



Mental health of students of biomedical sciences during the COVID-19 pandemic: a scoping review

Pathiyil Ravi Shankar¹, Min Hui Chan², Pei Se Wong³,
Sunil Pazhayannur Venkateswaran⁴

1) IMU Centre for Education, International Medical University, Malaysia

2) Foundation in Science, International Medical University, Malaysia

3) Teaching and Learning Department, International Medical University, Malaysia

4) School of Medicine, International Medical University, Malaysia

Abstract

Introduction. The coronavirus pandemic led to the closure of schools and colleges in March 2020. Medical and other schools shifted to online teaching-learning and assessment. Several factors have led to mental health problems among biomedical students.

Objectives. This scoping review seeks to identify stressors, delineate subgroups of students who may be at greater risk of mental health problems, and examine possible recommendations by the respondents and the authors to reduce stress levels and support students.

Methods. Eligibility criteria: studies published in English about the impact of the coronavirus pandemic on the mental health of health science students till 15th January 2021 were included. Sources of evidence: research articles and other publications obtained using the databases PubMed, Scopus, and Google Scholar. Charting methods: the criteria studied were the type of paper and study, the country, the institution, the mental health parameters studied, types and numbers of students/respondents involved, the main message, strengths and weaknesses and the main recommendation of the study.

Results. Thirty articles were included. Stressors were divided into health, workplace, academic, general, and financial apprehensions. Respondents at greater risk were females, below 20 years of age, and those with family/friends infected. Among the authors' recommendations to reduce stress were implementing effective plans to safeguard students' health, especially of those who were parents or interns, engaging in physical activities, workshops for faculty members in online teaching-learning, financial support, online counselling, reducing misinformation, further studies at later stages of the pandemic, and including topics related to the pandemic and pandemic preparedness in the curriculum.

Conclusions. Different types of apprehensions were responsible for stress and mental distress. Females, younger students, students with family and friends who were infected were at greater risk of problems. Recommendations were provided by the authors. Studies from countries which were not represented, and longitudinal studies may be required.

Keywords: anxiety, COVID-19, depression, health science students, mental health, stress

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Address for correspondence:
ravi.dr.shankar@gmail.com

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Introduction

The coronavirus disease-19 (COVID-19) pandemic has caused widespread suffering. As of 7th June 2021, over 174 million people have been infected and over 3.74 million have died [1]. The economic cost in terms of job losses, cessation of travel and tourism and closure of schools and colleges has been immense. Closure of institutions greatly affected their educational mission and disturbed the education of students [2]. In most countries, educational institutions closed with the first wave of the pandemic in March 2020 and teaching-learning and even assessment shifted online. There have been reports from many countries on this online shift in students teaching-learning [3-5].

Face-to-face interactions with other students and faculty members have been severely curtailed. Students study from home and face several challenges including lack of a quiet place to study, problems with internet bandwidth, lack of access to computers and other devices among others [6]. Multiple factors have been associated with psychological distress among students. In a Chinese study, post-traumatic stress disorder (PTSD) was seen among 6% of students [7]. PTSD was associated with family problems (infection suspicion of family members, the loss of loved ones, and family income decrease) and online course difficulties (little interaction, disturbing learning environment, and difficulty in adaptation). In Bangladesh it was noted that a substantial proportion of medical students were experiencing pandemic-related adverse psychological impact. Poor mental health conditions of these vulnerable medical students can seriously affect their potential contribution to future health care [8]. A study among health sciences students from both developing and developed countries found significant levels of anxiety and depression and the authors concluded that serious attention should be given to the mental health of this population [9].

The pandemic started in early 2020 in China and Chinese researchers have conducted several studies on the mental health of different categories of the population, including health science students. Different factors influencing mental health have also been studied. Some studies at two or more time points have also been conducted and a few studies followed respondents longitudinally for different periods of time. Studies have been done in many other countries and a few studies among postgraduate students/residents have been reported in the literature. In this scoping review the authors present an overview of studies conducted among health science students on their mental health during the ongoing pandemic.

The review seeks to answer three important questions. The first is to identify the stressors mentioned in published studies during the pandemic till January 15th, 2021. The second objective is to see which subgroups of students may be at greater risk of mental health problems. Recommendations by the authors of the manuscripts included in the review to reduce stress levels and support health science students will also be mentioned (third objective).

Methods

Article selection and data extraction

Only studies published in the English language were included. Preprints were excluded. The databases included were PubMed, Scopus, and Google Scholar. Articles published during the year 2020 dealing with the topic mentioned and during the year 2021 till 15th January 2021 were included. The most recent search was conducted on 16th January 2021. In many studies it was not clear if health science students were included. The authors contacted the authors of the published manuscript and if they were able to provide definite information about the inclusion of health science students; those studies were included. We followed the steps and guidelines as mentioned in the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist [10].

Search strategy

The databases were searched using the search terms, 'COVID-19', 'Mental health', 'Health Science students'. Other terms used were 'medical students', 'nursing students', 'residents', and 'pharmacy students'. The abstracts of the articles were read through in detail by the first two authors to check whether they were answering the study questions. Based on a consensus among the authors if the response was yes, then the full text was carefully read through. If it was not clear if health science students were involved, then the authors of the paper were contacted.

Inclusion and exclusion criteria

The data forms were discussed and approved by all the authors before the start of the study. Among the parameters considered for inclusion in the tables were the type of paper, the type of study, the country where the study was done, the institution, the mental health parameters studied, type and number of students/respondents involved, the main message of the study, strengths and weaknesses of the study and the main recommendations of the study. The charting was done by the first two authors independently and then the results were collated and combined. The table was then critically examined by the other authors. No critical appraisal of the studies included was carried out by the authors however, the strengths and limitations as mentioned by the study authors were included. We did not include systematic reviews and meta-analysis in the scoping review.

Data analysis

The charted data was analyzed according to the study questions. Whether a study was carried out in two or more countries, whether the study was cross-sectional, or a longitudinal follow-up was done, the stressors studied, the instruments used, and the sources of stress were noted. Stress levels among different subgroups of respondents, and recommendations to reduce stress by the respondents (if mentioned) and by the study authors were examined.

Results

Search results

Figure 1 shows the PRISMA flow diagram for the review. A total of 383 abstracts were retrieved from the three databases using the search terms mentioned. The abstracts were carefully read through by the first two authors and 82 full texts were included for further review. Among reasons for excluding the articles were: the study mainly focused on teaching-learning during the pandemic, the study was conducted among the general youth population, the study was among high school students, there were duplicate results, and the study was not conducted among health science students. The 82 full text articles were read through in detail, and many were conducted among university students. Some studies mentioned the study population, but they did not include health science students, and these were excluded. One systematic review and meta-analysis was excluded. A total of 42 studies were extracted. Twelve of them did not specify the university student population and the authors were contacted through e-mail. Eight of the authors mentioned that the study did not include health science students while four mentioned that they did not divide the students according to the stream of study. These articles were excluded. A total of 30 studies were included in the final analysis based on consensus among the authors.

Supplementary file 1 shows the studies included in

the review. Table I shows the characteristics of the included studies. Twenty-six studies included were original research. Ten studies were carried out exclusively among medical students, nine was carried out among different categories of health science students and two were among postgraduate medical students. Five of the studies were from China, and three each from Iran, India, Saudi Arabia, and Israel. Most studies were cross-sectional. A prospective longitudinal study was conducted in India, a longitudinal study was done among nursing students in Israel, and another prospective cohort study was done in China.

Table II shows the stressors and the recommendations by the authors to reduce stress. Among the stressors were health apprehensions, workplace apprehensions including the shortage of personal protective equipment, academic apprehensions due to online learning, delays, time management issues, delays in receiving unbiased information about COVID-19, and financial apprehension, among others. Among the recommendations by the authors to reduce stress were implementing effective plan/s to safeguard students' health, especially of those who were parents or interns, engaging in physical activities, workshops for faculty members in online teaching-learning, financial support, online counselling, reducing misinformation, further studies at later stages of the pandemic, and including topics related to the pandemic and pandemic preparedness in the curriculum.

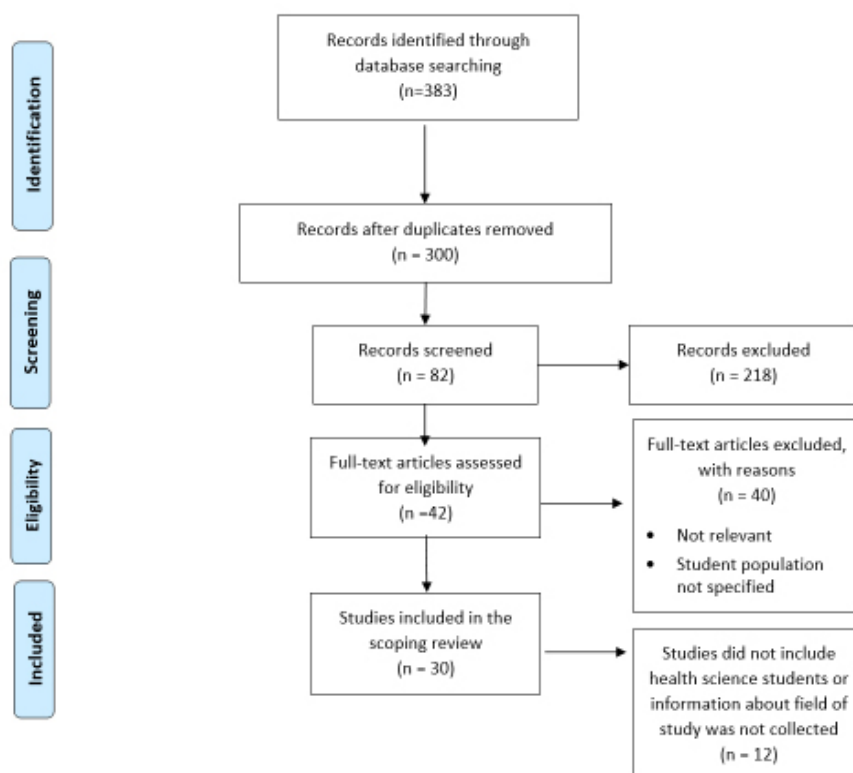


Figure 1. PRISMA flow diagram for the scoping review process.

Supplementary table I. The studies included in the review.

S. No.	Ref. No.	Type of paper	Title	Study Design	Country/Countries	Types of Tools	Institution	Parameter studied/addressed	Type/s of students and number	Stressors	Main Message
1	11	Original Research	Abdulghani HM, Sattar K, Ahmad T, Akram A. Association of COVID-19 Pandemic with undergraduate Medical Students' Perceived Stress and Coping. Psychology research and behavior management. 2020;13:871.	Quantitative, cross-sectional design study	Riyadh, Saudi Arabia.	self-administered questionnaire (18 items) and a well-known Kessler 10 Psychological Distress questionnaire (10 items)	Department of medical education, college of medicine, King Saud University (KSU),	Students' mental health	1st to 5th year medical students	did not prefer online learning time management problems online learning material not enough for study	Perception: - predominance of stress is higher in females than males; - more stress was perceived by the students during their transitional year, i.e., 3rd medical year (from pre-clinical to clinical) - respondents who regularly did religious meditation were at lower levels of stress. Challenges: limitation about the data collection setting as the subjects were from one region of Saudi Arabia. Suggestions: more exploratory events need to be carried out. This might highlight the difference (if found any) about COVID-19 pandemic on students learning and stress, but in a different time phase.
2	12	Original Research	Aslan I, Oehnik D, Çınar O. Exploring Perceived Stress among Students in Turkey during the COVID-19 Pandemic. International journal of environmental research and public health. 2020;17(23):8961.	Cross-sectional	Turkey	Online survey via Google forms data analysed using Perceived Stress Scale (PSS-10) Patient Health Questionnaire (PHQ-8) was used to measure depression symptoms	Fourteen universities in Turkey	Generalized Anxiety Disorder 7-item (GAD-7) scale, Patient Health Questionnaire (PHQ-8), Satisfaction with Life Scale (SWLS), Perception of COVID Impact on Student Well-Being (CI), Perceived Stress Scale (PSS-10), Physical Activity Scale (PA), and a sociodemographic survey	358 undergraduates	financial situation, job search, and completion of the semester.	Challenges: Cross-sectional Lack of random sampling. Very low response rate. Suggestions: Considering the high number of students experiencing a deterioration of economic status, special programs dedicated to financial support during the pandemic should emerge, i.e., scholarships or student loans. Also, fighting an infodemic (an overabundance of information) and misinformation Providing mental health support systems for students and promoting physical activity on a regular basis
3	13	Perspective	Chandrete S. Medical Students and COVID-19: Challenges and Supportive Strategies. J Med Educ Curric Dev. 2020; 7:2382120520935059.	Perspective	unspecified	Nil	University of Wisconsin School of Medicine and Public Health and the Medical College of Wisconsin	Support; mental health	Medical students	no on-campus activity. Exams are being offered online. Licensure exams are delayed lack of adequate personal protective equipment (PPE) Long-standing social distancing	Challenges: Medical students are retracted from clinical experiences. Suggestions: Schools should consider adding high-value, virtually deliverable, credit electives such as scientific writing, narrative writing, COVID-19 facts, biostatistics to continue student engagement
4	14	Editorial	Chinelatto LA, Costa TRD, Medeiros VMB, Boag GHP, Hojaij FC, Tempiski PZ, Martins MA. What You Gain and What You Lose in COVID-19: Perception of Medical Students on their Education. Clinics (Sao Paulo) 2020;75:e2133.		Brazil		Medical Colleges in Brazil	Students' gains and losses from Covid-19	Medical Students		Challenges: Anxiety on written tests, Anxiety on how they will be graded. Anxiety on how / when medical schools will make up for the lost practical classes Feeling of powerlessness Suggestions: Online education can be helpful and introducing it as part of the curriculum, teach them time management skills, allows new opportunities for teaching and learning, the volunteering experiences bring attention to the value of non-graded elective courses to make student's knowledge more diverse and increase their motivation in learning without worrying about grades.
5	15	Brief report Original research	Coyle C, Ghazi H, Georgiou I. The mental health and well-being benefits of exercise during the COVID-19 pandemic: a cross-sectional study of medical students and newly qualified doctors in the UK. Ir J Med Sci 2020;1-2.	Nation-wide cross-sectional study	United Kingdom	nationwide study - no mention of specific tool	Multiple institutions	Mental health impact of COVID-19	2075 medical students and foundation year one doctors	Not mentioned	Challenges: Suggestions: engage in physical activity—recognising the benefits that physical activity can have for their health and well-being. It is also hoped that higher education providers and employers recognise the importance of promoting physical activity for the well-being of their students and staff.

S. No.	Ref. No.	Type of paper	Title	Country/Countries	Types of Tools	Institution	Parameter studied/ addressed	Types of students and number	Stressors:	Main Message
6	16	Original research	Elsalem L, Al-Azzam N, Jum'ah AA, Obeidat N, Sindiani AM, Kheirallah KA. Stress and behavioral changes with remote E-exams during the Covid-19 pandemic: A cross-sectional study among undergraduates of medical sciences. <i>Ann Med Surg (Lond)</i> 2020;60:271-279.	Jordan	29 questions distributed via Google Forms demographics, stress experience, and factors contributing to stress as well as behavioural changes related to remote E-exams	Jordan University of Science and Technology	Demographics, stress related to remote e-exams Factors contributing Behavioural changes	1019 health science students	the exam duration, mode of questions navigation and technical problems (exam platform and internet connectivity)	Challenges: Single institution Suspension of teaching and F2F: interactions Suggestions: Robust exam platform and remote mock E-exams are recommended to reduce students' potential stress
7	17	Original research	Elsarkawy NB, Abdelaziz EM. Levels of fear and uncertainty regarding the spread of coronavirus disease (COVID-19) among university students. <i>Perspect Psychiatr Care</i> 2020;10:1111/ppc.12698.	Saudi Arabia	Four section Questionnaire (demographic, knowledge of Covid-19, Fear, Intolerance of uncertainty)	Jouf University	Fear and intolerance of uncertainty	416 undergraduate students	Not mentioned	Challenges: online sample with no random selection, weak generalizability, and the inability to infer causality because of the nature of study design (cross-sectional). Suggestions: Developing strategies to respond positively to students' worries and fears and proactively help them to solve their problems and guide them in preparing a plan for the future Academic staff advisers have imp role
8	18	Original research	Eweida RS, Rashwan ZI, Desoky GM, Khorji LM. Mental strain and changes in psychological health hub among intern-nursing students at pediatric and medical-surgical units amid ambience of COVID-19 pandemic: A comprehensive survey. <i>Nurse Educ Pract</i> 2020;49:102915.	Egypt	Middle East Respiratory Syndrome COVID-19 Staff Questionnaire and rated their psychological distress on the General Health Questionnaire.	Alexandria University hospitals	completed the Middle East Respiratory Syndrome COVID-19 Staff Questionnaire and rated their psychological distress on the General Health Questionnaire.	150 intern nursing students	possibility of getting COVID-19 infection (2.89 ± 0.39) and transmitting it to their families (2.72 ± 0.62) availability of protective equipment, and clear guidelines for infection control	Challenges: Smaller sample size Cross-sectional Suggestions: psychological first aid services should be available to the vulnerable intern-nursing students to excel their pursuit for successful career. Moreover; psychological training programs including counselling services and support systems should be conducted to help the nursing students to overcome stressors during any future outbreaks
9	19	Original research	Hakami Z, Khanagar SB, Vishwanathiah S, Hakami A, Bokhari AM, Jabali AH, Alasmari D. Address AM. Psychological impact of the coronavirus disease 2019 (COVID-19) pandemic on dental students: A nationwide study. <i>J Dent Educ</i> 2020.	Saudi Arabia	A cross-sectional analytical study, using 2-stage cluster sampling assessed using the validated Arabic version of the Depression, Anxiety and Stress Scale-21 Item questionnaire	Different universities	psychological impact was assessed using the validated Arabic version of the Depression, Anxiety and Stress Scale-21 Item questionnaire	697 dental students	performance pressure and course clinical requirements	Challenges: Online survey Reporting bias No baseline data Suggestions: Results of the current study can inform university efforts to assess and address current levels of stress, depression, and anxiety and guide program development and implementation of mental health
10	20	Original research	Kamaludin K, Chinna K, Sundarasan S, Khoshnaim HB, Nurumtobi M, Baloch GM, Sukayri A, Hossain SFA. Coping with COVID-19 and movement control order (MCO): experiences of university students in Malaysia. <i>Heliyon</i> 2020;6(11):e05339.	Malaysia	Online survey psychological impact was measured using Zung's Self-Rating Anxiety Scale (SAS)	Taylor's university	psychological impact was measured using Zung's Self-Rating Anxiety Scale (SAS). The students were assessed on the usage of adaptive (humanitarian and seeking social support) and maladaptive coping strategies (acceptance and mental disengagement).	963 undergraduate students	Not mentioned	Challenges: college health service providers and administrators need to consider proactive measures to support the mental health and well-being of students. Mental health interventions and professionally trained counsellors could help students address academic and financial concerns. Consider special needs of students.
11	21	Original research	Keckojevic A, Basch CH, Sullivan M, Davi NK. The impact of the COVID-19 epidemic on mental health of undergraduate students in New Jersey, cross-sectional study. <i>PLoS One</i> 2020;15:e0239696.	United States	survey collected information on demographics, knowledge levels and sources of COVID-19 information, behavior everyday difficulties, and mental health measurements	William Paterson University	demographics, knowledge levels and sources of COVID-19 information, behaviour changes, academic and everyday difficulties, and mental health measurements (depression, anxiety, somatization, and stress)	162 college students including health majors	academic and everyday difficulties	

S. No.	Ref. No.	Type of paper	Title	Study Design	Country/Countries	Types of Tools	Institution	Parameter studied/ addressed	Type/s of students and number	Stressors:	Main Message
12	22	Original research	Khanna RC, Honavar SG, Mehta AL, Bhattacharya A, Manuli PK. Psychological Impact of COVID-19 on ophthalmologists-in-training and practising ophthalmologists in India. <i>Indian J Ophthalmol</i> 2020;68:994-998.	Online cross-sectional survey	India	Online survey Psychological distress was assessed using the Patient Health Questionnaire-9 (PHQ-9)	Online survey all over the country	Demographics, economic and other impact, psychological distress	2,355 ophthalmologists	predictors for depression were age, gender, marital status, practicing status, type of service, concern about setbacks in training, and concern about ability to meet expenses	Challenges: national and state ophthalmology societies, health administration, and the government should support the mental health of all the health care workers, and not only those in the frontline of the management of COVID-19 infection
13	23	Original research	Li Y, Wang Y, Jiang J, Validimarsoditir UA, Fall K, Fang F, Song H, Lu D, Zhang W. Psychological distress among health professional students during the COVID-19 outbreak. <i>Psychol Med</i> 2020;1-3.	Prospective cohort study	China	The WeChat-based survey program Questionnaire Star, which contained questions from Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7).	Sichuan University	Participants were assessed for childhood adversity, stressful life events, internet addiction, and family functioning, associations with subsequent psychological distress and ASR	1442 health professional students		Perception: Challenges: not able to estimate an interpretable change of distress from baseline to the outbreak, around 30% of cohort enrollees did not participate in the COVID-19 survey Suggestions: family and psychological support during and after these unprecedented time
14	24	Original research	Liu J, Zhu Q, Fan W, Makumire J, Zheng C, Wang J. Online Mental Health Survey in a Medical College in China During the COVID-19 Outbreak. <i>Front Psychiatry</i> 2020;11:459. Erratum in: <i>Front Psychiatry</i> 2020;11:845	Cross-sectional	China	The WeChat-based survey program Questionnaire Star, which contained questions from Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7).	Tongji Medical College, Huazhong University of Science and Technology	WeChat-based survey program Questionnaire Star, which contained questions from Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7)	217 medical students	felt upset due to the disease (COVID-19), which led them to be quarantined at home, and expressed that this situation made their life generally boring disrupted schedule of the postgraduate entrance exam separated from their lovers	Challenges: Cross-sectional Small numbers, Self-report, Did not exclude students with previous mental illness Suggestions: universities need to take measures to prevent, identify, and deal with mental health problems among students during large-scale stressors. Effective screening procedures to identify students who are at high risk of developing mental health problems, and effective interventions
15	25	Original Article	Nakhoosin-Ansari A, Sherafatí A, Aghajani F, Khonji MS, Aghajani R, Shahmansouri N. Depression and Anxiety among Iranian Medical Students during COVID-19 Pandemic. <i>Iran J Psychiatry</i> 2020;15:228-235.	Cross Sectional; Quantitative	Iran	online survey of Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI) questionnaires	Tehran University of Medical Sciences (TUMS)	Depression, anxiety	Medical Students	Students with lower GPA and prior experience of COVID-19 symptoms were more likely to feel depressed.	Challenges: one region Suggestions:
16	26	Original research	Pandey U, Corbett G, Mohan S, Reagu S, Kumar S, Farrell T, Lindow S. Anxiety, Depression and Behavioural Changes in Junior Doctors and Medical Students Associated with the Coronavirus Pandemic: A Cross-Sectional Survey. <i>J Obstet Gynaecol India</i> 2020;1-5.	Cross-sectional online survey	India	online questionnaire validated tool for the assessment of anxiety and depression symptoms (GAD-7 and PHQ-9).	Institute of Medical Sciences, Banaras Hindu University	Participant's anxieties related to the pandemic, validated tool for the assessment of anxiety and depression symptoms (GAD-7 and PHQ-9)	83 undergraduate medical students and junior doctors	Not mentioned	Challenges: Self-report, Study only done at start of the pandemic Suggestions: a follow-up study as the epidemic evolves and starts taking longer-term toll on the coping strategies. Managing doctors mental health and psychosocial well-being during this time of Covid-19 is as important as managing physical health
17	27	Original research	Saraswathi I, Saikarthik J, Senthil Kumar K, Madhan Srinivasan K, Ardhanaari M, Gunapriya R. 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. <i>Peer J</i> 2020;8:e10164.	Prospective longitudinal	India	1) Depression Anxiety Stress Scale 21 Items (DASS21) 2) Pittsburgh Sleep Quality Index to assess sleep quality 3) a self-administered questionnaire to assess the impact of COVID-19 related stressors	Medical College, Chennai, India	Depression Anxiety Stress Sleep quality COVID-19 parameters	217 undergraduate medical students	academics (COVID-19-AA (academic apprehensions)) self and family/friends (COVID-19-GA (general apprehensions))	Challenges: Possible response bias; No students were COVID positive Suggestions: effective plan to safeguard the mental health of this already vulnerable population of undergraduate medical students is crucial. findings would help the medical educators in addressing and mitigating the rise in mental health disorders

S. No.	Ref. No.	Type of paper	Title	Study Design	Country/Countries	Types of Tools	Institution	Parameter studied/ addressed	Type/s of students and number	Stressors:	Main Message
18	28	Original research	Saravanan C, Mahmoud I, Elshami W, Taha MH. Knowledge, Anxiety, Fear, and Psychological Distress About COVID-19 Among University Students in the United Arab Emirates. <i>Front Psychiatry</i> . 2020;11:582189.	Cross-sectional web-based survey	United Arab Emirates	<p>Web-based survey results were measured using the following scales:</p> <ul style="list-style-type: none"> 1) Sociodemographic 2) Knowledge about Covid-19 3) Coronavirus Anxiety Scale 4) Fear of Covid-19 Scale 5) The Kessler Psychological Distress Scale 	University of Sharjah	Demographic scale, COVID-19 knowledge, anxiety, fear, and psychological distress scales	433 students	Not mentioned	<p>Challenges: sampling bias, one university, conducted before May 2020, the results may have been different, as at the beginning of the spread of COVID-19 students may have been more anxious and psychologically distressed</p> <p>Suggestions: Frequent web-based workshops that include insight, guidance, online counselling, scheduled activity, and coping mechanisms for COVID-19 are highly recommended.</p>
19	29	Original article	Sartorio Filho CI, Rodrigues WC, de Castro RB, Marçal AA, Pavelqueires S, Takano L, de Oliveira WL, Neto CI. Impact Of Covid-19 Pandemic On Mental Health Of Medical Students: A Cross-Sectional Study Using GAD-7 And PHQ-9 Questionnaires. <i>MedRxiv [Internet]</i> . [cited 2021 Mar 25]. Available from: https://www.medrxiv.org/content/10.1101/2020.06.24.20138925v1	Cross Sectional; Quantitative	Brazil	questionnaires regarding social and demographic status and GAD-7 for anxiety and PHQ-9 for depression questionnaires.	Medical school of Fundação Educacional do Município de Assis (FEMA)	anxiety and depression; epidemiological, educational and social factors related	Medical students above 18 years old.	social distancing affecting finances afraid of become infected by COVID-19,	<p>Perception: higher prevalence of moderated and severe anxiety and depression symptoms among medical students during COVID-19 pandemic, significantly among women and on medical students relating financial impairment related to COVID-19 epidemic.</p> <p>Challenges: cannot explain the heterogeneity between other studies; PHQ-9 is useful only for screening purposes for "current major depressive episode" as a result of its low positive predictive value, limitation concerning age sampling</p> <p>Suggestions: Future studies should investigate the convergent and discriminant validity of the GAD-7 with respect to other criteria (e.g., behavioral, biological, information-processing) that are relevant to the psychopathology of GAD.</p>
20	30	Original research	Savitsky B, Findling Y, Erel A, Hendel T. Nursing Students in Crisis Mode: Fluctuations in Anxiety During the COVID-19-Related Lockdown. <i>Nurse Educ</i> . 2020.	Completed 2 surveys conducted during the initial lockdown and 5 weeks later	Israel	Descriptive essay via questionnaire	Ashkelon Academic College	Levels of anxiety and ways of coping	244 nursing students	1) Delay in dissemination of Covid-19 information by gov 2) Distance learning 3)	<p>Challenges: One institution Anonymity of respondents and difficulties in drawing causality</p> <p>Suggestions: resilience-building be incorporated into the nursing curriculum, students should get updated information regarding medical news as part of their curriculum</p>
21	31	Original research	Savitsky B, Findling Y, Erel A, Hendel T. Anxiety and coping strategies among nursing students during the covid-19 pandemic. <i>Nurse Educ Pract</i> 2020;46:102809.	Cross-sectional study	Israel	questionnaire was conducted using Google Forms a) Generalized Anxiety Disorder 7-Item Scale with a cut-off point of 10 for moderate and of 15 for severe anxiety	Ashkelon Academic College, Southern District, Israel	Anxiety using GAD-7 COPE for coping behaviour	244 nursing students	Gender, lack of PPE, and fear of infection	<p>Challenges: self-report measures</p> <p>Suggestions: maximum schedule stabilization during the lockdown. Special consideration for students who were parents. Online teaching workshops for faculty.</p>
22	32	Original research	Sigitt S, Dolu I, Cangöel E. The relationship between COVID-19 knowledge levels and anxiety states of midwifery students during the outbreak: A cross-sectional web-based survey. <i>Perspect Psychiatr Care</i> 2021;57:246-252.	Online cross-sectional	Turkey	Cross-sectional, online form a) Questionnaire b) Beck Anxiety Inventory	Multiple institutions	Demographics Knowledge about COVID Beck anxiety inventory	972 female midwifery students	a) anxiety among female midwifery students who applied to a hospital after the COVID-19 outbreak and b) those who had chronic diseases in their parents or relatives	<p>Challenges: Low response rate less than 10% of those contacted</p> <p>Suggestions: further studies are recommended to be conducted in the late stages of the crisis and after the COVID-19 outbreak</p>
23	33	Reflection	Tabari P, Amini M. Educational and psychological support for medical students during the COVID-19 outbreak. <i>Med Educ</i> . 2021;55:125-127.	Reflection	Iran	Nil	Shiraz University of Medical Sciences	Training faculty; educational & emotional support;	Not specified	Nil	<p>Challenges: Alternative solutions such as using distance technology and social media platforms for consultation are needed to be generated quickly and required to rapidly become as productive as face-to face interaction during this unexpected crisis</p>

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24	34	Original research	Wang Y, Li Y, Jiang J, Valdimarsdóttir U.A, Fall K, Fang F, Song H, Lu D, Zhang W. Psychological distress among health professional students during the COVID-19 outbreak. <i>Psychol Med</i> 2020;1-3.	Prospective cohort study	China	evaluated psychological distress using the Kessler 6-item Psychological Distress Scale (K6) and acute stress reaction (ASR) using the Impact of Event Scale-Revised (IES-R)	Sichuan University	Participants were assessed for childhood adversity, stressful life events, internet addiction, and family functioning. associations of the above exposures with subsequent psychological distress and ASR	1442 health professional students	1) concerned about having COVID-19 2) If they were to work during the outbreak, personal protective equipment was stated as most important 3) pandemic would affect their future career choice; among them	Challenges: not able to estimate an interpretable change of distress from baseline to the outbreak. around 30% of cohort enrollees did not participate in the COVID-19 survey Suggestions: family and psychological support during and after these unprecedented time
25	35	Original research	Wang Y, Li Y, Jiang J, Feng Y, Lu D, Zhang W, Song H. COVID-19 outbreak-related psychological distress among healthcare trainees: a cross-sectional study in China. <i>BMJ Open</i> 2020;10:e041671.	Cross-sectional study	China	Cross sectional via WeChat Psychological distress was assessed using the Chinese version of the Kessler Psychological Distress Scale (K6).	Sichuan University	COVID-19-related psychological distress and acute stress reaction (ASR) were assessed using the Kessler 6-item Psychological Distress Scale and the Impact of Event Scale-Revised	4184 healthcare trainees	having active clinical duties, Academic pressures, workload and financial burden	Challenges: Cross-sectional Low response rates among residents Confounding variables, Single location Suggestions: Stress management should be provided for high-risk healthcare trainees during the outbreak, particularly if or when the training is accelerated, and trainees join the front lines of the workforce.
26	36	Original research	Xiao H, Shu W, Li M, Li Z, Tao F, Wu X, Yu Y, Meng H, Vermund SH, Hu Y. Social Distancing among Medical Students during the 2019 Coronavirus Disease Pandemic in China: Disease Awareness, Anxiety Disorder, Depression, and Behavioral Activities. <i>Int J Environ Res Public Health</i> 2020;17:5047. Erratum in: <i>Int J Environ Res Public Health</i> 2020;18:	nation-wide cross-sectional survey of college students	China	Patient Generalized Anxiety Disorder-7 and Health Questionnaire-9 to measure anxiety disorders and depression	Capital Medical University and Anhui Medical University	Patient Generalized Anxiety Disorder-7 and Health Questionnaire-9 to measure anxiety disorders and depression Student demographics	933 medical students studying public health	proximity to the pandemic's epicentre would be more anxiety-provoking social distancing due to lack of normal social activities	Challenges: Specific population Self-rating. Evolving knowledge of the pandemic Suggestions: incorporating pandemic preparedness education within health education, including mental health elements
27	37	Original research	Ye W, Ye X, Liu Y, Liu Q, Vafaei S, Gao Y, Yu H, Zhong Y, Zhan C. Pneumonia Pandemic on Medical Students' Psychological Stress and Its Influencing Factors. <i>Front Psychol</i> 2020;11:548506.	cross-sectional, survey-based, region-stratified study	China	Chinese Perceived Stress Scales (CPSS) under a self-design questionnaire	Multiple universities	Stress was measured using the Chinese Perceived Stress Scales (CPSS) under a self-design questionnaire. Sociodemographic, major characteristics, and knowledge of the novel coronavirus pneumonia were also identified as potential influencing factors of stress	2,498 medical students and 1,177 non-medical students in 31 provinces	familiarity with the novel coronavirus, family income, major of students, and status of the intern student	Challenges: Self-administered Suggestions: increase the level of our knowledge related to the novel coronavirus pneumonia to reduce stress and strongly focus on the special populations with certain features, such as intern students, clinical nursing students, and low-income families, to improve their learning attitudes and establish positive professional mental outlooks
28	38	Student Essay	O'Byrne L, Gavin B, McNicholas F. Medical students and COVID-19: the need for pandemic preparedness. <i>J Med Ethics</i> 2020;46:623-626.	Essay	Ireland	Nil	School of Medicine, University College Dublin, Dublin, Ireland	Challenges faced by medical students; Students' potential role during a pandemic	Medical students	without appropriate 'pandemic preparation'	Challenges: Suggestions: Schools should consider inclusion of pandemic preparedness in curriculum in order to mitigate effects of distress and to build resilience

S. No.	Ref. No.	Type of paper	Title	Study Design	Country/Countries	Types of Tools	Institution	Parameter studied/ addressed	Type/s of students and number	Stressors:	Main Message
29	39	Original research	Saiman M, Asif N, Mustafa ZU, Khan TM, Shehzadi N, Tahir H, Raza MH, Khan MT, Hussain K, Khan YH, Butt MH, Mallhi TH. Psychological Impairment and Coping Strategies During the COVID-19 Pandemic Among Students in Pakistan: A Cross-Sectional Analysis. Disaster Med Public Health Prep 2020;1-7.	web-based, cross-sectional study	Pakistan	Google forms (online questionnaire) to assess anxiety (Generalized Anxiety disorder-7), depression (Patient Health Questionnaire-9) and the coping strategies (Brief-COPE)	University of the Punjab, The University of Lahore, Gulab Devi Educational Complex, and University of Veterinary and Animal Sciences	Anxiety, depression, coping strategies	1134 students	a) turned their lives upside down (80.8%) b) restricted social meetings with friends (84.7%) c) shopping, sporting and other important activities (88.3%) d) afraid of travelling in transport with air-conditioning e) Fear of health of self and family members, majority (70.9%) f) afraid they could contract the disease g) scared of visiting healthcare settings	Challenges: problem of selective participation and coverage error, introspective ability, response bias, sampling bias) , clinical assessment for the diagnosis of depression and anxiety disorders as per criteria of Diagnostic and Statistical Manual of Mental Disorders (DSM-V) was not done Suggestions: Education authorities should take immediate measures to address the student related issues. Moreover, students should be encouraged to adopt healthy lifestyle, engage their students in several online activities
30	40	Brief report	Zolotov Y, Reznik A, Bender S, Israelowitz R. COVID-19 Fear, Mental Health, and Substance Use Among Israeli University Students. Int J Ment Health Addict 2020;1-7.		Israel		Ben Gurion University of the Negev	Fear related to Covid-19	370 Medical and Allied Health Science University Students		Challenges: findings are preliminary taken at one point in time across Israeli university students in front-line service professions Suggestions: tip sheets of relevance should be considered and made available to health and social service personnel, online and in print, for distribution to at-risk populations to mitigate stress, anxiety, and prevention of harmful behavior

Table III shows the students/respondents at greater risk of mental stress, anxiety, depression, and other illnesses due to COVID-19. Females, younger students, those early in the course, those with infected family and friends, those in training and/or in contact with patients, and those near the epicenter, Wuhan were at greater risk. Students who were in transition from the basic science to the clinical years or who were graduating also had higher stress levels.

Table IV shows the limitations of the included studies. The limitations were those mentioned by the authors. Among these were the possibility of bias as no included students were COVID-positive, conducted at a single institution or location, online sample which was not randomly selected, cross-sectional studies so difficult to draw inferences about causality, presence of confounding variables, and most were self-reported surveys. Figure 2 shows the summary of findings displayed with the framework of the transactional stress model.

Table I. Characteristics of the included studies.

Type of paper	
Original Research	26
Reflection	1
Perspective	1
Student Essay	1
Editorial	1
Total	30
Population studied	
Dental	1
Medical	9
Health Science	5
Not Specified	7
Combined group of medical students & Junior doctors	2
Health Science and others	1
Postgraduate	2
Medical and Others	3
Total	30
Countries studied	
India	3
Jordan	1
UAE	1
UK	1
Pakistan	1
Saudi Arabia	3
Israel	3
USA	1
Turkey	2
China	5
Egypt	1
Malaysia	1
Iran	3
Brazil	2
Unspecified	1
Ireland	1
Total	30

Table II. Stressors identified in the studies and authors' suggestions to reduce the stress.

Stressors	References
Health apprehension (Self and family)	18, 23, 25, 29, 31, 32, 39
Workplace apprehension (Hospitals where covid-19 patients are treated) lack of PPE	13, 18, 23, 31, 32, 34, 35
Academic Apprehension, Online learning, Academic delay, Time management, without pandemic preparation module	11, 12, 13, 19, 21, 24, 25, 27, 30, 35, 38
General Apprehension restricted movement	13, 21, 24, 27, 29, 34, 36, 39
E-exam apprehension	16
Delay in receiving Covid-19 information from authorities	18, 30, 34
Setbacks in training	12, 22, 23, 37
Financial apprehension	12, 22, 29, 35, 37
Infection locality apprehension	36, 37
Recommendations by authors	References
Have effective plan to safeguard students', healthcare workers' mental health and especially among special populations (students who are parents, interns)	19, 22, 26, 27, 28, 29, 35, 37, 39
Online teaching workshops for academics	31
Robust exam platform and remote mock exams	17
Engage in physical activities encourage students to adopt healthy lifestyle	12, 15, 39
Offer financial support	12
Develop strategies to respond to students' fears and worries	17, 20, 21, 23, 24, 33
Inclusion in curriculum: resilience building, pandemic preparedness, psychological training, Online learning / time management, Volunteerism elective	13, 14, 18, 30, 36, 38
Mitigate misinformation/ abundance of information & ensure timely dissemination of information	12, 20, 34, 37, 40
Further studies needed at later stage of pandemic	11, 26, 29, 32
Improve students' learning attitude	37
Establish professional mental outlooks	37
Effective screening procedure	24

Table III. Subgroups of students at greater risk of mental health problems.

Students at risk	References
Females	11, 12, 16, 17, 18, 19, 22, 25, 26, 29, 31, 39
Health science and medical students	16
Students staying in dorms	28
Students with history of mental illness	28
Below age 20 / younger/early years of studies	19, 29, 39
Those with family/friends who were infected / At risk	17, 32, 39
Those in training	22, 32
Singles	22
Inactive	12
Those in epicenter Wuhan	36
Those without personal protective equipment (PPE)	31
Students who were parents	31
Senior students	36

Table IV. Limitations of the included studies as mentioned by the study authors.

Limitations	References
Possible bias as no students were Covid-19 positive	19, 27, 28
Single institution / location	11, 16, 25, 28, 30, 34, 35, 40
Online sample with no / lack of random selection, weak generalizability	12, 17, 20, 24, 39
Difficulty in drawing causality	17, 30
Anonymity of respondents	30
Low response rate / small sample size	11, 12, 18, 23, 29, 32, 35
Confounding Variable	35, 39
Results not interpretable distress changes from baseline to outbreak / only one point in time	19, 23, 24, 26, 28, 34, 36, 40
Clinical diagnosis as per DSM-V was not done	39
Self-Administered survey / Self report scales	20, 24, 26, 31, 36, 37

Discussion

The authors have used the process model of the stress health relationship based on the transactional stress theory of Lazarus [41] as a framework while examining the effects of stress on health science students. The model describes how an individual appraises both the stressful life event and the resources which s/he possesses and then decides on coping mechanisms aided by social support. The health consequences mentioned in the addressed studies mentioned result as the individual tries to cope with the events. The impact, duration, predictability, and controllability of the life events are considered during the appraisal by the individual. The model predicts a reciprocal influence between perceived stress and cognitive performance. Individual characteristics play an important role in influencing this relationship. The individual adaptation process to a significant source of stress such as the COVID pandemic consists of appraisals of primary and secondary control [42]. Primary appraisal consists of perceived possibilities to reduce the negative impact of the situation while secondary control is concerned with perceived possibilities of modifying the appraisal of the situation to achieve a positive adjustment.

COVID-19 has been now around for over a year, and we know more about the disease and its management. However, at the time of conduct of included studies information was less and the disease had serious consequences on health and other aspects of a person's life. Personal, social, and material resources can influence the appraisal and the coping mechanisms and the health consequences.

Among the personal resources gender, and experience were important. In studies conducted in China it was noted students more distant from the epicenter in Wuhan had lesser levels of stress [36]. International students were under greater stress while religious meditation reduced

stress levels. Transitioning from preclinical to clinical years and from final year to internship increased stress levels [22,32]. Family support and place of residence were important social factors influencing the levels of stress. Among the material resources, access to computers, stable internet access, quiet place to attend sessions and study were important. Providing social support through social media groups, informal online forums, and counselling and support predominantly through online methods were recommended to reduce stress [17,20,21,23,24,33]. Engaging students in different online activities was also helpful. Three studies recommended that students engage in physical activities to reduce stress and adopt a healthy lifestyle [12,15,39].

We were able to obtain information about our three research questions. Sources of stress among health science students during the ongoing pandemic were identified. Health apprehensions about health of self and of family members were mentioned. Respondents were worried that they might act as a source of infection in their homes where there may be elderly relatives or even parents with comorbidities. Lack or shortage of PPE was mentioned as a worry limiting students' clinical experience and/or their ability to volunteer in the case of undergraduate students [31]. Academic apprehensions were mainly related to the shift to online learning, discontinuity in clinical teaching and lack of coverage of pandemic preparedness in the curriculum [13,14,18,30,36,38]. Financial apprehensions due to loss of job or reduced working hours of parents and guardians and decreased ability of students to find part-time work were also a major source of worry [12,22,29,35,37].

Subgroups of students at greater risk of mental health problems were identified. There were no recommendations by student respondents to reduce stress levels mentioned but the study authors mentioned several possible initiatives. Identifying early students at increased risk of mental stress due to various factors including economic factors, previous history of mental illness, students who are parents and providing them greater financial support were recommended [19,22,26,27,28,31,35,37,39]. Physical activities to reduce stress and stay healthy can be considered. Financial support can be offered to students at greater risk of financial difficulties and resilience building included in the curriculum. Misinformation must be mitigated and rapid spread of incorrect information through mass and social media was an important source of stress [12,20,34,37,40]. Four studies highlighted the need for further studies at later stages of the pandemic [11,26,29,30].

As the pandemic is continuing further studies can be considered at present. Gaps in the literature were identified. There are no studies from many countries and more studies among allied health students are required. More studies among postgraduate students and residents are also needed. The coping mechanisms were not identified in all studies. More longitudinal studies and studies on coping

mechanisms can be carried out. The different social support mechanisms available in different locations and providing social support online may also need greater work. Many studies had looked at university students and even other university employees together. We are of the opinion that health science students due to their better knowledge about COVID, the greater disruption caused especially to clinical learning, and their responsibility to support and treat patients may differ in certain respects from other student populations. More studies among health science students and comparing the results to other student populations may be required.

The scoping review process had limitations. COVID-19 is a rapidly evolving situation and due to logistic limitations, we only included studies till 15th January 2021. Only studies published in English and in the databases mentioned were included. The quality of the included studies was not appraised.

Conclusions

Studies on mental health of students during the ongoing pandemic were carried out in several countries. As the epidemic had originated in China there were a greater number of studies from this country. Health apprehensions, workplace apprehensions, academic apprehensions, general apprehensions, and financial apprehensions were noted. Among the recommendations were: having effective plan/s to safeguard respondents' health, promoting physical activities, responding to students' fears and worries, mitigate misinformation, including pandemic preparedness in the curriculum. Females, younger students, students with family and friends who were infected were at greater risk of mental distress.

The recommendations will be useful to preserve and support student mental health during the current and future pandemics. Studies from countries not represented may be required. Longitudinal studies may be needed.

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