021; Guse et al., 2021; Huarcaya-Victoria et al., 2021; Khalafallah et al., 2021; Kuman Tunçel et al., 2021; Kumar et al., 2020; Saali et al., 2021; Teixeira et al., 2021; Wang et al., 2020; Xie et al., 2020)	12
	Online learning trouble or dissatisfaction	(Abdulghani et al., 2020; AlJhani et al., 2021; Chang et al., 2021; Dwivedi et al., 2020; Ecker et al., 2022; Forycka et al., 2022; Nikas et al., 2022; Nishimura et al., 2021; Pelissier et al., 2021; Potapova et al., 2021; Teixeira et al., 2021; Wang et al., 2021; Zhao et al., 2021; Jin et al., 2021)	14
	Clinical duties	(Aftab et al., 2021; Alrashed et al., 2021; Wang et al., 2020)	3
COVID-19 factor	Infected with COVID-19 or symptoms of COVID-19	(Eleftheriou et al., 2021; Essadek et al., 2022; Kolcu and Başer Kolcu, 2021; Meng et al., 2021; Nakhostin-Ansari et al., 2020; Tahir et al., 2021; Wu et al., 2020; Zhang et al., 2020a)	8
	Fear of infection with COVID-19 or health worry	(Bilgi et al., 2021; Gruba et al., 2021; Kuman Tunçel et al., 2021; Safa et al., 2021; Saraswathi et al., 2020; Simic et al., 2021; Teixeira et al., 2021; Wang et al., 2021, 2020; Wu et al., 2020; Zhang et al., 2020a; Ma et al., 2021)	12
	Covid-19 related worry on daily life	(Cuschieri and Calleja Agius, 2020; Guo et al., 2021; Safa et al., 2021; Simic et al., 2021; Ren et al., 2021)	5
	Negative perception of lockdown or COVID-19	(Abdulghani et al., 2020; Essadek et al., 2022; Kumar et al., 2020; Pelaccia et al., 2021; Saguem et al., 2021; Xiong et al., 2021)	6
		(Gao et al., 2021; Jindal et al., 2020;	7

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Table 3 (*continued*)

Type	Details	Studies	Numbers
	Low health literacy or little knowledge of COVID-19	Muhammad Alfareed Zafar et al., 2020; Xie et al., 2021; Ye et al., 2020; Zhong et al., 2021; Gao et al., 2020)	
	High degree of focusing on COVID-19	(Muhammad Alfareed Zafar et al., 2020; Meng et al., 2021; Xie et al., 2020; Wu et al., 2020; Gao et al., 2020; Yang et al., 2021)	6
	Being in high-epidemic COVID-19 area or relatives infected with COVID-19	(Aftab et al., 2021; Bilgi et al., 2021; Cao et al., 2020; Çimen et al., 2021; Eleftheriou et al., 2021; Essangri et al., 2021; Halperin et al., 2021; Huarcaya-Victoria et al., 2021; Kolcu and Başer Kolcu, 2021; Kuman Tunçel et al., 2021; Lee et al., 2021; Lingyu et al., 2021; Lu et al., 2022; Meng et al., 2021; Moayed et al., 2021; Risal et al., 2020; Saraswathi et al., 2020; Tahir et al., 2021; Teixeira et al., 2021; Xiao et al., 2020; Xie et al., 2021; Zhang et al., 2021b; Zhang et al., 2021c; Zhang et al., 2020a; Zhang et al., 2020c; Ma et al., 2021)	26
Health factor	Current health status or physical distress history	(Capdevila-Gaudens et al., 2021; Çimen et al., 2021; Mishra et al., 2021; Natalia and Syakurah, 2021; Risal et al., 2020; Sandoval et al., 2021; Yang et al., 2021; Zhang et al., 2021b; Zhang et al., 2022; Feng et al., 2021; Wang et al., 2022)	11
Lifestyle factor	Problematic smartphone/ internet use or much screen time or smartphone/ internet addiction	(Biswas et al., 2021; Dhamija et al., 2021; Goweda et al., 2020; Milasauskiene et al., 2021; Mishra et al., 2022, 2021; Tahir et al., 2021; Telgote et al., 2021; Xie et al., 2021; Zhang et al., 2021a)	10
	Smoking or other substance use	(Capdevila-Gaudens et al., 2021; Cardoso et al., 2022; Gao et al., 2021; Pelissier et al., 2021; Safarini et al., 2021; Saguem et al., 2021)	6
	Unhealthy lifestyle (such as irregular diet, irregular sleep, and soft-drink consumption)	(Gao et al., 2021; Mishra et al., 2021; Shafique et al., 2021; Teixeira et al., 2021; Xiao et al., 2020, 2021; Zhang et al., 2021c; Miu and Y, 2021)	8
	Low physical activity	(Cardoso et al., 2022; Mendes et al., 2021; Menon et al., 2021; Mishra et al., 2022; Saguem et al., 2021; Souza et al., 2021; Toubasi et al., 2021; Xiao et al., 2021; Zhang et al., 2021c; Chen et al., 2020; Lei et al., 2021)	11
Relational factor	Family relationship	(Capdevila-Gaudens et al., 2021; Chang et al., 2021; Lingyu et al., 2021; Simic et al., 2021; Song et al., 2021; Ren et al., 2021; Wang et al., 2022; Jiang et al., 2020; Jin et al., 2021)	9
	Living alone or loneliness	(Allah et al., 2021; Bolatov et al., 2020; Cao et al., 2020; Elhadi et al., 2020; Lee et al., 2021; Lu et al., 2022; Menon et al., 2021; Rolland et al., 2022a; Ren et al., 2021; Feng et al., 2021; Xia et al., 2022; Zhang et al., 2021d; Zheng et al., 2021c; Chen et al., 2020)	14
	Low social support	(Al-Hasani et al., 2021; Cao et al., 2020; Capdevila-Gaudens et al., 2021; Lu et al., 2022; Pelissier et al., 2021; Puranachaikere et al., 2021; Saali et al., 2021; Zhong et al., 2021; Zhang et al., 2020c; Zheng et al., 2021b)	10
Predictors of response to trauma	History of traumatic events (such as traffic accidents or sexual harassments)	(Pelissier et al., 2021; Rolland et al., 2022b; Saali et al., 2021; Soltan et al., 2021)	4

[a] Factors which were reported as statistically significant associated factors in at least k = 3 studies were defined as frequently reported associated factors.
[b] Junior students refer to 1st year or 2nd year medical students.
[c] Senior students refer to 4th year or 5th year medical students.
[d] Compared with undergraduate students.

2020; Simic et al., 2021; Teixeira et al., 2021; Wang et al., 2021, 2020; Wu et al., 2020) and little health literacy (Gao et al., 2021; Jindal et al., 2020; Muhammad Alfareed Zafar et al., 2020; Xie et al., 2021; Ye et al., 2020; Zhong et al., 2021) was found negatively associated with mental health. Therefore, more education on the knowledge of the prevention and control of COVID-19 might help reduce the mental burden. Dissatisfaction with online learning and fear of education impairment due to COVID-19 was other risk factor for mental symptoms (Abdulghani et al., 2020; AlJhani et al., 2021; Chang et al., 2021; Forycka et al., 2022; Nikas et al., 2022; Nishimura et al., 2021; Pelissier et al., 2021; Potapova et al., 2021; Teixeira et al., 2021; Wang et al., 2021; Zhao et al., 2021). Difficulties in following online learning, communicating with teachers, and developing practical skills are major concerns of medical students (Forycka et al., 2022; Pelissier et al., 2021; Jin et al., 2021). Those findings highlighted the need for medical colleges to gather students' opinions on the present online learning mode and made timely adjustments. Besides, growing studies showed unhealthy lifestyles (i.e., low physical activities (Cardoso et al., 2022; Mendes et al., 2021; Menon et al., 2021; Saguem et al., 2021; Souza et al., 2021; Toubasi et al., 2021;

Xiao et al., 2021; Zhang et al., 2021c)), increasing substance use (Capdevila-Gaudens et al., 2021; Cardoso et al., 2022; Gao et al., 2021; Pelissier et al., 2021; Safarini et al., 2021; Saguem et al., 2021), irregular diet and sleep (Gao et al., 2021; Mishra et al., 2021; Shafique et al., 2021; Teixeira et al., 2021; Xiao et al., 2020, 2021; Zhang et al., 2021c), and problematic smartphone and internet use (Biswas et al., 2021; Dhamija et al., 2021; Goweda et al., 2020; Milasauskiene et al., 2021; Mishra et al., 2021; Tahir et al., 2021; Telgote et al., 2021; Xie et al., 2021; Zhang et al., 2021a) was an emerging risk factor for mental problems, which were less frequently discussed among medical students before the pandemic. The rapid lifestyle change might result from the stay-at-home policy during this period (Colley et al., 2020; Li et al., 2021; Tison et al., 2020). Further studies are in need to determine whether lifestyle modification, such as exercise at home, will help protect students from mental symptoms.

5. Strength and limitation

The present study has several substantial strengths. First, to our knowledge, this study is the first meta-analysis and systemic review that assessed the prevalence and risk factors for mental problems in medical students in the context of the COVID-19 pandemic. By including a broader range of mental problems (depression, anxiety, stress, sleep problem, PTSD, burnout, psychological distress, burnout, and suicidal ideation), our study provided a more comprehensive description of mental problems in this population. Second, we applied the validated risk categorization scheme, which provided a detailed taxonomy of risk factors for mental problems. In addition to risk factors that were consistently reported in previous findings in the general population, our study also identified a unique set of risk factors, which was closely related to the medicine learning process such as being preclinical students, low academic performance, fear of education impairment, online learning trouble, and decreased willingness in medicine learning. In addition, most of the risk factors we identified were reversible, which could be promising targets for the prevention and intervention of psychological distress in medical students. Taken together, our findings could help hospitals, universities, and health policymakers to identify groups of medical students at risk of poor mental health and to make timely modifications.

Our results should be interpreted with the following limitation. First, there is a high heterogeneity between studies, which might come from the varied study design and measurement tools. The subgroup analysis and meta-regression didn't account for the total heterogeneity. Second, as most of the studies included were cross-sectional, we could not establish a causal relationship between mental symptoms and risk factors. Moreover, the inconsistency of those risk factors across literature might affect the accuracy of our results. Besides, the lack of longitudinal studies limited us to track the trajectory of these symptoms. Third, only one study adapted diagnosed interviews to identify major depression disorder (Rolland et al., 2022b). Most studies used a self-rating scale which might reduce the accuracy of the study. Fourth, there might be a large selection bias as only a few studies gave a reasonable response rate. Also, most of the studies were web-based and applied convenience sampling, which limited the representativeness of the participants. Fifth, although our meta-analysis included all available research up to date and provided the most comprehensive analysis of the prevalence and risk factors for mental problems during the COVID-19 period, most of those studies were carried out during the first year of COVID-19 and were limited to the first wave. More studies regarding the mental problems during the recurrent waves or remission period of the COVID-19 pandemic are in need. Taken together, more longitudinal, multicenter studies with large sample sizes and validated measurement tools are in need to track the dynamics of those mental symptoms.

6. Conclusion and relevance

Our study demonstrated an extremely high prevalence of mental symptoms during the COVID-19 pandemic and identified multiple risk factors. These findings call for timely mental screening and intervention for medical students. The revealed risk factors are valuable for schools, health systems, and policymakers to identify high-risk subgroups of medical students and provide targeted intervention, as most of the risk factors we found in this study are reversible.

CRediT authorship contribution statement

QX Wu, P Peng, TQ Liu contributed to study design, article search, review and quality assessment. Q Yang, MY Li, and X Wang reviewed the study protocol and contributed to the data collection. P Peng, HY He, YZ Hao, and QX Wu contributed to the drafting of the manuscript. SB Chen, YF Wang, and YH Liu designed the statistical analysis strategy and performed statistical analyses. All authors contributed to the critical revision of the paper and have agreed to be accountable for all aspects of the work.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Appendix A. Supplementary data

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References

Abdulghani, H.M., Sattar, K., Ahmad, T., Akram, A., 2020. Association of COVID-19 pandemic with undergraduate medical students' perceived stress and coping. Psychol. Res. Behav. Manag. 13, 871–881. https://doi.org/10.2147/prbm.S276938.

AbuDujain, N.M., Almuhaideb, Q.A., Alrumaihi, N.A., Alrabiah, M.A., Alanazy, M.H., Abdulghani, H., 2021. The impact of the COVID-19 pandemic on medical interns' education, training, and mental health: a cross-sectional study. Cureus 13, e19250. https://doi.org/10.7759/cureus.19250.

Adhikari, A., Sujakhu, E., Sandervee, G.C., Zoowa, S.B., 2021. Depression among medical students of a medical college in Nepal during covid-19 pandemic: a descriptive cross-sectional study. J. Nepal Med. Assoc. 59, 645–648. https://doi.org/10.31729/jnma.5441.

Aftab, M., Abadi, A.M., Nahar, S., Ahmed, R.A., Mahmood, S.E., Madaan, M., Ahmad, A., 2021. COVID-19 pandemic affects the medical students' learning process and assaults their psychological wellbeing. Int. J. Environ. Res. Public Health 18. https://doi.org/10.3390/ijerph18115792.

Al-Hasani, I.D., Salih, H.S., Abdul Wahid, A.T., Jabarah, M., 2021. The impact of social support on students' behavior in the context of iraqi medical education. Open Access Macedonian J. Med. Sci. 9, 1553–1559. https://doi.org/10.3889/oamjms.2021.7688.

Ali, A., Mahnoor, S., Ahmed, S., Naseem, S., Shah, S.W., Shehryar, S., 2020. COVID-19 online teaching and its impact on psychological health in higher education: a cross sectional study on medical students of 1st 2nd and 3rd year MBBS. J. Res. Med. Dental Sci. 8, 275–279.

AlJhani, S., Alateeq, D., Alwabili, A., Alamro, A., 2021. Mental health and online learning among medical students during the COVID-19 pandemic: a saudi national study. J. Mental Health Train. Educ. Pract. https://doi.org/10.1108/jmhtep-04-2021-0037.

Alkhamees, A.A., Alaqil, N.S., Alsoghayer, A.S., Alharbi, B.A., 2020. Prevalence and determinants of burnout syndrome and depression among medical students at qassim university, Saudi Arabia. Saudi Med. J. 41, 1375–1380. https://doi.org/10.15537/smj.2020.12.25427.

Alkwai, H.M., 2021. Graduating from medical school amid a pandemic: a study of graduates' mental health and concerns. Educ. Res. Int. 2021 https://doi.org/10.1155/2021/8854587.

Allah, A.A., Algethami, N.E., Algethami, R.A., RH, A.LAyyubi, Altalhi, W.A., Atalla, A.A. A., 2021. Impact of COVID-19 on psychological and academic performance of medical students in Saudi Arabia. J. Fam. Med. Prim. Care 10, 3857–3862. https://doi.org/10.4103/jfmpc.jfmpc_1004_21.

Alotiby, A., Almaghrabi, M., Alosaimy, R., Alharthi, A., Khawandanah, B., Alansari, R., Basahal, A., Zamil, G., 2021. Learning environment quality for medical students at umm Al-Qura University: a comprehensive study on stressors, sources, and solutions after introduction of a new bachelor of medicine and bachelor of surgery (MBBS) curriculum. Adv. Med. Educ. Pract. 12, 1487–1497. https://doi.org/10.2147/amep.S343792.

Alrashed, F.A., Sattar, K., Ahmad, T., Akram, A., Karim, S.I., Alsubiheen, A.M., 2021. Prevalence of insomnia and related psychological factors with coping strategies among medical students in clinical years during the COVID-19 pandemic. Saudi J. Biol. Sci. 28, 6508–6514. https://doi.org/10.1016/j.sjbs.2021.07.022.

Alshammari, K.F., Alassaf, O.M., Alomaim, H.Y., Alnais, I.A., Alswayda, S.H., 2021. Prevalence of low back pain and its relation to stress and study hours among medical students in University of Hail in Saudi Arabia. Med. Sci. 25, 432–439.

Atta, I.S., Almilaibary, A., 2022. The prevalence of stress among medical students studying an integrative curriculum during the COVID-19 pandemic. Adv. Med. Educ. Pract. 13, 35–45. https://doi.org/10.2147/amep.S345330.

Ausín, B., González-Sanguino, C., Castellanos, M.A., Sáiz, J., Zamorano, S., Vaquero, C., Muñoz, M., 2022. The psychological impact of the COVID-19 pandemic in Spain: a longitudinal study. Psicothema 34, 66–73. https://doi.org/10.7334/psicothema2021.290.

Balakrishnan, V., Ng, K.S., Kaur, W., Govaichelvan, K., Lee, Z.L., 2022. COVID-19 depression and its risk factors in Asia Pacific - a systematic review and meta-analysis. J. Affect. Disord. 298, 47–56. https://doi.org/10.1016/j.jad.2021.11.048.

Bilgi, K., Aytaş, G., Karatoprak, U., Kazancıoğlu, R., Özçelik, S., 2021. The effects of coronavirus disease 2019 outbreak on medical students. Front. Psychiatry 12. https://doi.org/10.3389/fpsyt.2021.637946.

Biswas, M., Hasan, M.T., Samir, N., Alin, S.I., Homaira, N., Hassan, M.Z., Khatun, M.R., Anjum, A., Hossain, S., Koly, K.N., Safa, F., Alam, S.F., Rafi, M.A., Osman Biswas, M. A.A., Yasmin, F., Podder, V., Trisa, T.I., Azad, D.T., Nodi, R.N., Ashraf, F., Akther, S. M.Q., Ahmed, H.U., 2021. The prevalence and associated factors of depressive symptoms among medical students in Bangladesh during the COVID-19 pandemic: a cross-sectional pilot study. Front. Public Health 9, 811345. https://doi.org/10.3389/fpubh.2021.811345.

Bleichhardt, G., Hiller, W., 2007. Hypochondriasis and health anxiety in the German population. Br. J. Health Psychol. 12, 511–523. https://doi.org/10.1348/135910706X146034.

Bolatov, A.K., Seisembekov, T.Z., Askarova, A.Z., Baikanova, R.K., Smailova, D.S., Fabbro, E., 2020. Online-learning due to COVID-19 improved mental health among medical students. Med. Sci. Educ. 31, 1–10. https://doi.org/10.1007/s40670-020-01165-y.

Büssing, A., Lindeberg, A., Stock-Schröer, B., Martin, D., Scheffer, C., Bachmann, H.S., 2021. Motivations and experiences of volunteering medical students in the COVID-19 pandemic-results of a survey in Germany. Front Psychiatry 12, 768341. https://doi.org/10.3389/fpsyt.2021.768341.

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., Zheng, J., 2020. The psychological impact of the COVID-19 epidemic on college students in China. Psychiatry Res. 287 https://doi.org/10.1016/j.psychres.2020.112934.

Capdevila-Gaudens, P., Miguel García-Abajo, J., Flores-Funes, D., García-Barbero, M., García-Estañ, J., 2021. Depression, anxiety, burnout and empathy among spanish medical students. PLoS One 16. https://doi.org/10.1371/journal.pone.0260359.

Cardoso, A.C.C., Quintanilha, L.F., Barbosa, L.A.de O., Avena, K.de M., 2022. Prevalence of common mental disorders among medical students during the Covid-19 pandemic. Revista Brasileira de Educação Médica 46, e006. https://doi.org/10.1590/1981-5271v46.1-20210242.ing.

Chan, C.K., Yin Lam, T., Seevalingam, K.K., Rajandram, R., Kuppusamy, S., 2022. The impact of recurrent waves of COVID-19 on the mental health of medical students: a cross-sectional study. Asia Pac. J. Public Health. https://doi.org/10.1177/10105395221077061, 10105395221077060.

Chandratre, S., 2020. Medical students and COVID-19: challenges and supportive strategies. J. Med. Educ. Curric. Dev. 7 https://doi.org/10.1177/2382120520935059, 2382120520935059.

Chang, W.W., Shi, L.X., Zhang, L., Jin, Y.L., Yu, J.G., 2021. The mental health status and associated factors among medical students engaged in online learning at home during the pandemic: a cross-sectional study from China. Front. Psychiatry 12. https://doi.org/10.3389/fpsyt.2021.755503.

Chootong, R., Sono, S., Choomalee, K., Wiwattanaworaset, P., Phusawat, N., Wanghirankul, N., Laojaroensuk, P., Thongkhundum, P., Saetang, R., Euanontat, S., Anantathaweekul, S., 2022. The association between physical activity and prevalence of anxiety and depression in medical students during COVID-19 pandemic: a cross-sectional study. Ann. Med. Surg. (Lond.) 75, 103408. https://doi.org/10.1016/j.amsu.2022.103408.

Çimen, İ.D., Alvur, T.M., Coşkun, B., Şükür, N., 2021. Mental health of Turkish medical students during the COVID-19 pandemic. Int. J. Soc. Psychiatry. https://doi.org/10.1177/00207640211066734, 207640211066734.

Cockburn, J.G., Tan, C.Y., Poh, D., Tan, D.J., Foong, C.C., Hong, W.H., 2022. Mental health and self-determination profiles of the diverse population of medical students in Malaysia during the COVID-19 pandemic. BMC Psychol. 10, 49. https://doi.org/10.1186/s40359-022-00759-y.

Colley, R.C., Bushnik, T., Langlois, K., 2020. Exercise and screen time during the COVID-19 pandemic. Health Rep. 31, 3–11. https://doi.org/10.25318/82-003-x202000600001-eng.

Crisol-Deza, D., Poma-Ramírez, D., Pacherres-López, A., Noriega-Baella, C., Villanueva-Zúñiga, L., Salvador-Carrillo, J., Huarcaya-Victoria, J., 2022. Factors associated with suicidal ideation among medical students during the initial phase of the COVID-19 pandemic in Peru: a multicenter study. Death Stud. 1–9 https://doi.org/10.1080/07481187.2022.2042752.

Cuschieri, S., Calleja Agius, J., 2020. Spotlight on the shift to remote anatomical teaching during COVID-19 pandemic: perspectives and experiences from the University of Malta. Anat. Sci. Educ. 13, 671–679. https://doi.org/10.1002/ase.2020.

Dahanayake, D., Rajapakse, H., Wickramasinghe, A., Chandradasa, M., Rohanachandra, Y., Perera, S., Nillo, A.M., Molodynski, A., 2021. Psychological wellbeing and mental health amongst medical undergraduates: a descriptive study assessing more than 1,000 medical students in Sri Lanka. Int. J. Soc. Psychiatry. https://doi.org/10.1177/00207640211027211, 207640211027211.

de Sousa, G.M., de Meiroz Grilo, M.L.P., Coelho, M.L.G., de Lima-Araújo, G.L., Schuch, F. B., Galvão-Coelho, N.L., Tavares, V.D.de O., 2021. Mental health in COVID-19 pandemic: a meta-review of prevalence meta-analyses. Front. Psychol. 12, 703838. https://doi.org/10.3389/fpsyg.2021.703838.

Deng, J., Que, J., Wu, S., Zhang, Y., Liu, J., Chen, S., Wu, Y., Gong, Y., Sun, S., Yuan, K., Bao, Y., Ran, M., Shi, J., Wing, Y.K., Shi, L., Lu, L., 2021. Effects of COVID-19 on career and specialty choices among chinese medical students. Med. Educ. Online 26, 1913785. https://doi.org/10.1080/10872981.2021.1913785.

Deng, Jiawen, Zhou, F., Hou, W., Silver, Z., Wong, C.Y., Chang, O., Drakos, A., Zuo, Q.K., Huang, E., 2021. The prevalence of depressive symptoms, anxiety symptoms and sleep disturbance in higher education students during the COVID-19 pandemic: a systematic review and meta-analysis. Psychiatry Res. 301, 113863 https://doi.org/10.1016/j.psychres.2021.113863.

Dhamija, S., Shailaja, B., Chaudhari, B., Chaudhury, S., Saldanha, D., 2021. Prevalence of smartphone addiction and its relation with sleep disturbance and low self- esteem among medical college students. Ind. Psychiatry J. 30, S189–s194. https://doi.org/10.4103/0972-6748.328813.

Domínguez-González, A.D., Guzmán-Valdivia, G., Ángeles-Téllez, F.S., Manjarrez-Ángeles, M.A., Secín-Diep, R., 2022. Depression and suicidal ideation in Mexican medical students during COVID-19 outbreak. A longitudinal study. Heliyon 8, e08851. https://doi.org/10.1016/j.heliyon.2022.e08851.

Duan, H., Gong, M., Zhang, Q., Huang, X., Wan, B., 2022. Research on sleep status, body mass index, anxiety and depression of college students during the post-pandemic era in Wuhan, China. J. Affect. Disord. 301, 189–192. https://doi.org/10.1016/j.jad.2022.01.015.

Dwivedi, D., Kaur, N., Shukla, S., Gandhi, A., Tripathi, S., 2020. Perception of stress among medical undergraduate during coronavirus disease-19 pandemic on exposure to online teaching. Natl. J. Physiol. Pharm. Pharmacol. 10, 657–662. https://doi.org/10.5455/njppp.2020.10.05107202009052020.

Ecker, A., Berenson, A.B., Gonzalez, S.J., Zoorob, R., Hirth, J.M., 2022. Depression among medical students in the United States during the COVID-19 pandemic: the role of communication between universities and their students. Disast. Med. Public Health Prep. 1–21 https://doi.org/10.1017/dmp.2022.56.

Eid, M.M., Alsufiany, M.B., Alshehri, F.H., Wazna, N.I., Alzahrani, H., Ahmed, R.M., Faizo, N.L., El-Gendy, A.M., Abdelbasset, W.K., Eladl, H.M., 2021. Psychological impact of COVID-19 pandemic on university students: a cross-sectional study. Med. Sci. 25, 964–972.

Eleftheriou, A., Rokou, A., Arvaniti, A., Nena, E., Steiropoulos, P., 2021. Sleep quality and mental health of medical students in Greece during the COVID-19 pandemic. Front. Public Health 9, 775374. https://doi.org/10.3389/fpubh.2021.775374.

Elhadi, M., Buzreg, A., Bouhuwaish, A., Khaled, A., Alhadi, A., Msherghi, A., Alsoufi, A., Alameen, H., Biala, M., Elgherwi, A., Elkhafeefi, F., Elmabrouk, A., Abdulmalik, A., Alhaddad, S., Elgzairi, M., Khaled, A., 2020. Psychological impact of the civil war and COVID-19 on Libyan medical students: a cross-sectional study. Front. Psychol. 11, 570435 https://doi.org/10.3389/fpsyg.2020.570435.

Esmat, S., Attia, A., Elhabashi, E., 2021. Prevalence and predictors for depression among medical students during coronavirus disease-19 pandemic: a cross-sectional study. Open Access Macedonian J. Med. Sci. 9, 1454–1460. https://doi.org/10.3889/oamjms.2021.7390.

Essadek, A., Gressier, F., Robin, M., Shadili, G., Bastien, L., Peronnet, J.C., Falissard, B., Rabeyron, T., 2022. Mental health of medical students during the COVID19: impact of studies years. J. Affect Disord. Rep. 100318 https://doi.org/10.1016/j.jadr.2022.100318.

Essangri, H., Sabir, M., Benkabbou, A., Majbar, M.A., Amrani, L., Ghannam, A., Lekehal, B., Mohsine, R., Souadka, A., 2021. Predictive factors for impaired mental health among medical students during the early stage of the COVID-19 pandemic in Morocco. Am. J. Trop. Med. Hyg. 104, 95–102. https://doi.org/10.4269/AJTMH.20-1302.

Forycka, J., Pawłowicz-Szlarska, E., Burczyńska, A., Cegielska, N., Harendarz, K., Nowicki, M., 2022. Polish medical students facing the pandemic-assessment of resilience, well-being and burnout in the COVID-19 era. PLoS One 17, e0261652. https://doi.org/10.1371/journal.pone.0261652.

Frajerman, A., Morvan, Y., Krebs, M.-O., Gorwood, P., Chaumette, B., 2019. Burnout in medical students before residency: a systematic review and meta-analysis. Eur. Psychiatry 55, 36–42. https://doi.org/10.1016/j.eurpsy.2018.08.006.

Furber, G., Leach, M., Guy, S., Segal, L., 2017. Developing a broad categorisation scheme to describe risk factors for mental illness, for use in prevention policy and planning. Aust. N. Z. J. Psychiatry 51, 230–240. https://doi.org/10.1177/0004867416642844.

Gao, F., Jiao, S.X., Bi, Y.Q., Huang, Z.Y., Wang, P., Zhang, B.Y., Fang, J., Han, R.L., Fan, L., Wang, M.J., Lv, X.L., Li, J., Hu, Y.X., Zhang, M.D., Qiao, Q., Zhao, X., Li, D., Xiao, Z.B., Chang, F.H., Bai, T.Y., 2021. The impact of the SARS-COV-2 pandemic on the mental health and employment decisions of medical students in North China. Front. Psychiatry 12. https://doi.org/10.3389/fpsyt.2021.641138.

Goweda, R.A., Hassan-Hussein, A., Alqahtani, M.A., Janaini, M.M., Alzahrani, A.H., Sindy, B.M., Alharbi, M.M., Kalantan, S.A., 2020. Prevalence of sleep disorders among medical students of umm Al-Qura University, Makkah, Kingdom of Saudi Arabia. J. Public Health Res. 9, 45–49. https://doi.org/10.4081/jphr.2020.1921.

Gruba, G., Kasiak, P.S., Gębarowska, J., Adamczyk, N., Sikora, Z., Jodczyk, A.M., Mamcarz, A., Śliż, D., 2021. Pals study of sleep deprivation and mental health consequences of the covid-19 pandemic among university students: a cross-sectional survey. Int. J. Environ. Res. Public Health 18. https://doi.org/10.3390/ijerph18189581.

Guo, A.A., Crum, M.A., Fowler, L.A., 2021. Assessing the psychological impacts of covid-19 in undergraduate medical students. Int. J. Environ. Res. Public Health 18, 1–14. https://doi.org/10.3390/ijerph18062952.

Gupta, P., BK, A., Ramakrishna, K., 2021. Prevalence of depression and anxiety among medical students and house staff during the covid-19 health-care crisis. Academic Psychiatry. https://doi.org/10.1007/s40596-021-01454-7.

Guse, J., Heinen, I., Mohr, S., Bergelt, C., 2021. Understanding mental burden and factors associated with study worries among undergraduate medical students during the COVID-19 pandemic. Front. Psychol. 12, 734264 https://doi.org/10.3389/fpsyg.2021.734264.

Hakami, Z., Vishwanathaiah, S., Abuzinadah, S.H., Alhaddad, A.J., Bokhari, A.M., Marghalani, H.Y.A., Shahin, S.Y., 2021. Effects of COVID-19 lockdown on the mental health of dental students: a longitudinal study. J. Dent. Educ. 85, 1854–1862. https://doi.org/10.1002/jdd.12758.

Halperin, S.J., Henderson, M.N., Prenner, S., Grauer, J.N., 2021. Prevalence of anxiety and depression among medical students during the Covid-19 pandemic: a cross-sectional study. J. Med. Educ. Curric. Dev. 8 https://doi.org/10.1177/2382120521991150, 2382120521991150.

Hassnain, S., Ahmad, A., Qayyum, M.S., Farrukh, M.G., Nawaz, U.A., Ahmad, H., 2021. Effects of covid-19 lockdown on mental health of medical students in Lahore, Pakistan. Bangladesh J. Med. Sci. 20, 125–130. https://doi.org/10.3329/BJMS.V20I5.55406.

Hope, V., Henderson, M., 2014. Medical student depression, anxiety and distress outside North America: a systematic review. Med. Educ. 48, 963–979. https://doi.org/10.1111/medu.12512.

Huarcaya-Victoria, J., Elera-Fitzcarrald, C., Crisol-Deza, D., Villanueva-Zúñiga, L., Pacherres, A., Torres, A., Huertas, G., Calderón, D., Noriega-Baella, C., Astonitas, E., Salvador-Carrillo, J., 2021. Factors associated with mental health in peruvian medical students during the COVID-19 pandemic: a multicentre quantitative study. Rev. Colomb. Psiquiatr (Engl. Ed.). https://doi.org/10.1016/j.rcp.2021.06.002.

Ismail, N., Tajjudin, A.I., Jaafar, H., Nik Jaafar, N.R., Baharudin, A., Ibrahim, N., 2021. The relationship between internet addiction, internet gaming and anxiety among medical students in a malaysian public university during covid-19 pandemic. Int. J. Environ. Res. Public Health 18. https://doi.org/10.3390/ijerph182211870.

Jahrami, H.A., Alhaj, O.A., Humood, A.M., Alenezi, A.F., Fekih-Romdhane, F., AlRasheed, M.M., Saif, Z.Q., Bragazzi, N.L., Pandi-Perumal, S.R., BaHammam, A.S., Vitiello, M.V., 2022. Sleep disturbances during the COVID-19 pandemic: a systematic review, meta-analysis, and meta-regression. Sleep Med. Rev. 62, 101591 https://doi.org/10.1016/j.smrv.2022.101591.

Jindal, V., Mittal, S., Kaur, T., Bansal, A.S., Kaur, P., Kaur, G., Sati, H.C., Garg, A., 2020. Knowledge, anxiety and the use of hydroxychloroquine prophylaxis among health care students and professionals regarding COVID-19 pandemic. Adv. Respir. Med. 88, 520–530. https://doi.org/10.5603/ARM.a2020.0163.

Khalafallah, A.M., Jimenez, A.E., Lam, S., Gami, A., Dornbos, D.L., Sivakumar, W., Johnson, J.N., Mukherjee, D., 2021. Burnout among medical students interested in neurosurgery during the COVID-19 era. Clin. Neurol. Neurosurg. 210 https://doi.org/10.1016/j.clineuro.2021.106958.

Khurram, R., Razzak, D.A., Ahmad, W., Qamar, A., Mumtaz, T., Sameed, Q.U.A., 2020. Mental distress after 1st wave of COVID-19 among medical students. J. Pharm. Res. Int. 32, 7–12. https://doi.org/10.9734/JPRI/2020/v32i4431075.

Kok, A.A.L., Pan, K.-Y., Ottenheim, N.R., Jörg, F., Eikelenboom, M., Horsfall, M., Luteijn, R., van Oppen, P., Rhebergen, D., Schoevers, R.A., Giltay, E.J., Penninx, B. W.J.H., 2022. Mental health and perceived impact during the first Covid-19 pandemic year: a longitudinal study in dutch case-control cohorts of persons with and without depressive, anxiety, and obsessive-compulsive disorders. J. Affect. Disord. S0165–0327 (22) https://doi.org/10.1016/j.jad.2022.02.056, 00205–1.

Kolcu, G., Başer Kolcu, M., 2021. Psychological effects of COVID-19 in medical students. Psychiatr. Danub. 33, 387–391.

Kostina, L., Ibragimov, I., Kubekova, A., Sergeeva, M., 2021. Depression and attitudes to depression among students of a russian medical university during the pandemic coronavirus. Archiv. Euromedica 11, 16–19. https://doi.org/10.35630/2199-885x/2021/11/6.3.

Kuman Tunçel, Ö., Taşbakan, S.E., Gökengin, D., Erdem, H.A., Yamazhan, T., Sipahi, O. R., Pullukçu, H., Önen Sertöz, Ö., Işıkgöz Taşbakan, M., 2021. The deep impact of the COVID-19 pandemic on medical students: an online cross-sectional study evaluating Turkish students' anxiety. Int. J. Clin. Pract. 75 https://doi.org/10.1111/ijcp.14139.

Kumar, A., Kumar, A., Shrama, D., Sharma, S., Bansal, R., Shukla, A., Ahmad, S., 2020. The psychological impact of the covid-19 lockdown on medical students of a college in North India. Indian J. Public Health Res. Dev. 11, 82–87. https://doi.org/10.37506/ijphrd.v11i10.11118.

Kumar, R., Kumar, H., Kumari, R., Dars, J., Qureshi, S., Hamza, M.A., Khoso, A.B., Mubeen, S.M., 2021. The impact of covid-19 on medical students: a cross sectional survey. Pakistan Journal of Medical and Health Sciences 15, 2905–2908. https://doi.org/10.53350/pjmhs2115112905.

Kunzler, A.M., Röthke, N., Günthner, L., Stoffers-Winterling, J., Tüscher, O., Coenen, M., Rehfuess, E., Schwarzer, G., Binder, H., Schmucker, C., Meerpohl, J.J., Lieb, K., 2021. Mental burden and its risk and protective factors during the early phase of the SARS-CoV-2 pandemic: systematic review and meta-analyses. Global Health 17, 34. https://doi.org/10.1186/s12992-021-00670-y.

Lasheras, I., Gracia-García, P., Lipnicki, D.M., Bueno-Notivol, J., López-Antón, R., de la Cámara, C., Lobo, A., Santabárbara, J., 2020. Prevalence of anxiety in medical students during the COVID-19 pandemic: a rapid systematic review with meta-analysis. Int. J. Environ. Res. Public Health 17, E6603. https://doi.org/10.3390/ijerph17186603.

Lee, C.M., Juarez, M., Rae, G., Jones, L., Rodriguez, R.M., Davis, J.A., Boysen-Osborn, M., Kashima, K.J., Krane, N.K., Kman, N., Langsfeld, J.M., Harries, A.J., 2021. Anxiety, PTSD, and stressors in medical students during the initial peak of the COVID-19 pandemic. PLoS One 16, e0255013. https://doi.org/10.1371/journal.pone.0255013.

Leroy, A., Wathelet, M., Fovet, T., Habran, E., Granon, B., Martignène, N., Amad, A., Notredame, C.E., Vaiva, G., D'Hondt, F., 2021. Mental health among medical, healthcare, and other university students during the first COVID-19 lockdown in France. J. Affect. Disord. Rep. 6, 100260 https://doi.org/10.1016/j.jadr.2021.100260.

Li, Y.-Y., Sun, Y., Meng, S.-Q., Bao, Y.-P., Cheng, J.-L., Chang, X.-W., Ran, M.-S., Sun, Y.-K., Kosten, T., Strang, J., Lu, L., Shi, J., 2021. Internet addiction increases in the general population during COVID-19: evidence from China. Am. J. Addict. 30, 389–397. https://doi.org/10.1111/ajad.13156.

Lim, G.Y., Tam, W.W., Lu, Y., Ho, C.S., Zhang, M.W., Ho, R.C., 2018. Prevalence of depression in the community from 30 countries between 1994 and 2014. Sci. Rep. 8, 1–10. https://doi.org/10.1038/s41598-018-21243-x.

Lingyu, Z., Jiaying, W., Chuying, D., Meimei, Z., Changjin, L., Qi, W., 2021. Mental health and personality implications among medical students during the outbreak of the COVID-19 pandemic. Social Behavior & Personality: an international journal 49, 1–11. https://doi.org/10.2224/sbp.10544.

Liu, B., Qiao, K., Lu, Y., 2021a. The relationship between perceived stress, state-trait anxiety, and sleep quality among university graduates in China during the COVID-19 pandemic. Front. Psychol. 12, 664780 https://doi.org/10.3389/fpsyg.2021.664780.

Lu, L., Wang, X., Wang, X., Guo, X., Pan, B., 2022. Association of Covid-19 pandemic-related stress and depressive symptoms among international medical students. BMC Psychiatry 22. https://doi.org/10.1186/s12888-021-03671-8.

MacDonald, J.J., Baxter-King, R., Vavreck, L., Naeim, A., Wenger, N., Sepucha, K., Stanton, A.L., 2022. Depressive symptoms and anxiety during the COVID-19 pandemic: large, longitudinal, cross-sectional survey. JMIR Ment Health 9, e33585. https://doi.org/10.2196/33585.

Mendes, T.B., de Souza, K.C., Franca, C.N., Rossi, F.E., Guimaraes Santos, R.P., Duailibi, K., Tuleta, I., Stubbs, B., Neves, L.M., Armond, J.de E., 2021. Physical activity and symptoms of anxiety and depression among medical students during a pandemic. Revista Brasileira De Medicina Do Esporte 27, 582–587. https://doi.org/10.1590/1517-8692202127062021_0059.

Meng, N., Liu, Z., Wang, Y., Feng, Y., Liu, Q., Huang, J., Li, X., 2021. Beyond sociodemographic and COVID-19-related factors: the association between the need for psychological and information support from school and anxiety and depression. Med. Sci. Monit. 27 https://doi.org/10.12659/MSM.929280 e929280-1-e929280-11.

Menon, B., Sannapareddy, S., Menon, M., 2021. Assessment of severity of stress among medical and dental students during the COVID-19 pandemic. Ann. Indian Acad. Neurol. 24, 703–707. https://doi.org/10.4103/aian.AIAN_19_21.

Milasauskiene, E., Burkauskas, J., Podlipskyte, A., Király, O., Demetrovics, Z., Ambrasas, L., Steibliene, V., 2021. Compulsive internet use scale: psychometric properties and associations with sleeping patterns, mental health, and well-being in lithuanian medical students during the coronavirus disease 2019 pandemic. Front. Psychol. 12, 685137 https://doi.org/10.3389/fpsyg.2021.685137.

Mishra, J., Panigrahi, A., Samanta, P., Dash, K., Mahapatra, P., Behera, M.R., 2022. Sleep quality and associated factors among undergraduate medical students during Covid-19 confinement. Clin. Epidemiol. Glob. Health 15, 101004. https://doi.org/10.1016/j.cegh.2022.101004.

Mishra, J., Samanta, P., Panigrahi, A., Dash, K., Behera, M.R., Das, R., 2021. Mental health status, coping strategies during covid-19 pandemic among undergraduate students of healthcare profession. Int. J. Ment. Heal. Addict. https://doi.org/10.1007/s11469-021-00611-1.

Mittal, R., Su, L., Jain, R., 2021. COVID-19 mental health consequences on medical students worldwide. J. Commun. Hosp. Intern. Med. Perspect. 11, 296–298. https://doi.org/10.1080/20009666.2021.1918475.

Moayed, M.S., Vahedian-Azimi, A., Mirmomeni, G., Rahimi-Bashar, F., Goharimoghadam, K., Pourhoseingholi, M.A., Abbasi-Farajzadeh, M., Khatibzadeh, A., Sathyapalan, T., Guest, P.C., Sahebkar, A., 2021. Coronavirus (COVID-19)-associated psychological distress among medical students in Iran. Adv. Exp. Med. Biol. 1321, 245–251. https://doi.org/10.1007/978-3-030-59261-5_21.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., PRISMA Group, 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 6, e1000097. https://doi.org/10.1371/journal.pmed.1000097.

Muhammad Alfareed Zafar, S., Junaid Tahir, M., Malik, M., Irfan Malik, M., Kamal Akhtar, F., Ghazala, R., 2020. Awareness, anxiety, and depression in healthcare professionals, medical students, and general population of Pakistan during COVID-

19 pandemic: a cross sectional online survey. Med J Islam Repub Iran 34, 131. https://doi.org/10.34171/mjiri.34.131.
Nakhostin-Ansari, A., Sherafati, A., Aghajani, F., Khonji, M., Aghajani, R., Shahmansouri, N., 2020. Depression and anxiety among iranian medical students during COVID-19 pandemic. Iran. J. Psychiatry 15, 228–235.
Natalia, D., Syakurah, R.A., 2021. Mental health state in medical students during COVID-19 pandemic. J. Educ. Health Promot. 10, 208. https://doi.org/10.4103/jehp.jehp_1296_20.
Ni, J., Wang, F., Liu, Y., Wu, M., Jiang, Y., Zhou, Y., Zhou, Y., Sha, D., 2021. Psychological impact of the COVID-19 pandemic on chinese health care workers: cross-sectional survey study. JMIR Mental Health 8. https://doi.org/10.2196/23125.
Nihmath Nisha, S., Francis, Y.M., Balaji, K., Raghunath, G., Kumaresan, M., 2020. A survey on anxiety and depression level among south indian medical students during the COVID 19 pandemic. Int. J. Res. Pharm. Sci. 11, 779–786. https://doi.org/10.26452/ijrps.v11iSPL1.3082.
Nikas, I.P., Lamnisos, D., Meletiou-Mavrotheris, M., Themistocleous, S.C., Pieridi, C., Mytilinaios, D.G., Michaelides, C., Johnson, E.O., 2022. Shift to emergency remote preclinical medical education amidst the Covid-19 pandemic: a single-institution study. Anat. Sci. Educ. 15, 27–41. https://doi.org/10.1002/ase.2159.
Nishimura, Y., Ochi, K., Tokumasu, K., Obika, M., Hagiya, H., Kataoka, H., Otsuka, F., 2021. Impact of the COVID-19 pandemic on the psychological distress of medical students in Japan: cross-sectional survey study. J. Med. Internet Res. 23, e25232 https://doi.org/10.2196/25232.
Pedraz-Petrozzi, B., Krüger-Malpartida, H., Arevalo-Flores, M., Salmavides-Cuba, F., Anculle-Arauco, V., Dancuart-Mendoza, M., 2021. Emotional impact on health personnel, medical students, and general population samples during the COVID-19 pandemic in Lima, Peru. Rev. Colomb. Psiquiatria 50, 189–198. https://doi.org/10.1016/j.rcp.2021.04.006.
Pelaccia, T., Sibilia, J., Fels, É., Gauer, L., Musanda, A., Severac, F., Abbiati, M., 2021. And if we had to do it all over again, would we send medical students to the emergency departments during a pandemic? Lessons learned from the COVID-19 outbreak. Intern. Emerg. Med. 16, 1967–1974. https://doi.org/10.1007/s11739-020-02629-0.
Pelissier, C., Viale, M., Berthelot, P., Poizat, B., Massoubre, C., Tiffet, T., Fontana, L., 2021. Factors associated with psychological distress in french medical students during the covid-19 health crisis: a cross-sectional study. Int. J. Environ. Res. Public Health 18. https://doi.org/10.3390/ijerph182412951.
Peng, P., Yang, W.F., Liu, Y., Chen, S., Wang, Y., Yang, Q., Wang, X., Li, M., Wang, Y., Hao, Y., He, L., Wang, Q., Zhang, J., Ma, Y., He, H., Zhou, Y., Long, J., Qi, C., Tang, Y.Y., Liao, Y., Tang, J., Wu, Q., Liu, T., 2022. High prevalence and risk factors of dropout intention among chinese medical postgraduates. Med. Educ. Online 27, 2058866. https://doi.org/10.1080/10872981.2022.2058866.
Periasamy, P., Suganthi, V., Sukala, P.M., Janani, S., Krishnakumar, V., Kannan, V.R., Gunasekaran, S., 2021. Burnout amongmedical students and correlation with academic performance, sleep quality during covid19 pandemic online class in erode district. Pharmacologyonline 2, 962–971.
Perissotto, T., Silva, T.C.R.P.D., Miskulin, F.P.C., Pereira, M.B., Neves, B.A., Almeida, B. C., Casagrande, A.V., Ribeiz, S.R.I., Nunes, P.V., 2021. Mental health in medical students during COVID-19 quarantine: a comprehensive analysis across year-classes. Clinics (Sao Paulo, Brazil) 76, e3007. https://doi.org/10.6061/clinics/2021/e3007.
Potapova, E.A., Zemlyanoy, D.A., Kondratyev, G.V., 2021. Features of life and well-being in medical students during distance learning in the course of the COVID-19 epidemic. Psikhologicheskaya Nauka I Obrazovanie 26, 70–81. https://doi.org/10.17759/pse.2021260304.
Prati, G., Mancini, A.D., 2021. The psychological impact of COVID-19 pandemic lockdowns: a review and meta-analysis of longitudinal studies and natural experiments. Psychol. Med. 51, 201–211. https://doi.org/10.1017/S0033291721000015.
Puranachaikere, T., Hataiyusuk, S., Anupansupsai, R., In-Iw, S., Saisavoey, N., Techapanuwat, T., Arunrodpanya, F., Charonpongsuntorn, C., Wiwattanaworaset, P., Siripongpan, A., Pruttithavorn, W., Wonglertwisawakorn, C., Pojanapotha, P., Rueangrong, B., Pattrakornkul, N., Piyawattanametha, N., Piyawattanametha, S., Ratanapichayachai, D., 2021. Stress and associated factors with received and needed support in medical students during COVID-19 pandemic: a multicenter study. Korean J. Med. Educ. 33, 203–213. https://doi.org/10.3946/kjme.2021.200.
Quek, T.T.-C., Tam, W.W.-S., Tran, B.X., Zhang, M., Zhang, Z., Ho, C.S.-H., Ho, R.C.-M., 2019. The global prevalence of anxiety among medical students: a meta-analysis. Int. J. Environ. Res. Public Health 16, E2735. https://doi.org/10.3390/ijerph16152735.
Rao, W.-W., Li, W., Qi, H., Hong, L., Chen, C., Li, C.-Y., Ng, C.H., Ungvari, G.S., Xiang, Y.-T., 2020. Sleep quality in medical students: a comprehensive meta-analysis of observational studies. Sleep Breath. 24, 1151–1165. https://doi.org/10.1007/s11325-020-02020-5.
Risal, A., Shikhrakar, S., Mishra, S., Kunwar, D., Karki, E., Shrestha, B., Khadka, S., Holen, A., 2020. Anxiety and depression during COVID-19 pandemic among medical students in Nepal. Kathmandu Univ. Med. J. 18, 333–339.
Roka, K., Khadka, S., Dahal, S., Yadav, M., Thapa, P., Rubina, K.C., 2020. Excessive daytime sleepiness among first to fourth year undergraduate students of a medical (allege in Nepal: a descriptive cross-sectional study. J. Nepal Med. Assoc. 58, 640–644. https://doi.org/10.31729/jnma.5297.
Rolland, F., Frajerman, A., Falissard, B., Bertschy, G., Diquet, B., Marra, D., 2022a. Impact of the first wave of the COVID-19 pandemic on french health students. Encéphale. https://doi.org/10.1016/j.encep.2021.12.004.
Rolland, F., Hadouiri, N., Haas-Jordache, A., Gouy, E., Mathieu, L., Goulard, A., Morvan, Y., Frajerman, A., 2022b. Mental health and working conditions among french medical students: a nationwide study. J. Affect. Disord. 306, 124–130. https://doi.org/10.1016/j.jad.2022.03.001.
Romic, I., Silovski, H., Mance, M., Pavlek, G., Petrovic, I., Figl, J., Grbavac, D., Moric, T., Romic, R., Bakula, B., Vulic, A., 2021. Psychological effects of "Double crisis" (COVID-19 pandemic and Earthquakes) on croatian medical students. Psychiatr. Danub. 33, 120–125.
Rotenstein, L.S., Ramos, M.A., Torre, M., Segal, J.B., Peluso, M.J., Guille, C., Sen, S., Mata, D.A., 2016. Prevalence of depression, depressive symptoms, and suicidal ideation among medical students: a systematic review and meta-analysis. JAMA 316, 2214–2236. https://doi.org/10.1001/jama.2016.17324.
Saali, A., Stanislawski, E.R., Kumar, V., Chan, C., Hurtado, A., Pietrzak, R.H., Charney, D. S., Ripp, J., Katz, C.L., 2021. The psychiatric burden on medical students in New York city entering clinical clerkships during the covid-19 pandemic. Psychiatry Q. https://doi.org/10.1007/s11126-021-09955-2.
Saeed, N., Javed, N., 2021. Lessons from the covid-19 pandemic: perspectives of medical students. Pakistan J. Med. Sci. 37, 1402–1407. https://doi.org/10.12669/pjms.37.5.4177.
Safa, F., Anjum, A., Hossain, S., Trisa, T.I., Alam, S.F., Rafi, M.A., Podder, V., Koly, K.N., Azad, D.T., Ahmad, W.U., Nodi, R.N., Ashraf, F., Akhter, S.M.Q., Ahmed, H.U., Hasan, M.T., 2021. Immediate psychological responses during the initial period of the COVID-19 pandemic among bangladeshi medical students. Child Youth Serv. Rev. 122 https://doi.org/10.1016/j.childyouth.2020.105912.
Safarini, O.A., Taya, H., Abu Elhija, Y., Qadous, M., Farhoud, A., Thabaleh, A., Khayyat, A., Nazzal, Z., Abuhassan, A.M., Ghanim, N., Mahamid, F., Al Ali, R., Damiri, B., 2021. Assessment of the relationship of depression with tobacco and caffeine use among university students: a cross-sectional study. Cureus 13, e19098. https://doi.org/10.7759/cureus.19098.
Saguem, B.N., Nakhli, J., Romdhane, I., Nasr, S.B., 2021. Predictors of sleep quality in medical students during COVID-19 confinement. Encéphale. https://doi.org/10.1016/j.encep.2021.03.001.
Sandoval, K.D., Morote-Jayacc, P.V., Moreno-Molina, M., Taype-Rondan, A., 2021. Depression, stress and anxiety in students of human medicine in Ayacucho (Peru) in the context of the COVID-19 pandemic. Rev. Colomb. Psiquiatr. https://doi.org/10.1016/j.rcp.2021.10.005.
Saraswathi, I., Saikarthik, J., Senthil Kumar, K., Madhan Srinivasan, K., Ardhanaari, M., Gunapriya, R., 2020. Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study. PeerJ 8, e10164. https://doi.org/10.7717/peerj.10164.
Saravia-Bartra, M.M., Cazorla-Saravia, P., Cedillo-Ramirez, L., 2020. Anxiety level of first-year medicine students at a private university in Peru in times of covid-19. Rev Facult. Med. Hum. 20, 568–573. https://doi.org/10.25176/RFMH.V20I4.3198.
Seetan, K., Al-Zubi, M., Rubbai, Y., Athamneh, M., Khamees, A., Radaideh, T., 2021. Impact of COVID-19 on medical students' mental wellbeing in Jordan. PLoS One 16. https://doi.org/10.1371/journal.pone.0253295.
Shafique, Z., Syed, F., Naz, S., Urooj, S., Khan, S., Javed, S., 2021. Assessment of factors affecting the sleep hygiene of medical students in Bahawalpur, Pakistan: a cross-sectional study. Sleep Sci 14, 273–279. https://doi.org/10.5935/1984-0063.20200063.
Sheldon, E., Simmonds-Buckley, M., Bone, C., Mascarenhas, T., Chan, N., Wincott, M., Gleeson, H., Sow, K., Hind, D., Barkham, M., 2021. Prevalence and risk factors for mental health problems in university undergraduate students: a systematic review with meta-analysis. J. Affect. Disord. 287, 282–292. https://doi.org/10.1016/j.jad.2021.03.054.
Shrestha, D., Adhikari, S.P., Rawal, N., Budhathoki, P., Pokharel, S., Adhikari, Y., Rokaya, P., Raut, U., 2021. Sleep quality among undergraduate students of a medical college in Nepal during COVID-19 pandemic: an online survey. F1000Research 10, 505. https://doi.org/10.12688/f1000research.53904.2.
Simic, S., Obrdalj, E.C., Bevanda, M., Bevanda, D., Rizikalo, A., Marijanovic, I., 2021. Impact of COVID-19 pandemic on mental health of medical students at the university of Mostar. Psychiatr. Danub. 33, 114–119. https://doi.org/10.24869/psyd.2021.114.
Solomou, I., Constantinidou, F., 2020. Prevalence and predictors of anxiety and depression symptoms during the COVID-19 pandemic and compliance with precautionary measures: age and sex matter. Int. J. Environ. Res. Public Health 17, 4924. https://doi.org/10.3390/ijerph17144924.
Soltan, M.R., Soliman, S.S., Dawoud, M.E., 2021. A study of anxiety, depression and stress symptoms among Fayoum medical students during COVID-19 lockdown, Egypt. Egyptian Journal of Neurology, Psychiatry and Neurosurgery 57. https://doi.org/10.1186/s41983-021-00377-2.
Song, H.-T., Ge, C.-H., Chang, L.-X., Zhao, T.-T., Wu, W., Ge, D.-X., Zhai, C.-P., Zhang, X.-L., 2021. Investigation on the psychological status of college students during the coronavirus disease-2019 epidemic. J. Gen. Psychol. https://doi.org/10.1080/00221309.2021.1893637.
Souza, K.C.D., Mendes, T.B., Gomes, T.H.S., Silva, A.A.D., Nali, L.H.D.S., Bachi, A.L.L., Rossi, F.E., Gil, S., França, C.N., Neves, L.M., 2021. Medical students show lower physical activity levels and higher anxiety than physical education students: a cross-sectional study during the COVID-19 pandemic. Front. Psychiatry 12. https://doi.org/10.3389/fpsyt.2021.804967.
Tahir, M.J., Malik, N.I., Ullah, I., Khan, H.R., Perveen, S., Ramalho, R., Siddiqi, A.R., Waheed, S., Shalaby, M.M.M., De Berardis, D., Jain, S., Vetrivendan, G.L., Chatterjee, H., Gopar Franco, W.X., Shafiq, M.A., Fatima, N.T., Abeysekera, M., Sayyeda, Q., Shamat, S.F., Aiman, W., Akhtar, Q., Devi, A., Aftab, A., Shoib, S., Lin, C.Y., Pakpour, A.H., 2021. Internet addiction and sleep quality among medical students during the COVID-19 pandemic: a multinational cross-sectional survey. PLoS One 16, e0259594. https://doi.org/10.1371/journal.pone.0259594.

Teixeira, L.de A.C., Costa, R.A., Mattos, R.M.P.R.de, Pimentel, D., 2021. Saúde mental dos estudantes de Medicina do Brasil durante a pandemia da coronavirus disease 2019. Jornal Brasileiro de Psiquiatria 70, 21–29. https://doi.org/10.1590/0047-2085000000315.

Telgote, S.A., Ghogare, A.S., Khadse, V., Karwande, S.G., 2021. Smartphone addiction and its impact on insomnia among the undergraduate medical students of a teaching Hospital of Maharashtra, India-a cross-sectional study. J. Clin. Diagn. Res. 15, VC01–VC05. https://doi.org/10.7860/JCDR/2021/52819.15753.

Tison, G.H., Avram, R., Kuhar, P., Abreau, S., Marcus, G.M., Pletcher, M.J., Olgin, J.E., 2020. Worldwide effect of COVID-19 on physical activity: a descriptive study. Ann. Intern. Med. 173, 767–770. https://doi.org/10.7326/M20-2665.

Toubasi, A.A., Khraisat, B.R., AbuAnzeh, R.B., Kalbouneh, H.M., 2021. A cross sectional study: the association between sleeping quality and stress among second and third medical students at the University of Jordan. Int. J. Psychiatry Med. 912174211011287 https://doi.org/10.1177/00912174211011287.

Vala, N.H., Vachhani, M.V., Sorani, A.M., 2020. Study of anxiety, stress, and depression level among medical students during covid-19 pandemic phase in Jamnagar city. Natl. J. Physiol. Pharm. Pharmacol. 10, 1043–1045. https://doi.org/10.5455/njppp.2020.10.07205202031072020.

Vythilingam, D.I., Atiomo, W.U., 2021. A Systematic Scoping Review on the Impact of the COVID-19 Quarantine on the Psychological Wellbeing of Medical Students. medRxiv. https://doi.org/10.1101/2021.11.28.21266956.

Wang, J., Liu, W., Zhang, Y., Xie, S., Yang, B., 2021. Perceived stress among chinese medical students engaging in online learning in light of COVID-19. Psychol. Res. Behav. Manag. 14, 549–562. https://doi.org/10.2147/prbm.S308497.

Wang, Y., Li, Y., Jiang, J., Feng, Y., Lu, D., Zhang, W., Song, H., 2020. COVID-19 outbreak-related psychological distress among healthcare trainees: a cross-sectional study in China. BMJ Open 10. https://doi.org/10.1136/bmjopen-2020-041671.

Wathelet, M., Duhem, S., Vaiva, G., Baubet, T., Habran, E., Veerapa, E., Debien, C., Molenda, S., Horn, M., Grandgenèvre, P., Notredame, C.-E., D'Hondt, F., 2020. Factors associated with mental health disorders among university students in France confined during the COVID-19 pandemic. JAMA Netw. Open 3, e2025591. https://doi.org/10.1001/jamanetworkopen.2020.25591.

Wu, S., Li, Z., Li, Z., Xiang, W., Yuan, Y., Liu, Y., Xiong, Z., 2020. The mental state and risk factors of chinese medical staff and medical students in early stages of the COVID-19 epidemic. Compr. Psychiatry 102. https://doi.org/10.1016/j.comppsych.2020.152202.

Wu, S., Zhang, K., Parks-Stamm, E.J., Hu, Z., Ji, Y., Cui, X., 2021. Increases in anxiety and depression during COVID-19: a large longitudinal study from China. Front. Psychol. 12, 706601 https://doi.org/10.3389/fpsyg.2021.706601.

Wu, T., Jia, X., Shi, H., Niu, J., Yin, X., Xie, J., Wang, X., 2021. Prevalence of mental health problems during the COVID-19 pandemic: a systematic review and meta-analysis. J. Affect. Disord. 281, 91–98. https://doi.org/10.1016/j.jad.2020.11.117.

Xiao, H., Shu, W., Li, M., Li, Z., Tao, F., Wu, X., Yu, Y., Meng, H., Vermund, S.H., Hu, Y., 2020. Social distancing among medical students during the 2019 coronavirus disease pandemic in China: disease awareness, anxiety disorder, depression, and behavioral activities. Int. J. Environ. Res. Public Health 17, 1–13. https://doi.org/10.3390/ijerph17145047.

Xiao, P., Chen, L., Dong, X., Zhao, Z., Yu, J., Wang, D., Li, W., 2021. Anxiety, depression, and satisfaction with life among college students in China: nine months after initiation of the outbreak of COVID-19. Front Psychiatry 12, 777190. https://doi.org/10.3389/fpsyt.2021.777190.

Xie, J., Li, X., Luo, H., He, L., Bai, Y., Zheng, F., Zhang, L., Ma, J., Niu, Z., Qin, Y., Wang, L., Ma, W., Yu, H., Zhang, R., Guo, Y., 2020. Depressive symptoms, sleep quality and diet during the 2019 novel coronavirus epidemic in China: a survey of medical students. Front. Public Health 8, 588578. https://doi.org/10.3389/fpubh.2020.588578.

Xie, X., Zhu, K., Xue, Q., Zhou, Y., Liu, Q., Wu, H., Wan, Z., Zhang, J., Meng, H., Zhu, B., Song, R., 2021. Problematic internet use was associated with psychological problems among university students during COVID-19 outbreak in China. Front. Public Health 9. https://doi.org/10.3389/fpubh.2021.675380.

Xiong, P., Ming, W.K., Zhang, C., Bai, J., Luo, C., Cao, W., Zhang, F., Tao, Q., 2021. Factors influencing mental health among chinese medical and non-medical students in the early stage of the COVID-19 pandemic. Front. Public Health 9, 603331. https://doi.org/10.3389/fpubh.2021.603331.

Yang, K.H., Wang, L., Liu, H., Li, L.X., Jiang, X.L., 2021. Impact of coronavirus disease 2019 on the mental health of university students in Sichuan Province, China: an online cross-sectional study. Int. J. Ment. Health Nurs. 30, 875–884. https://doi.org/10.1111/inm.12828.

Yang, Q., Liu, Y., Yang, W.F., Peng, P., Chen, S., Wang, Y., Wang, X., Li, M., Wang, Y., Hao, Y., He, L., Wang, Q., Zhang, J., Ma, Y., He, H., Zhou, Y., Long, J., Qi, C., Tang, Y.Y., Liao, Y., Tang, J., Wu, Q., Liu, T., 2022. Mental health conditions and academic burnout among medical and non-medical undergraduates during the mitigation of COVID-19 pandemic in China. Environ. Sci. Pollut. Res. Int. https://doi.org/10.1007/s11356-022-19932-2.

Yang, X., Gao, L., Zhang, S., Zhang, L., Zhang, L., Zhou, S., Qi, M., Chen, J., 2022. The professional identity and career attitude of chinese medical students during the COVID-19 pandemic: a cross-sectional survey in China. Front. Psychiatry 13, 774467. https://doi.org/10.3389/fpsyt.2022.774467.

Ye, W., Ye, X., Liu, Y., Liu, Q., Vafaei, S., Gao, Y., Yu, H., Zhong, Y., Zhan, C., 2020. Effect of the novel coronavirus pneumonia pandemic on medical students' psychological stress and its influencing factors. Front. Psychol. 11, 548506 https://doi.org/10.3389/fpsyg.2020.548506.

Yuan, K., Zheng, Y.-B., Wang, Y.-J., Sun, Y.-K., Gong, Y.-M., Huang, Y.-T., Chen, X., Liu, X.-X., Zhong, Y., Su, S.-Z., Gao, N., Lu, Y.-L., Wang, Z., Liu, W.-J., Que, J.-Y., Yang, Y.-B., Zhang, A.-Y., Jing, M.-N., Yuan, C.-W., Zeng, N., Vitiello, M.V., Patel, V., Fazel, S., Minas, H., Thornicroft, G., Fan, T.-T., Lin, X., Yan, W., Shi, L., Shi, J., Kosten, T., Bao, Y.-P., Lu, L., 2022. A systematic review and meta-analysis on prevalence of and risk factors associated with depression, anxiety and insomnia in infectious diseases, including COVID-19: a call to action. Mol. Psychiatry. https://doi.org/10.1038/s41380-022-01638-z.

Yuan, L.L., Lu, L., Wang, X.H., Guo, X.X., Ren, H., Gao, Y.Q., Pan, B.C., 2021. Prevalence and predictors of anxiety and depressive symptoms among international medical students in China during COVID-19 pandemic. Front. Psychiatry 12. https://doi.org/10.3389/fpsyt.2021.761964.

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 https://doi.org/10.1016/j.ijnurstu.2021.104136.

Zhan, J., Sun, S., Xie, L., Wen, Y., Fu, J., 2020. Medical students' mental health, professional pride, and intention to work in the front-line during coronavirus disease 2019 pandemic. Zhong nan da xue xue bao. Yi xue ban = journal of Central South University. Med. Sci. 45, 649–656. https://doi.org/10.11817/j.issn.1672-7347.2020.200440.

Zhang, C., Zeng, P., Tan, J., Sun, S., Zhao, M., Cui, J., Zhang, G., Jia, J., Liu, D., 2021. Relationship of problematic smartphone use, sleep quality, and daytime fatigue among quarantined medical students during the COVID-19 pandemic. Front. Psychiatry 12. https://doi.org/10.3389/fpsyt.2021.755059.

Zhang, K., Lin, Z., Peng, Y., Li, L., 2021b. A longitudinal study on psychological burden of medical students during COVID-19 outbreak and remission period in China. Eur. J. Psychiatry 35, 234–241. https://doi.org/10.1016/j.ejpsy.2021.06.003.

Zhang, M., Zhou, Z., Tao, X., Huang, L., Zhu, E., Yu, L., Liu, H., 2022. Prevalence of subhealth status and its effects on mental health and smartphone addiction: a cross-sectional study among chinese medical students. Rev. Assoc. Med. Bras. 1992 (68), 222–226. https://doi.org/10.1590/1806-9282.20210977.

Zhang, X., Shi, X., Wang, Y., Jing, H., Zhai, Q., Li, K., Zhao, D., Zhong, S., Song, Y., Zhang, F., Bao, Y., 2021c. Risk factors of psychological responses of chinese university students during the COVID-19 outbreak: cross-sectional web-based survey study. J. Med. Internet Res. 23, e29312 https://doi.org/10.2196/29312.

Zhao, F.F., Yang, L., Ma, J.P., Qin, Z.J., 2022. Path analysis of the association between self-compassion and depressive symptoms among nursing and medical students: a cross-sectional survey. BMC Nurs. 21, 67. https://doi.org/10.1186/s12912-022-00835-z.

Zhao, L., Sznajder, K., Cheng, D., Wang, S., Cui, C., Yang, X., 2021. Coping styles for mediating the effect of resilience on depression among medical students in web-based classes during the covid-19 pandemic: cross-sectional questionnaire study. J. Med. Internet Res. 23 https://doi.org/10.2196/25259.

Zheng, X., Guo, Y., Yang, H., Luo, L., Ya, B., Xu, H., Xue, Z., Li, Q., Shi, J., Bi, J., Ma, W., Wang, P., 2021a. A cross-sectional study on mental health problems of medical and nonmedical students in Shandong during the COVID-19 epidemic recovery period. Front. Psychiatry 12. https://doi.org/10.3389/fpsyt.2021.680202.

Zhong, Y., Schroeder, E., Gao, Y., Guo, X., Gu, Y., 2021. Social support, health literacy and depressive symptoms among medical students: an analysis of mediating effects. Int. J. Environ. Res. Public Health 18, 1–12. https://doi.org/10.3390/ijerph18020633.

Zhu, J., Racine, N., Xie, E.B., Park, J., Watt, J., Eirich, R., Dobson, K., Madigan, S., 2021. Post-secondary student mental health during COVID-19: a meta-analysis. Front Psychiatry 12, 777251. https://doi.org/10.3389/fpsyt.2021.777251.

Zis, P., Artemiadis, A., Bargiotas, P., Nteveros, A., Hadjigeorgiou, G.M., 2021. Medical studies during the COVID-19 pandemic: the impact of digital learning on medical students' burnout and mental health. Int. J. Environ. Res. Public Health 18, 1–9. https://doi.org/10.3390/ijerph18010349.

Ren, H.J., Tian, W.P., Wang, Y.L., Wang, H., Wei, C.H., Zhao, W.X., 2021. A survey on the depression status of clinical medicine postgraduates in a university in Inner Mongolia (In Chinese). J. Baotou Med. Coll. 37, 112–114. https://doi.org/10.16833/j.cnki.jbmc.2021.06.036.

Feng, G., Wu, X.H., Chen, M., Wang, K., Yan, Q.Q., 2021. A study on the association between depression and anxiety states of medical students based on generalized summation model (In Chinese). China Pharm. Herald 18, 59–62.

Liu, W., Li, F.Q., Zhou, T., Li, Q., Liu, L.Q., Wu, C., Liu, Y.L., 2020. A survey of medical students' daily behavior during holidays (In Chinese). Chin. Geriatr. Orthop. Rehabil. Electron. J. 6, 217–222.

Liu, P.J., Wang, S., Ding, Y., Qin, N., Li, R.Z., Xu, X.Y., 2021b. A survey of medical students' perceptions and levels of psychological behavior and anxiety regarding the COVID-19 pandemic. J. Qingdao Univ. (Med. Ed.) 57, 286–289.

Xia, X.F., Pan, W.X., Li, X.L., Luo, Q., Deng, C.Q., Xiang, H.R., 2022. In: The Moderating Role of Psychological Defense Mechanisms Between Solitary Behavior and Depression in Medical Students (In Chinese), 38, pp. 684–689. https://doi.org/10.13329/j.cnki.zyyjk.2022.0112.

Zhang, T.J., Meng, Y.B., Deng, D.Y., Huang, H.T., Tang, L., You, S.N., Jiang, Y., Duan, Y., 2020. Survey on the mental health of medical students in the face of public health emergencies (In Chinese). J. Xiangnan Coll. (Med. Ed.) 22, 51–55. https://doi.org/10.16500/j.cnki.1673-498x.2020.04.015.

Zhang, X.L., Jia, W., Duan, L.M., 2020. A survey and analysis of 1486 medical students' psychological status during the COVID-19 pandemic (In Chinese). J. Inner Mongolia Med. Univ. 42, 128–130. https://doi.org/10.16343/j.cnki.issn.2095-512x.20200305.001.

Zhang, S.Y., Gao, L., Yang, X.J., Zhang, L.G., Qi, M., Chen, J.X., 2020. Association of COVID-19 exposure with depression and anxiety and social support among medical students (In Chinese). School Health China 41, 657–660. https://doi.org/10.16835/j.cnki.1000-9817.2020.05.006.

Zhang, Y.L., Wang, C., Zou, G.S., Lv, J.C., 2021. The relationship between sense of meaning in life and suicidal ideation among medical students (In Chinese). J. Shandong Univ. (Med. Ed.) 59, 93-99+107.

Xu, J.C., Chen, L., Fan, R., 2021. The mediating role of psychological resilience in the relationship between stress and anxiety symptoms among medical students in the post-epidemic period (In Chinese). J. Environ. Occup. Med. 38, 853–859. https://doi.org/10.13213/j.cnki.jeom.2021.20612.

Wang, C., Zhang, Y.L., Zou, G.S., Lv, J.C., 2022. Survey of 686 medical students with or without suicidal ideation and analysis of influencing factors (In Chinese). J. Shandong Univ. (Med. Ed.) 60, 78–85.

Tian, C., Su, J., Wang, A.H., 2021. Current state of knowledge and beliefs about novel coronavirus pneumonia among general medical students in Chongqing based on job competency (In Chinese). Guangxi Med. 43, 1491–1496.

Miu, X.S., Y, S., 2021. Investigation and analysis of sleep disorders during the COVID-19 pandemic among medical students (In Chinese). Journal of Kunming Medical University 42, 166–169.

Jiang, P., Yu, W.Z., Guan, L.Y., Zhuang, N.N., Cao, J.Q., Hou, W.L., Hou, Y.Y., Zhu, Z.H., Yin, X.L., Jia, Q.F., Hui, L., 2020. A survey on the psychological condition of Chinese medical students during winter vacation (In Chinese). Modern Chin. Doctors 58, 141–146.

Xing, B.Y., Ge, W.J., Lu, Y.G., Shu, W., Miu, Q.F., 2020. Medical students' perception, psychological and behavioral survey on the COVID-19 pandemic (In Chinese). Health Res. 40, 369–372.

Zheng, Y.W., Xu, J.B., Yang, T.T., Gao, W.N., Wang, Y.J., Jiang, Q., 2021. The relationship between perceived stress status, coping style and perceived social support among medical students during the COVID-19 pandemic: an example from Fujian Province (In Chinese). Strait Science 71–73. +77.

Zheng, Q.Y., Wei, M., Jiang, Q., Ye, X., Lin, X.H., 2021. Effects of the COVID-19 pandemic on medical Students' psychological status and attitudes toward medical practice. J. Fujian Med. Univ. (Soc. Sci. Ed.) 22, 29-33+39.

Jin, Y.L., Chang, W.W., Chang, X., Zhu, L.J., Fang, Z.M., Chen, Y., Yao, Y.S., 2021. Analysis of mental health and factors affecting college students during online study of the COVID-19 pandemic (In Chinese). School Health China 42, 574–578. https://doi.org/10.16835/j.cnki.1000-9817.2021.04.022.

Chen, G., Xu, J.D., Lu, J., 2020. Anxiety and its associated factors when medical students' return to school during the COVID-19 pandemic (In Chinese). School Health China 41, 1851–1855. https://doi.org/10.16835/j.cnki.1000-9817.2020.12.022.

Lei, Q.L., Liao, M.L., Jia, J., Wang, L.L., Jiang, Q., 2021. A study on the relationship between physical exercise, emotion regulation and suicidal ideation among medical students (In Chinese). Fujian Sports Technol. 40, 14–19.

Ma, S.Y., Chen, Y., Wang, F.F., Wang, H.H., Jin, Y.L., Yao, Y.S., 2021. Medical students' anxiety and its influencing factors during the COVID-19 pandemic (In Chinese). School Health China 42, 1351–1355. https://doi.org/10.16835/j.cnki.1000-9817.2021.09.018.

Gao, L., Yang, X.J., Zhang, S.Y., Zhang, L.G., Chen, K., Qi, M., Chen, J.X., 2020. Depressive and anxiety symptoms and associated factors among medical students during the COVID-19 pandemic (In Chinese). Chin. J. Mental Health 34, 878–882.