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Review

Global Impact of Burnout Syndrome in Medical Students During the COVID-19 Pandemic: A Systematic Review

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Abstract

Background: The prevalence of burnout syndrome among medical students is a growing concern, warranting comprehensive exploration, particularly in the context of the COVID-19 pandemic. This review aims to elucidate the burnout phenomenon, considering its impact on medical students' mental health, physical well-being, and academic performance. **Methods:** A thorough analysis was conducted, drawing on data from 31 studies encompassing over 37,000 participants in 25 countries. A systematic search across PubMed, Google Scholar, APA PsycNET, and Scopus utilized specific keyword combinations related to COVID-19, medical students, and burnout syndrome. The selected studies were evaluated to ensure relevance to the research aim. **Results:** The review reveals burnout complexity, highlighting its diverse manifestations, exacerbated by the pandemic. Varied outcomes emerged from the studies, reflecting contrasting impacts on students. During lockdown, some reported having spent quality time with their families and delved into their academic interests, while others suffered due to the absence of clinical engagement. A notable correlation between burnout levels and academic year was observed, though interpretations differed among studies. Factors such as gender, family status, coping mechanisms, and the absence or presence of a supportive network were identified as influencers of burnout likelihood. **Conclusion:** Medical student burnout persists as a significant challenge, intensified by pandemic disruptions to academic and clinical experiences. Urgent proactive measures by academic institutions are crucial to safeguard future physicians' well-being, with implications for enhancing healthcare delivery. This study underscores the immediate need to prioritize strategies for burnout prevention and management in medical education.

Introduction

According to the World Health Organization (WHO), "Burnout" (or "burn-out") is an occupational phenomenon, as stated in the 11th Revision of the International Classification of Diseases (ICD-11). Even though it is not classified as a medical condition, it represents an established factor influencing health status or contact with health services. Defined as a syndrome resulting from chronic workplace stress that has not been successfully managed,[7] burnout is characterized by three main hallmarks, namely emotional exhaustion, depersonalization, and reduced personal accomplishment.[37]

When referring to medical students, exhaustion is attributed to rigorous academic requirements, alongside a prevailing sense of cynicism and disinterest in studying, coupled with feelings of incompetence. Taking into consideration the high workload, the competitive nature of the field, the emotional toll of their studies, feelings of isolation, and a lack of adequate support, it is not surprising that medical students are more susceptible to experiencing burnout compared to their peers in other academic disciplines. On a global scale, medical students encounter notably heightened rates of burnout syndrome,[24,37,47] varying widely, with estimates ranging from around 10% to as high as 77% when evaluated using the Maslach Burnout Inventory Student-Survey (MBI-SS).[37] According to a recent meta-analysis, the prevalence of burnout in medical students is estimated to be over 37%,3 while other sources state that at least half of all medical students may be affected by burnout during their university years.[7,29] More specifically, as highlighted by recent research, first-year students exhibit the lowest frequency of burnout, with the prevalence of this phenomenon increasing as they progress through medical school.[29]

According to studies, experiencing even a single burnout symptom can have negative effects on the educational process, leading to problems such as drowsiness, fatigue, eating disorders, migraines, emotional instability, and even the use of illicit drugs.[29,37] Apart from the above, there is a well-established relationship between burnout, depression, and anxiety among medical students, which, in turn, has a significant impact on multiple facets of their physical, mental, emotional, and social well-being.[37] The potential long-term outcomes for healthcare professionals also give rise to significant concerns, encompassing heightened occurrences of medical errors, decreased levels of

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empathy towards patients, compromised care quality, and a decline in professional standards.[37]

The risk of burnout among medical students has multiplied during the SARS-CoV-2 pandemic, as uncertainty, quarantine measures, and ongoing stressors have intensified their psychological burden. The advent of the COVID-19 has had a profound impact on their mental and physical well-being, altering learning behaviors and deteriorating work performance and study, particularly for those in clinical years.[29,37]

This review aims to assess burnout syndrome and its associated factors among medical students worldwide during the COVID-19 pandemic. Additionally, there is an endeavor underway to juxtapose the incidence of burnout pre- and post-pandemic within the same demographic. Moreover, we examine potential strategies for intervention and prevention of burnout, encompassing initiatives both by the students themselves and academic institutions..

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement is an evidence-based approach for reporting in systematic reviews and meta-analyses. We used the PRISMA statement to guide the reporting of this systematic review.[10]

Primarily, we developed a range of text words, synonyms and subject headings for the three major concepts in this review of 1) burnout, 2) COVID-19 pandemic, and 3) medical students. We then combined phrases related to these main categories, namely "COVID-19", "Coronavirus disease 2019", "Medical students", Medical school students", "Burnout syndrome", "Professional burnout" with "AND" and "OR" and used them to undertake a systematic search of four electronic databases from the beginning of the pandemic to September 2023. Databases searched were PubMed, Scopus, APA PsycNET, and Google Scholar. We also utilized data from other sources (e.g., BMC Medical Education) to gather further information for composing different sections of this present review. For instance, we used these data to direct on how to appropriately apply the PRISMA guidelines to our systematic review.10 Other studies provided insights into the comparison of burnout levels between pre-pandemic and pandemic periods,16 as well as into coping mechanisms used to manage stressful events.63 However, we did not include data from sources other than PubMed, Scopus, APA PsycNET and Google Scholar in the PRISMA flow diagram, as we did not initially intend to incorporate them into the research, thus not selected using the same criteria, such as publication date prerequisites and absolute congruence with the research inquiries. Finally, we merged results exclusively from database search using reference-management software (Zotero) and duplicates removed.

Only studies meeting the following criteria were included: free access, original studies, available in the English language, and reporting data published from January 2020 to September 2023. This timeframe was chosen because it includes both the beginning and the peak of the COVID-19 pandemic, offering a complete picture of its effects on medical students' burnout levels. All pertinent studies published up until the time of our review in September 2023 are included. Each of the studies involved medical students as participants, yet not exclusively, as they may have also included residents, students from diverse academic disciplines, and so forth. Moreover, all publications had the burnout syndrome as their primary focus, with a specific emphasis on the impact of the COVID-19 pandemic on the prevalence of this phenomenon. Due to the limited number of eligible publications, we did not exclude studies without a control group of medical student burnout incidence before the pandemic. Additionally, we included studies investigating risk factors for burnout emergence or revolving around prevention and management strategies. In research papers that included professionals from other fields in the sample (e.g., nurses, doctors, residents, or students from other academic disciplines), we extracted only data related to medical students for the present review.

Articles were excluded if they did not meet the above criteria. Literature assessing hypothetical vignettes or scenarios rather than actual experience was excluded, in addition to studies that focused on general well-being or psychological well-being but not specifically burnout. Articles that focus on medical teachers, trainees, residents, nurses and nurse students were excluded.[10]

Study selection and data extraction

A single reviewer (MKT) conducted the initial assessment of titles and abstracts. Due to practical constraints, a complete duplicate screening was not feasible. To ensure rigor and reliability, a validation step was implemented. The second author (AT) randomly reviewed a subset of the studies, examining one out of every twenty titles and one out of every five abstracts. Given the exploratory nature of this review, which aimed to summarize the available evidence on burnout during pandemics, this validation step was deemed sufficient to mitigate bias and maintain accuracy. Any disagreements identified were discussed thoroughly until a consensus was reached. The screening and validation processes were conducted manually, as limited resources and the need for flexibility in reviewing heterogenous data precluded the use of software. The diverse study designs and outcomes necessitated a nuanced evaluation, which was more effectively managed through non-automatic review. Copies of full articles were then obtained for those that were potentially relevant to at least one research query explored in this review, namely the variation in burnout rates among medical students in different regions globally, risk factors associated with psychosomatic exhaustion symptoms, and preventive or/and intervention strategies. Inclusion criteria were then applied, and the following data were extracted: lead author, publication year, country, sample, outcome measure, primary aim and key findings.

Table 1. Summary of Included Studies.

Lead author	Year	Country	Participants	Primary aim	Outcome measure	Key findings
Aebischer [1]	2020	Switzerland	550 medical students and 227 residents	To assess the physical and psychological health of Swiss medical students involved in the COVID-19 response and compare it with their non-involved peers	Generalized Anxiety Disorder-7 (GAD-7), Patient Health Questionnaire-9 (PHQ-9), Maslach Burnout Inventory (MBI)	Students involved in the COVID-19 response reported lower levels of burnout, compared with their non-involved peers (median 1 vs 3 on de-personalisation item, p <0.001). Frontline students had lower levels of burnout than frontline residents.
Alkureishi [2]	2022	US	3826 medical students	To assess the impact of the initial phase of the pandemic on burnout, stress, and loneliness among US medical students, while identifying risk and protective factors for informing support interventions.	MBI-HSS, Perceived Stress Scale (PSS-10), UCLA scale	Half of students experienced burnout (29% high depersonalization, 40% high emotional exhaustion, 42% low personal accomplishment). No significant difference was found by sex (52% males vs. 48% females, P = 0.07). Burnout during the pandemic was lower than pre-pandemic (50% vs. 52%). Risk factors for high burnout levels: second- & third-year students, racial minorities, financial strain, experiences of racism. Nearly half of the respondents volunteered during the pandemic, reporting lower burnout.
Asl [4]	2021	Iran	251 medical students	To meditate the role of compassion in the relationship between COVID-19 anxiety syndrome and COVID-19 burnout	COVID-19 Anxiety Syndrome Questionnaire, Compassion Scale, and COVID-19 Burnout Scale	COVID-19 burnout had a positive and significant relationship with the overall score of anxiety syndrome (r = 0.42, P = 0.01), while it has a negative and significant relationship with compassion (r = −0.37, P = 0.01).
Bolatov [5]	2020	Kazakstan	619/798 medical students (TL/OL)	To investigate the mental state of the medical students switching to online learning (OL) in comparison with the mental state of the students who had traditional learning (TL)	Copenhagen Burnout Inventory (CBI-S), PHQ-9 scale, GAD-7 scale, Patient Health Questionnaire-15 (PHQ-15) scale, and 5-point adapted Snell's questionnaire (FCV-19)	Prevalence of burnout syndrome decreased after transitioning from TL to OL (28% vs 17% p<0.001), whereas the prevalence of colleague-related burnout increased (general average scores on the CBI-S scale during the TL and OL were 40 and 33, respectively, p < 0.001). The prevalence of burnout decreased in 4th-year students. The level of cynicism increased in all study groups (1–6 years) after switching to OL.
Compton [11]	2020	Singapore	179 medical students	To assess medical students' preference for re-entering the clinical setting during the COVID-19 pandemic and to explore personal and environmental characteristics associated with that preference.	Oldenburg Burnout Inventory (OLBI), Tolerance for Ambiguity Scale, Modified Treatment Self-Regulation Questionnaire, Modified Archer's Health Promotions Motivation Survey, Author-developed measure of professionalism related to COVID-19	About one-third of students preferred not to return to the clinical setting. Students favoring a return exhibited greater autonomous (internal) motivation, a stronger sense of professional responsibility and lower self-perception of harboring risk to patients compared to the group preferring not to return.
Daryanto [12]	2023	Indonesia	413 medical students	To assess burnout prevalence and its associated factors among Indonesian medical students during the COVID-19 pandemic	MBI-SS	Around one-sixth (17.9%) of medical students experienced burnout during the COVID-19 pandemic (29.5% reported high level of emotional exhaustion, 32.9% depersonalization), with a higher prevalence among preclinical students (higher levels of emotional exhaustion, depersonalization, and lower levels of personal accomplishment).
Duarte [14]	2022	Portugal	462 medical students	To explore the mediating role of resilience and life satisfaction in the relationship between perceived stress and burnout among medical students in the context of COVID-19	PSS-10, Resilience Scale-25 items, Satisfaction with Life Scale (SWLS), OLBI	Regarding burnout, the students scored an average of 40, with a standard deviation of 7 and a range of 22–61 (OLBI). Positive association was found between exhaustion burnout and stress (β = 0.329, p < 0.001), while there was a negative association between resilience (β = 0.029, p = 0.001) and exhaustion burnout and between life satisfaction (β = −0.215, p = 0.002) and exhaustion burnout.

El Mouedden [16]	2022	Belgium	194 medical students and residents	To describe academic and professional burnout levels and their associations with working in COVID-19-related care and with perceived COVID-19 impact on studies and internships among medical students and residents	French version of the MBI-SS	High professional burnout (17%), lower academic burnout (0.5%). Compared to previous studies, higher professional burnout, similar personal accomplishment. COVID-19 impact: Higher impact on studies and work for those involved in COVID-19 care. Emotional exhaustion, reduced personal accomplishment, interpersonal issues, and cynicism due to COVID-19.
Forycka [19]	2022	Poland	1858 medical students	To assess resilience, well-being and burnout among Polish medical students in the COVID-19 era	Resilience Scale 14; RS-14, Medical Student Well-Being Index, MBI	1311 students answered all MBI-GS(S) questions and two-dimensional and three-dimensional burnout scores were calculated (59.9% and 54.2% respectively). Low resilience levels were observed. Higher resilience was associated with a better attitude towards online and hybrid classes. 16.8% of respondents would volunteer to be at the pandemic frontline, showing lower exhaustion, cynicism, and higher academic efficacy.
Frajerman [20]	2022	France	1925 students (medical n=1597, pharmacy students n= 233, dental students n= 95)	To assess mental health in health students from the same university and identify the associated factors.	Hospitalization Anxiety and Depression scale, Composite International Diagnostic Interview-Short Form, MBI	Burnout: 42% among nonclinical students (dental/pharmacy/pre-clinical students) and 65% among clinical students and residents.
Jezzini-Martinez [29]	2023	Mexico	613 medical students	To assess burnout syndrome and its associated factors among medical students during the COVID-19 pandemic	MBI-SS	Most students had burnout symptoms (54.2%) High emotional exhaustion (79.6%), high cynicism (57.3%), and low academic effectiveness (36.4%) were also prevalent. Highest burnout and cynicism were observed in the 6th year, emotional exhaustion in the 3rd, and lowest academic efficacy in the first year. Female students had a higher incidence of burnout, emotional exhaustion and cynicism compared to male students who were statistically more prevalent towards lower academic effectiveness. Death of a family member due to COVID-19 increased the risk of burnout.
Joshi [30]	2022	USA, Saudi Arabia, India	487 medical students	To examine the association between burnout in medical students based on gender and residency specialty choice during COVID-19	MBI, Oldenburg Burnout Inventory (OLBI)	More female participants reported that COVID-19 affected their energy levels (68.9%), interest in education (53.2%), and developed reservations about their residency specialty choice (46%) Female participants also experienced higher levels of emotional exhaustion and physical exhaustion compared to male participants.
Kasemy [32]	2022	Egypt	3582 participants (1056 staff members and 2526 students)	To investigate the technostress creators and outcomes among University medical and nursing faculties and students as direct effects of the remote working environment during the COVID-19 pandemic.	Scale developed by Ragu-Nathan et al., Utrecht Work Engagement Scale	Medical staff members and students reported moderate-to-high technostress associated with high burnout, strain, and cortisol level.
Liu [33]	2022	China	817 medical students	To investigate the influencing factors and mechanism of academic burnout in medical students' online learning process.	Adapted DASS Scale developed by Lovibond and Lovibond, Gregory MSPSS, 10-Item Connor–Davidson Resilience Scale (CD-RISC), MBI-SS	In online learning, medical students' stress was positively correlated with academic burnout, with their resilience playing a partial mediating role. Social support did not directly affect academic burnout but reduced it indirectly through enhancing resilience. Stress negatively impacted resilience. Higher resilience was associated with lower academic burnout.

Metakides [35]	2023	Cyprus	333 medical students	To investigate medical students' burnout and motivation levels in each of the six years of their studies during the COVID-19 pandemic and identify independent predictors of burnout and motivation.	OLBI-S, updated Strength of Motivation for Medical School (SMMS-R)	Higher burnout levels correlated with lower motivation to study medicine. Burnout levels differ significantly between the 6 years of medical school, peaking in years two and four whereas being the lowest in year one. Being a female, studying in the fourth year vs. first year, having a perceived beginner/intermediate vs. advanced/expert technology level and a perceived poor school support system were independently associated with higher burnout levels.
Muaddi [37]	2023	Saudi Arabia	444 medical students	To estimate the prevalence of burnout and its determinants among medical students at Jazan University during the COVID-19 pandemic.	Arabic version of the MBI-SS	The prevalence of burnout was 54.5%. Burnout reached its peak during the fourth year whereas it was the lowest in the internship year. Males (54.0%) and females (55.0%) had almost similar burnout rates. The most important predictive factor was having separated parents. Financial instability, being a resident in mountain areas and being delayed in college level are also associated with higher burnout risk.
Nasr [39]	2023	Lebanon	120 medical students	To evaluate changes in the prevalence rates of burnout among Lebanese pre-final and final year medical students while taking into consideration the impact of COVID-19 on both the academical and clinical experiences.	Copenhagen Burnout Inventory questionnaire	The overall burnout prevalence was 40.01% (39.36% personal burnout, 41.52% work-related burnout, and 39.16% pandemic-related burnout). Theoretical learning and clinical training were reported to be affected in respectively 66.70% and 71.70%. 10% of the students have regretted choosing medicine and 67.50% felt comfortable to get to the next academic level.
Phillips [42]	2022	N/A	53 medical students	To address the relationship between medical student volunteer motivations and specific outcomes during the COVID-19 pandemic	Volunteer Functions Inventory (VFI)	Altruistic and humanitarian values-centric motivation predicts positive volunteering outcomes (increased resilience, improved ability to deal with disappointment and loss, enhanced ability to cope with the COVID-19 pandemic, increased volunteer empathy) Values-centric motivation promotes student empathy and resilience, especially in activities with patient contact. Career-centric motivation does not predict positive outcomes and these students are more likely to engage in research-oriented activities.
Qu [44]	2022	China	995 medical students	To investigate the mediating role of general academic emotions in procrastination and burnout among Chinese medical students during the COVID-19 pandemic.	Chinese version of the MBI-SS, Aitken Procrastination Inventory (API), General Academic Emotion Questionnaire for College Students (GAEQ).	Significant positive correlation between procrastination and burnout. Procrastination had positive associations with negative academic emotions, while it had negative associations with positive academic emotions. The contributions (as mediators) of GAEs to burnout and procrastination were 21.16% (NAEs), 29.75% (PAEs), 54.25% (NDEs) and 23.69% (PDEs).
Rolland [45]	2022	France	11754 medical students	To assess French medical students' mental health.	Hospitalization Anxiety and Depression scale, Composite International Diagnostic Interview-Short Form, MBI	Prevalence of 7-day anxiety symptoms, 7-day depressive symptoms, 12-month MDE, and 12-month suicidal thoughts were 52%, 18%, 25%, and 19% respectively. Burnout syndrome concerned 67% of clinical students and residents and 39% of preclinical students. Having important or very important financial issues, experienced humiliation, sexual harassment and sexual abuse were associated with an increased risk of MDE.
Ruiz [46]	2022	Guatemala	159 medical students (2017), of whom 132 participated in the second phase (2020)	To assess levels of burnout in 2017 and then again in December 2020	Spanish version of the MBI-SS	Rates of burnout were higher during the pandemic. Rates of depersonalization had not increased, and levels of personal accomplishment had.

Silistraru [50]	2022	Romania	126 medical students	To investigate the prevalence of burnout in Romanian medical students during the COVID-19 pandemic and to identify the presence of intentional shift in medical specialty compared to their initial pursued choice	MBI-GS(S)	36.5% of the medical students experienced burnout. Exhaustion and Cynicism, which are associated with depersonalization, showed high scores compared to the average scale while the Professional Efficacy score was relatively high. About one third of the respondents (30% Cluj students and 37.5% Iasi students) considered changing residency options.
Sulaiman [52]	2023	Qatar	272 health profession students (dental, medicine, pharmacy, health sciences)	To evaluate the prevalence of burnout and its relationship to anxiety and empathy during the COVID-19 pandemic among health profession students in the main governmental institution in Doha, Qatar using validated instruments	MBI-GS(S), Generalized Anxiety Disorder (GAD-7), Interpersonal Reactivity Index (IRI)	Burnout was found to be prevalent amongst the students. The mean scores for the MBI-GS(S) subscales of emotional exhaustion, cynicism, and professional efficacy were 4.07, 2.63, and 3.97, respectively. Anxiety was found to be a strong predictor for burnout and burnout was positively associated with empathy.
Tee [53]	2022	Malaysia	378 clinical year undergraduate medical students	To determine the prevalence of anxiety and burnout, and the coping mechanisms among clinical year undergraduate medical students in Universiti Kebangsaan Malaysia (UKM) during the COVID-19 pandemic	DASS-21, CBI, Brief-COPE	The prevalence of anxiety and burnout were 44.2% and 22.2%, respectively. There was a significant difference in the percentage of students with extremely severe anxiety in the presence and absence of burnout, 23.8% vs. 4.8%. Among the three coping mechanisms, avoidant coping had a significant positive moderate correlation with both the presence of anxiety and the presence of burnout. Meanwhile, coping that was neither approach nor avoidant had a positive weak correlation with the presence of burnout.
Tokumasu [54]	2023	Japan	211 medical students	To investigate the differences in stress perception of medical students depending on in-person communication and online communication during the COVID-19 pandemic	Jefferson Scale of Empathy, Japanese version of the PSS, developed by Cohen et al.	No significant association between perceived stress and online communication, but the number of people with which students had in-person communication and the length of communication were associated with a reduction in perceived stress. In subgroup analysis, the number of people with in-person communication and the length of communication had significant associations with stress reduction even in the group of students who had a preference for being by themselves.
Wilkes [56]	2021	Canada	101 medical students	To review medical student wellness in the context of the collaboration of a core study group in the UK with 12 countries around the world	Short-form general health questionnaire (GHQ-12), OLBI	21% reported a mental health condition, most commonly an anxiety disorder and or depressive disorder. Study (81%), relationships (62%), money (35%), and accommodation or housing (10%) are the most significant stressors. 14% tested CAGE positive and 20% reported having taken a non-prescription substance to feel better or regulate their mood. 75% met specific case criteria for exhaustion on the Oldenburg Burnout inventory and 74% met criteria for the GHQ questionnaire.
Yang [58]	2023	China	4661 undergraduate students	To compare the mental health conditions and academic burnout between medical and non-medical undergraduates in China when the COVID-19 pandemic is mitigating	Academic Burnout Scale (ABS), PHQ-9, GAD-7, Epworth Sleepiness Scale (ESS), PSS-10, 3-item Alcohol Use Dependence Identification Test (AUDIT-C)	Compared with medical undergraduates, non-medical undergraduates had higher rates of moderate to severe depression symptoms, moderate to severe anxiety symptoms, alcohol abuse/dependence, excessive daytime sleepiness, high perceived stress, high level of fatigue, low QOL, and higher academic burnout score.

Zhang [59]	2021	China	684 medical students	To evaluate the association between learning burnout and social support in Chinese medical students.	Lian version of the MBI, Social Support Rating Scale (SSRS)	315 students (46.12%) met standard criteria for learning burnout. Seniors, low family income and low social support were significant predictors of learning burnout. After adjusting for the grade and family income, there was a significant and relevant association between social support and learning burnout.
Zis [60]	2021	Cyprus	154 medical students	To investigate what the impact of digital learning due to the COVID-19 pandemic was on the burnout and overall mental health (MH) of medical students.	MH domain of the 36-item Short Form Health Survey (SF-36), MBI-SS	The overall burnout prevalence was similar (pre-COVID-19 18.1% vs. COVID-19 18.2%). However, the burnout prevalence dropped significantly in year 4 (pre-COVID-19 40.7% vs. COVID-19 16.7%), whereas it increased significantly in year 6 (pre-COVID-19 27.6% vs. COVID-19 50%). Emotional exhaustion decreased significantly in year 4 but increased in year 6, and cynicism increased in all years. The overall MH deteriorated significantly between the two periods (pre-COVID-19 58.8 ± 21.6 vs. COVID-19 48.3 ± 23).
Žuljević [61]	2021	Croatia	Medical students. 437 before and 235 after lockdown - 160 participant responses eligible for pairing	To evaluate the impact of the first COVID-19 lockdown in 2020 on the burnout and study satisfaction of medical students.	OLBI, Copenhagen Burnout Inventory	No significant difference for both paired and unpaired participants in study satisfaction before and after lockdown. No evidence for an increase in the level of burnout before and after lockdown, both in independent and paired samples.
Zúñiga [62]	2021	Chile	102 fourth-year medical students	To report the implementation and impact of an eight-week multifaceted mindfulness-based self-care program on medical students' distress and well-being during the COVID-19 pandemic.	MBI-HSS, PSS, IES-R, Brief-COPE, Mindful Attention Awareness Scale (MAAS), Mental Health Continuum Short-Form (MHCSF), Connor-Davidson Resilience Scale (CD-RISC)	Burnout prevalence decreased from 48% to 24%, whereas students with high dispositional mindfulness increased from 25% to 44%. Burnout reduction was mostly due to decreased emotional exhaustion. Additionally, students reported lower levels of stress, self-blaming, and traumatic stress reactions alongside an increased use of active coping strategies and resilience levels after the program.

Data analysis

The analysis of the findings followed a narrative synthesis approach, which was conducted in stages aligned with the study objectives.[10] This narrative approach was chosen due to the diverse nature of the outcome measures employed in the studies. While many studies employed variations of the same measure, they were not consistently applied across all studies, making a narrative synthesis the appropriate method in this context. A quantitative approach was deemed unsuitable because the measures could not be directly compared.43 In light of this, we concluded that while a meta-analysis would be a powerful tool for synthesizing the data of our review, it would not be feasible in this case, primarily due to the heterogeneity in study designs (e.g., methodologies, sample sizes, research designs, and measurement tools, such as different burnout scales). Such variability would make it challenging to pool results meaningfully and could risk introducing bias or misrepresentation of the findings. Moreover, the number of studies was limited, and some presented insufficient data reporting. For all these reasons, we chose the narrative synthesis approach over a meta-analysis that would, by definition, lack statistical robustness. Initially, summaries of the eligible studies and their outcomes were compiled and presented in ***Table 1.*** Subsequently, an exploration of data patterns was carried out manually to identify consistent findings related to the study objectives. An in-depth analysis of the findings investigated the relationships between various study characteristics, with particular emphasis on the number of participants and outcome measurements, and their respective outcomes, compared findings across different studies, and assessed how the utilization of distinct outcome measures, methods, and settings influenced the resulting data. The stages of this narrative synthesis process are illustrated in ***Figure 2.***

While the narrative synthesis approach allowed for a comprehensive analysis of diverse studies, it is not without limitations. The subjective character of this method could lead to bias because it mainly depends on the reviewers' interpretations. Furthermore, it may be difficult to make straight comparisons and generalizations due to the variations in research designs and outcome measures. The findings are further limited by potential selection bias and the exclusion of studies written in languages other than English. Notwithstanding these difficulties, the narrative synthesis offered a methodical way to combine and analyze the diverse data, ensuring a thorough examination of the research goals.

Quality Assessment

We used the Critical Appraisal Skills Programme (CASP) checklists to perform a quality assessment and guarantee the rigor and quality of the included studies. This 10-item tool is designed to

assess the methodological trustworthiness, applicability, and conclusions of each study.64 Precisely, the CASP incorporates three main sections when appraising a systematic review to answer to these questions: are the results valid; what are the results; will the results help locally. Important factors like the clarity of the research objectives, suitability of the study design, recruitment strategy, data collection techniques, ethical considerations, and the validity and reliability of the findings were all examined in each study and are detailed in ***Table 2***. This quality assessment provided an additional layer of rigor to our systematic review, ensuring that the conclusions drawn are based on high-quality evidence

Results

Search Results

Using the search strategy outlined above, 579 references were retrieved, comprising 110 articles from PubMed, 346 articles from Scopus, 85 articles from PsycNET and 38 articles from Google Scholar. Among these publications, 250 were excluded at the subsequent stage of the study, with 68 being duplicates and the remaining 182 removed due to technical issues with the Scopus database that prevented us from accessing the initial list of results after secondary assessment. To maintain the integrity of our study, we decided to exclude these records. Of the 329 records assessed through title and abstract screening, 259 were removed due to their lack of relevance to the study objective or due to limited accessibility. From the remaining 70 reports, it was not feasible to retrieve full text for 4 of them, resulting in full text screening for 66 articles. At this early stage, it was not always clear whether the studies focused on medical students, burnout syndrome, or the timeline of the COVID-19 pandemic. To avoid prematurely excluding potentially relevant studies, we permitted studies that were not clearly irrelevant to proceed to the full-text review. This approach allowed for a more detailed assessment, ultimately leading to the exclusion of studies that did not meet the inclusion criteria upon closer examination. Among these 66 articles , 7 did not focus on medical students, 18 did not refer to the burnout syndrome and/or the COVID-19 pandemic, 6 utilized very small sample populations or specific, non-representative groups of medical students, and 4 articles were not original research papers but rather meta-analysis, clinical trials, etc. Consequently, an additional 35 records were eliminated, ultimately culminating in the inclusion of thirty-one studies ***(Figure 1).***

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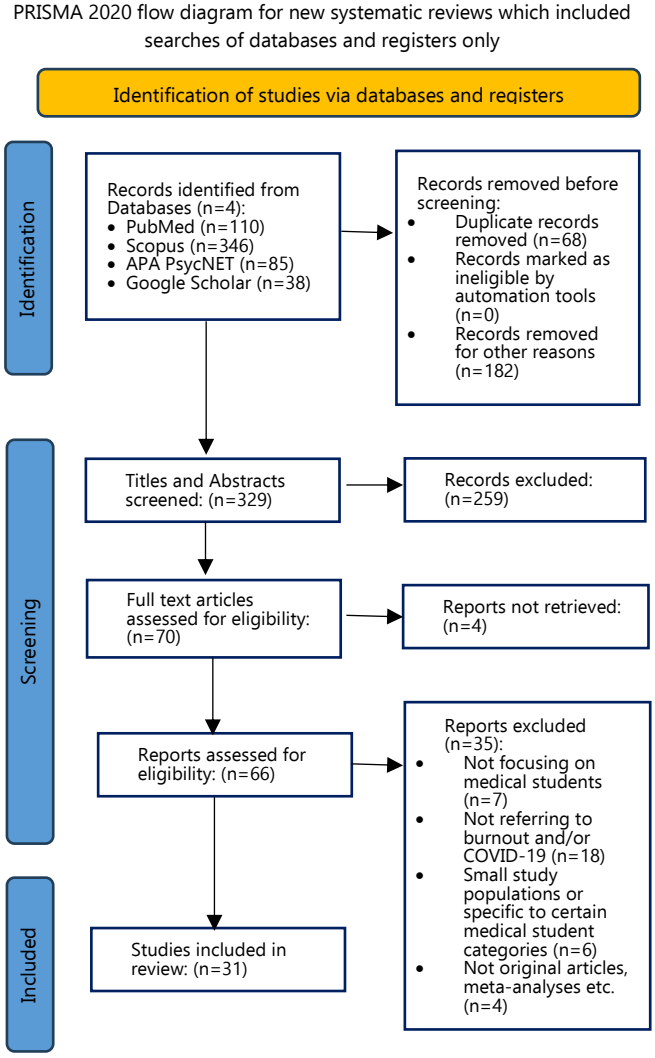
Figure 1. PRISMA Flow Diagram.



Legend: From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

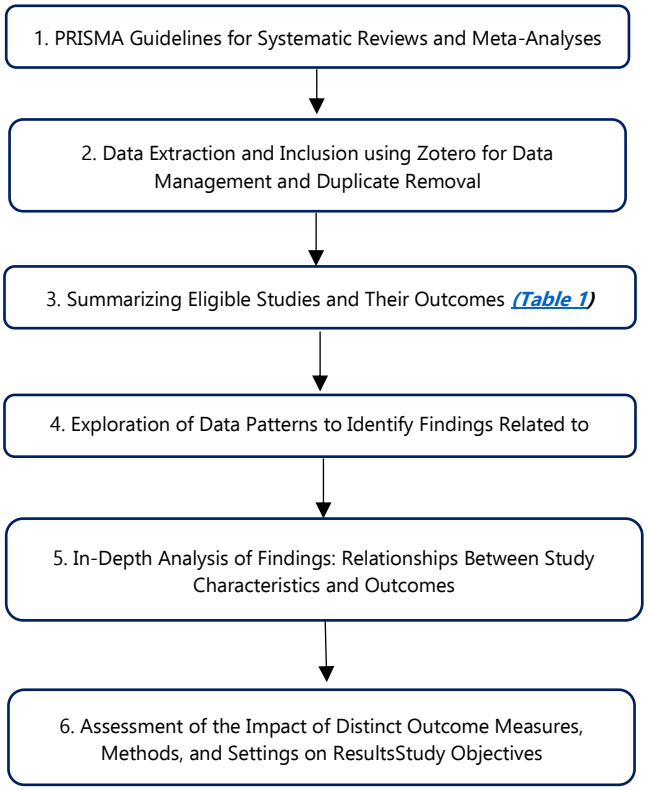
prematurely excluding potentially relevant studies, we permitted studies that were not clearly irrelevant to proceed to the full-text review. This approach allowed for a more detailed assessment, ultimately leading to the exclusion of studies that did not meet the inclusion criteria upon closer examination. Among these 66 articles , 7 did not focus on medical students, 18 did not refer to the burnout syndrome and/or the COVID-19 pandemic, 6 utilized very small sample populations or specific, non-representative groups of medical students, and 4 articles were not original research papers but rather meta-analysis, clinical trials, etc. Consequently, an additional 35 records were eliminated, ultimately culminating in the inclusion of thirty-one studies ***(Figure 1).***

Characteristics of Included Studies

The main characteristics of the included studies are listed in ***Table 1.*** The range of sample size was between 53 and 11754. There

was a total of 37166 participants from 25 different countries across all the studies. The year of the studies included were from 2020 to 2023. Most of the thirty-one studies included in this review were cross-sectional and examined the impact of the COVID-19 pandemic on the levels of burnout among medical students by comparing their results with data from pre-pandemic studies. Only three of these studies incorporated a control group as they were conducted in two distinct phases, one before and one during the pandemic. These phases involved students from the same educational institutions, ensuring the ability to draw dependable conclusions. Ten publications enlisted students from multiple institutions.

Figure 2. Narrative Synthesis Process Flowchart.



Concerning the outcome measurements, in 18 studies the Maslach Burnout Inventory (MBI) was employed, the Perceived Stress Scale (PSS) was utilized in 5, the Oldenburg Burnout Inventory (OLBI) was chosen in 6 cases, and 3 studies incorporated questionnaires related to COVID-19, often utilizing the FCV-19S. Four investigations encompassed the Generalized Anxiety Disorder (GAD), and three included the Patient Health Questionnaire (PHQ). Furthermore, four studies utilized the Copenhagen Burnout Inventory (CBI-SS), while two studies adopted outcome measures such as the Depression, Anxiety, Stress Scale (DASS), or the brief COPE respectively.

Review Findings

The studies that were included found that an outsize proportion of medical students, exceeding 35% in most of the studies, experienced prominent levels of burnout. This was observed irrespective of the presence of the COVID-19 pandemic, as indicated by references.2,20,29,37,39,45,50,59 The results of the studies were often conflicting regarding the comparison of the prevalence of burnout before and during the pandemic, as some studies showed a higher prevalence,46 while others indicated a lower one,2,5 and some exhibited no significant variation.60 What remains consistent across a spectrum of research findings is the notable prevalence of the burnout syndrome among medical students. Furthermore, certain studies presented contradicted findings regarding the comparison between medical students and other undergraduates. On the one hand, Shpakou et al. revealed least satisfaction with life and more elevated level of perceived stress for future doctors compared with students of physical culture and pedagogical departments. On the other hand, Yang et al. indicated a heightened incidence of perceived stress, depression and anxiety, lower QOL, and elevated academic burnout scores among health sciences students compared with those from other academic disciplines.

I. Demographic Factors

Gender, age, and the year of medical school of students were identified as potential predictors of burnout in several studies, though the findings were not consistent. In total, five studies attempted to investigate gender as a risk factor for burnout.[2,29,30,37,44] Two research teams indicated higher rates of burnout in females, two showed no significant correlation, and one study indirectly suggested an increased likelihood of burnout for male students. Jezzini-Martinez et al. and Joshi et al. suggested that female students exhibit poorer overall mental health compared to their male peers,[29,30] identifying notably higher emotional exhaustion scores in those students. According to the Mexican study, female medical students had higher burnout scores, while lower academic effectiveness was described primarily among male participants.[29] On the contrary, other researchers found no significant differences in total burnout scores between genders,[2,37] while Alkureishi et al. reported higher stress levels among females.[2] Moreover, Qu et al. reported statistically significant stronger negative and positive deactivation emotions (NDEs, PDEs) for males. This indicated that academic emotions such as hopelessness and boredom as well as pride and relief more frequently lead male than female students to procrastination and eventually burnout.

Conflicting results were found among studies that compared levels of burnout and overall mental health between undergraduate medical students in different academic years of their university degree. A study in Switzerland, involving both students and residents, indicated that clinical-year students involved in the COVID-19 response had lower rates of burnout, depression, and anxiety compared to their non-involved peers,[1] while according to Polish researchers respondents who volunteered to be at the pandemic frontline, showed lower exhaustion, cynicism, and higher academic efficacy.[19] Another research, encompassing students from 22 medical schools, demonstrated elevated levels of burnout in students during their second and third years of education.[2] Interestingly, Metakides et al. and Muaddi et al. results coincided on burnout levels varying

Table 2. CASP Checklist for Systematic Reviews.

	Section A: Are the results of the review valid?					Section B: What are the results?			Section C: Will the results help locally?	
Paper Lead Author	Did the review address a clearly focused question?	Did the authors look for the right type of papers?	Do you think all the important, relevant studies were included?	Did the review's authors do enough to assess the quality of the included studies?	If the results of the review have been combined, was it reasonable to do so?	What are the overall results of the review?	How precise are the results?	Can the results be applied to the local population?	Were all important outcomes considered?	Are the benefits worth the harms and costs?
Aebischer [1]	Yes. The study examines the physical and psychological health impacts on medical students involved in the COVID-19 response in Switzerland.	Yes. The study used a cross-sectional survey method, which is suitable for assessing health impacts.	Can't tell. While the study used a cross-sectional survey method, it is not clear if all relevant studies were included.	Yes. The authors assessed the quality of the included studies by examining the methodologies and outcomes.	Yes. The results were combined in a reasonable manner to provide a comprehensive view of the health impacts	The overall results indicate that medical students involved in the COVID-19 response experienced significant physical and psychological health impacts.	Can't Tell: The precision of the results is not explicitly detailed, but the findings are supported by the data presented	Yes. Applicable to medical students globally.	Yes. The study considered a range of physical and psychological health outcomes, which are important for understanding the impact.	Yes. Understanding the health impacts on medical students can inform future support strategies.
Alkureishi [2]	Yes. Focused on the impact of the early COVID-19 phase on medical students.	Yes. They conducted a multisite survey relevant to the topic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. They utilized a detailed survey method.	Yes. They compared data from multiple sites.	The early phase of COVID-19 had a significant negative impact on student well-being.	Can't tell. Specific statistical precision measures are not mentioned.	Yes. Applicable to medical students globally.	Yes. They looked at various aspects of well-being.	Yes. The study highlights important areas for intervention.
Asl [4]	Yes. Investigated the mediating role of compassion between COVID-19 anxiety and burnout.	Yes. Focused on studies related to COVID-19 anxiety and burnout.	Can't tell. The comprehensiveness of the search is not specified.	Yes. Detailed analysis of the mediating factors.	Yes. They assessed relationships between variables.	Compassion mediates the relationship between anxiety and burnout.	Can't tell. Specific statistical precision measures are not mentioned.	Yes. Applicable to medical students globally.	Yes. Focused on anxiety, compassion, and burnout.	Yes. Provides insights into intervention strategies.
Bolatov [5]	Yes. Examined the impact of online learning on mental health.	Yes. Included studies on online learning and mental health.	Can't tell. The comprehensiveness of the search is not specified.	Yes. Detailed methodological approach.	Yes. Combined data from relevant studies.	Online learning had a positive impact on mental health.	Can't tell. Specific statistical precision measures are not mentioned.	Yes. Applicable to medical students globally.	Yes. Focused on mental health outcomes.	Yes. Positive implications for online learning strategies.
Compton [11]	Yes. Investigated students' preferences for returning to clinical settings.	Yes. Relevant studies on student preferences and clinical settings.	Can't tell. The comprehensiveness of the search is not specified.	Yes. Detailed methodological approach.	Yes. Combined data on preferences.	Students preferred returning to clinical settings with adequate safety measures.	Can't tell. Specific statistical precision measures are not mentioned.	Yes. Applicable to medical students globally.	Yes. Focused on preferences and safety concerns.	Yes. Important for planning clinical rotations.
Daryanto [12]	Yes. Investigated burnout prevalence and factors during COVID-19.	Yes. Relevant studies on burnout among medical students.	Yes. Comprehensive analysis of burnout factors.	Yes. Detailed methodological approach.	Yes. Combined data from relevant studies.	High prevalence of burnout, with several associated factors identified.	Yes. Statistical precision is discussed.	Yes. Applicable to medical students globally.	Yes. Considered various burnout factors.	Yes. Important for addressing burnout.
Duarte [14]	Yes. Examined resilience and life satisfaction as mediators between stress and burnout.	Yes. Relevant studies on stress, burnout, and resilience.	Can't tell. The comprehensiveness of the search is not specified.	Yes. Detailed analysis of mediating factors.	Yes. Combined data on stress and burnout.	The results indicate that resilience and life satisfaction mediate the relationship between stress and burnout among medical students during COVID-19.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered stress, burnout, resilience, and life satisfaction, which are critical for understanding the full impact on medical students.	Yes. Understanding these relationships can help develop supportive measures.

El Moueddeen [16]	Yes. The study focuses on academic and professional burnout in medical students and residents during the first COVID-19 lockdown in Belgium.	Yes. The authors looked for studies that examine burnout among medical students and residents during the COVID-19 lockdown.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by examining the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of burnout experiences.	The results indicate significant experiences of burnout among medical students and residents during the first lockdown.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered both academic and professional burnout, which are critical for understanding the full impact.	Yes. Understanding burnout experiences can help develop supportive measures.
Forycka [19]	Yes. The study focuses on resilience, well-being, and burnout among Polish medical students during the COVID-19 pandemic.	Yes. The authors examined papers that explore resilience, well-being, and burnout among medical students during the pandemic	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of resilience, well-being, and burnout.	The results indicate significant issues related to resilience, well-being, and burnout among medical students during the pandemic.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered resilience, well-being, and burnout, which are critical for understanding the full impact on medical students.	Yes. Understanding these factors can help develop supportive measures.
Frajerman [20]	Yes. The study focuses on the mental health of medical, dental, and pharmacy students.	Yes. The authors examined papers that explore mental health among students in medical, dental, and pharmacy fields.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of mental health among these student populations.	The results indicate significant mental health issues among medical, dental, and pharmacy students.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical, dental and pharmacy students globally.	Yes. The study considered various aspects of mental health, which are critical for understanding the full impact on students.	Yes. Understanding mental health issues in these student populations can help develop supportive measures.
Jezzini-Martinez [29]	Yes. The study focuses on assessing burnout syndrome and associated factors among medical students during the COVID-19 pandemic.	Yes. The authors examined papers related to burnout among medical students during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of burnout and associated factors.	The results indicate significant burnout syndrome and identify various associated factors among medical students during the pandemic.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered various factors associated with burnout, which are critical for understanding the full impact.	Yes. Understanding burnout and its associated factors can help develop supportive measures.
Joshi [30]	Yes. The study focuses on factors influencing burnout in millennial medical students during the COVID-19 pandemic.	Yes. The authors examined papers related to burnout among millennial medical students during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of factors influencing burnout.	The results indicate significant factors influencing burnout among millennial medical students during the pandemic.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered various factors influencing burnout, which are critical for understanding the full impact.	Yes. Understanding burnout and its associated factors can help develop supportive measures.

Kasemy [32]	Yes. The study focuses on technostress creators and outcomes among Egyptian medical staff and students during the COVID-19 pandemic.	Yes. The authors examined papers related to technostress among medical staff and students during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of technostress creators and outcomes.	The results indicate significant technostress creators and their outcomes among medical staff and students during the pandemic.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. The results are specific to Egyptian medical staff and students but can be informative for similar populations in other regions.	Yes. The study considered various aspects of technostress, which are critical for understanding the full impact.	Yes. Understanding burnout and its associated factors can help develop supportive measures.
Liu [33]	Yes. The study focuses on the impact of social support and stress on academic burnout among medical students in online learning, with resilience as a mediating factor.	Yes. The authors examined papers related to social support, stress, resilience, and academic burnout among medical students.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of the impact of social support and stress on academic burnout.	The results indicate significant impacts of social support and stress on academic burnout, with resilience playing a mediating role.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students in online environments globally.	Yes. The study considered social support, stress, resilience, and academic burnout, which are critical for understanding the full impact.	Yes. Understanding burnout and its associated factors can help develop supportive measures.
Metakides [35]	Yes. The study focuses on burnout and motivation to study medicine among students during the COVID-19 pandemic.	Yes. The authors examined papers related to burnout and motivation among medical students during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of burnout and motivation.	The results indicate significant burnout and its impact on motivation to study medicine among students during the pandemic.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered burnout and motivation, which are critical for understanding the full impact.	Yes. Understanding burnout and its associated factors can help develop supportive measures.
Muaddi [37]	Yes. The study focuses on assessing burnout among medical students during the COVID-19 pandemic.	Yes. The authors examined papers related to burnout among medical students during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of burnout among medical students.	The results indicate significant burnout among medical students during the pandemic.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered various aspects of burnout, which are critical for understanding the full impact.	Yes. Understanding burnout and its associated factors can help develop supportive measures.
Nasr [39]	Yes. The study focuses on burnout rates among Lebanese pre-final and final year medical students during the COVID-19 pandemic.	Yes. The authors examined papers related to burnout among medical students during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of burnout rates.	The results indicate significant burnout rates among Lebanese pre-final and final year medical students during the pandemic.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered various aspects of burnout, which are critical for understanding the full impact.	Yes. Understanding burnout rates can help develop supportive measures.

Phillips [42]	Yes. The study focuses on medical student volunteerism and its impact during the COVID-19 pandemic.	Yes. The authors examined papers related to medical student volunteerism during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of the impact of volunterism.	The results indicate significant impacts of medical student volunteerism during the pandemic.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered various aspects of volunteerism and its impacts, which are critical for understanding the full impact.	Yes. Understanding burnout rates can help develop supportive measures.
Qu [44]	Yes. The study focuses on the mediating role of general academic emotions in burnout and procrastination among Chinese medical undergraduates during the COVID-19 pandemic.	Yes. The authors examined papers related to academic emotions, burnout, and procrastination among medical students.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of the mediating role of academic emotions.	The results indicate significant mediating effects of general academic emotions on burnout and procrastination among medical undergraduates.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered academic emotions, burnout, and procrastination, which are critical for understanding the full impact.	Yes. Understanding burnout rates can help develop supportive measures.
Rolland [45]	Yes. The study focuses on mental health and working conditions among French medical students.	Yes. The authors examined papers related to mental health and working conditions among medical students.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. The results were combined reasonably to provide a comprehensive view of mental health and working condition.	The results indicate significant impacts of working conditions on mental health among French medical students.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered various aspects of working conditions and their impacts on mental health, which are critical for understanding the full impact.	Yes. Understanding burnout rates can help develop supportive measures.
Ruiz [46]	Yes. The study clearly focused on comparing the prevalence of burnout in medical students before and during the COVID-19 pandemic.	Yes. The authors focused on studies relevant to burnout in medical students during the specified periods.	Can't tell. The comprehensiveness of the search is not specified.	Yes. The authors assessed the quality by evaluating the methodologies and outcomes of the included studies.	Yes. Combining the results was reasonable to compare the prevalence before and during the pandemic	The review found an increased prevalence of burnout among medical students during the COVID-19 pandemic compared to before.	Can't Tell. The precision of the results is not explicitly detailed but is supported by the presented data.	Yes. Applicable to medical students globally.	Yes. The study considered key outcomes like prevalence rates and contributing factors.	Yes. Understanding prevalence can help in designing interventions to mitigate its effects.
Silistraru [50]	Yes. The study focused on burnout and residency choices among Romanian medical students during lockdown.	Yes. They examined papers addressing burnout and medical education during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. They assessed the quality of the studies included.	Yes. Combining results provided a comprehensive overview of the impact on Romanian students.	The review indicated significant burnout levels and shifts in residency preferences among students.	Can't tell. Specific precision metrics were not detailed.	Yes. Applicable to medical students in Romania and worldwide.	Yes. Important outcomes such as burnout levels and residency choices were considered.	Yes. Understanding these factors can help in policy-making and educational planning.

Sulaiman [52]	Yes. The study focused on burnout, anxiety, and empathy among health profession students during the pandemic.	Yes. They included papers on mental health and burnout among health profession students.	Can't tell. The comprehensiveness of the search is not specified.	Yes. Quality assessment was conducted for included studies.	Yes. It was reasonable to combine the results for a comprehensive analysis.	The study found high levels of burnout, anxiety, and variable levels of empathy among students.	Can't tell. The precision of the results was not explicitly discussed.	Yes. Applicable to medical students in Qatar Univeristy and worldwide.	Yes. Key outcomes like burnout, anxiety, and empathy were considered.	Yes. Insights from the study can inform support strategies for students.
Tee [53]	Yes. The study focused on anxiety, burnout, and coping mechanisms among medical students.	Yes. The authors included papers relevant to mental health among medical students during the pandemic	Can't tell. The comprehensiveness of the search is not specified.	Yes. Quality assessment was mentioned.	Yes. Combining results was reasonable to understand the overall impact.	The review found significant levels of anxiety and burnout, with various coping mechanisms employed by students.	Can't tell. Precision details were not explicitly provided.	Yes. Applicable to medical students in Malaysia and worldwide.	Yes. Important outcomes such as prevalence of anxiety, burnout, and coping mechanisms were considered.	Yes. The findings can guide interventions to support student mental health.
Tokumasu [54]	Yes. The study focused on stress perception related to in-person and online communication among medical students.	Yes. They included papers related to stress and communication modes during the pandemic.	Can't tell. The comprehensiveness of the search is not specified.	Yes. Quality assessment was conducted for included studies.	Yes. Combining results was reasonable to understand the overall impact.	The study found differences in stress perception based on the mode of communication.	Can't tell. The precision of the results was not explicitly discussed.	Yes. The results are applicable to Japanese medical students and medical students worldwide.	Yes. Important outcomes such as stress perception and communication modes were considered.	Yes. Understanding stress perception can help in planning better communication strategies.
Wilkes [56]	Yes. The study focused on the wellbeing and mental health of medical students in Canada during the pandemic.	Yes. They included studies relevant to mental health and wellbeing among medical students.	Can't tell. The study did not detail the search strategy comprehensively.	Yes. Quality assessment of included studies was mentioned.	Yes. Combining the results provided a comprehensive overview of mental health and wellbeing.	The review found significant mental health challenges and varying levels of wellbeing among Canadian medical students.	Can't tell. The precision was not explicitly discussed.	Yes. The results are applicable to Canadian medical students and medical students worldwide.	Yes. Important outcomes like mental health status and wellbeing were considered.	Yes. Understanding these factors can help in developing support strategies for students.
Yang [58]	Yes. The study focused on mental health and academic burnout among undergraduates during the pandemic.	Yes. The review included studies on mental health and academic burnout during the pandemic.	Can't tell. The search strategy was not fully detailed.	Yes. The quality of included studies was assessed.	Yes. Combining results was reasonable for a comprehensive analysis.	The review found significant mental health challenges and academic burnout among undergraduates.	Can't tell. Precision details were not explicitly provided.	Yes. The findings are relevant to the population of Chinese undergraduates.	Yes. Important outcomes like mental health conditions and academic burnout were considered.	Yes. Understanding these issues can help in designing interventions for student support.
Zhang [59]	Yes. The study focused on the role of social support in learning burnout among medical students.	Yes. They included studies relevant to social support and learning burnout.	Can't tell. The search strategy was not fully detailed.	Yes. Quality assessment of included studies was conducted.	Yes. Combining results was reasonable for a comprehensive analysis.	The review found that social support plays a significant role in mitigating learning burnout among medical students.	Can't tell. Precision details were not explicitly provided.	Yes. The findings are applicable to medical students in similar contexts.	Yes. Important outcomes like social support and learning burnout were considered.	Yes. Insights from the study can inform support strategies to reduce burnout.
Zis [60]	Yes. The study focused on the impact of digital learning on burnout and mental health among medical students.	Yes. They included studies relevant to digital learning and its impact on students' mental health.	Can't tell. The search strategy was not comprehensively detailed.	Yes. The quality of included studies was assessed.	Yes. Combining results provided a comprehensive overview of the impact of digital learning.	The review found that digital learning had a significant impact on burnout and mental health among medical students.	Can't tell. Precision details were not explicitly provided.	Yes. The findings are applicable to medical students experiencing digital learning environments.	Yes. Important outcomes like burnout and mental health impacts were considered.	Yes. Understanding these impacts can help in designing better digital learning strategies.

Žulje vić [61]	Yes. The study focused on the impact of the first COVID-19 lockdown on study satisfaction and burnout among medical students.	Yes. They included studies on study satisfaction and burnout during the lockdown.	Can't tell. The search strategy was not comprehe nsively detailed.	Yes. Quality assessme nt was conducte d for included studies.	Yes. Combin ing results was reasona ble for underst anding the overall impact.	The study found changes in study satisfaction and burnout levels pre- and post-lockdown.	Can't tell. Precision was not explicitly discussed.	Yes. The findings are applicable to medical students in Split, Croatia but also worldwid e.	Yes. Important outcomes like study satisfaction and burnout were considered.	Yes. Understandi ng these impacts can help in designing intervention s to support students.
Zúñi ga [62]	Yes. The study clearly focused on assessing the impact of a self-care program on burnout and mindfulness among medical students during the COVID-19 pandemic.	Yes. They included studies that evaluated the effects of self-care programs on burnout and mindfulness in medical students.	Can't tell. The search strategy was not comprehe nsively detailed.	Yes. The article indicates that the quality of the included studies was assessed, although specific details on the assessme nt process are not provided.	Yes. Combin ing results from similar interve ntions to assess overall effectiv eness is reasona ble and provide s a more compre hensive underst anding of the progra m's impact.	The review found that the self-care program led to reduced burnout and increased mindfulness among medical students, suggesting positive mental health outcomes.	Can't tell. Precision was not explicitly discussed.	Yes. The results can be applied to medical students who are experienci ng similar stressors and challenge s, especially in the context of the COVID-19 pandemic .	Yes. Important outcomes like burnout and mindfulness were considered, which are critical measures of mental health and well-being.	Yes. The benefits of reduced burnout and increased mindfulness are significant. The self-care program likely has a positive impact.

significantly between the 6 years of medical school, peaking in year four. Daryanto et al. state that burnout presented a higher prevalence among preclinical students during the pandemic.[12] In contrast, two French studies reported similar burnout prevalences, ranging between 39% and 42% among nonclinical students and between 65% and 67% among clinical students and residents.[20,45] Jezzini-Martinez et al. also found significant correlation between school year and burnout, describing highest burnout and cynicism in the 6th year, emotional exhaustion in the 3rd, and lowest academic efficacy in the first year.[29]

As evident from the findings, there is substantial variation among the results of different studies, rendering it challenging to determine any discernible pattern regarding the escalation or reduction of burnout rates throughout the academic years. This divergence could be attributed to disparities in geographic locations, different lockdown conditions and distinct educational curricula implemented by each university included.

II. Pandemic vs. Pre-Pandemic Burnout Levels and Education

Regarding the comparison of burnout levels between two distinct chronic periods (pre-pandemic and during the pandemic), the studies incorporated in this investigation once again do not exhibit unanimous consensus. Some research indicates an escalation in burnout levels during COVID-19 outbreak,16,46 while others contend that they remained relatively stable.60,61 Additionally, there are a few studies that have documented a decline in burnout among medical students.[2,5] This observed inconsistency arises from differences in study designs (cross-sectional vs. longitudinal), population characteristics (e.g. sample size, year of study), and contextual factors, including country-specific responses to the pandemic, healthcare system characteristics, and variations in educational approaches, such as remote learning, changes in clinical rotations, and mental health support.

The pandemic affected both theoretical learning and clinical training.[39] According to a Kazakhstan study, the prevalence of burnout syndrome, depression, anxiety, and somatic symptoms decreased after transitioning from traditional to online learning.[5] One study found that rates of depersonalization had not increased;[46] notwithstanding, most of the studies reported increased prevalence of colleague-related burnout, indicating the negative impact of online learning on students' communication and interpersonal relationships.[5,50] Tokumasu et al. did not reveal significant association between perceived stress and online communication. Nonetheless, there was a notable reduction in perceived stress observed when students engaged in face-to-face interactions, which was evident even in the subgroup of those who preferred being by themselves.[54]

Hence, the pandemic exerted distinct effects on various facets of burnout, specifically those associated with the educational process and interpersonal communication. It manifested a propensity to ameliorate the former while concurrently presenting an adverse influence on the latter. This phenomenon aligns logically with the fact that, during the lockdown period, educational demands were notably less stringent than usual as students had more available time to absorb new knowledge, facilitated by the absence of commutes and the limited availability of time-consuming extracurricular activities. In parallel, the importance of interpersonal relationships was inadvertently underprioritized, thereby negatively impacting the psychological well-being of students due to the lack of face-to-face interactions with peers and colleagues. This phenomenon may explain the preference of approximately two-thirds of

students, as emphasized by Compton et al., to return to clinical settings, showcasing increased internal motivation, a stronger sense of professional responsibility, and diminished self-perceived risk to patients, in comparison to those who preferred not to return.[11]

Additionally, it is noteworthy that higher resilience was linked to a more positive attitude towards online and hybrid classes,[19] whereas moderate-to-high technostress reported by Egyptian medical students was associated with heightened levels of burnout, strain, and cortisol levels.32 Kalauni et al. demonstrated that Nepali students with internet access at their residence were less likely to exhibit depressive symptoms compared to those lacking internet services. Furthermore, results from a Cypriot study indicated that perceiving oneself as a technology novice or intermediate, as opposed to an advanced or expert, and perceiving a deficient school support system were independently associated with elevated levels of burnout.[35]

III. Social Factors

As indicated by numerous research studies, the family environment of students and their interpersonal relationships, specifically their friendships, played a pivotal role in molding the levels of resilience they displayed throughout the lockdown. The most significant predictive factor for the occurrence of burnout was the divorced parental status, as it was observed to be above 77% in students with divorced parents or parents living separately, while only half of the students with married parents reported burnout.[37] These findings align perfectly with concurrent studies on the mental health of medical students and underscore the crucial role of a stable and content family environment in safeguarding the psychological well-being of young individuals.[38]

Another critical factor is whether the students themselves or their close relatives had been infected with COVID-19. Respondents who had been diagnosed with COVID-19 or had a family member or friend who had been infected exhibited elevated stress levels[2] while the death of a family member due to COVID-19 increased the risk of burnout.[29] Regarding the domestic environment, students living alone during quarantine were more susceptible to depression during online learning[5] and about half of the participants in a US study had high loneliness scores.[2]

In terms of social support, two Chinese studies investigated its association with burnout.[33,59] Liu et al. did not demonstrate a direct influence of social support on academic burnout rates but showed that it reduced indirectly through enhancing resilience. Stress negatively impacted resilience, while social support positively influenced it. Higher resilience was associated with lower academic burnout.[33]

Concerning the aspect of social support, two Chinese studies delved into its correlation with burnout, as indicated by references.[33,59] In the study by Liu et al. it was revealed that social support exerts an indirect influence on academic burnout rates by fortifying resilience.[33] Additionally, Zhang et al. established that low social support serves as a significant predictor of learning burnout.[59]

IV. Psychological factors

Among the identified studies, three revealed worsening of the overall mental health (MH) due to the COVID-19 pandemic.[19,53,60] According to Forycka et al. 26.4% of those who reported diagnosed mental conditions presented more severe burnout in all three dimensions and worsened symptoms, while Tee et al. found a significant difference in the percentage of students with extremely severe anxiety in the presence (23.8%) and absence (4.8%) of burnout. Finally, a study conducted in a Cypriot university revealed that overall MH deteriorated significantly between the two periods (pre-COVID-19 and COVID-19).60

V. Volunteering and Coping Mechanisms

Among the thirty-one studies included in the research, three reported a positive impact of volunteering on the overall mental health of medical students.[2,19,42] Specifically, according to a study in the US, students who volunteered during the pandemic were less likely to report burnout, high emotional exhaustion, and low personal accomplishment than those who did not volunteer. The same study did not show significant differences between pandemic volunteer and non-volunteer students for stress and loneliness.[2] The findings of Polish researchers align with the aforementioned, highlighting that individuals who worked voluntarily on the pandemic frontlines displayed greater resilience, lower exhaustion and cynicism, as well as enhanced academic efficacy in terms of burnout.[19] As per Phillips et al., volunteering fosters resilience, emotional empathy, and the overall well-being of medical students. Researchers identify two types of volunteerism: one rooted in altruistic and humanitarian values and the other primarily focused on advancing students' careers. Value-centered volunteerism has a positive influence on participants' well-being, enhancing resilience, coping with challenges, and addressing the COVID-19 pandemic. It also boosts emotional empathy, regardless of the student's educational stage. Those motivated by these values are more inclined to select volunteer activities involving patient interaction, promoting empathy and resilience. Conversely, career-centric motivation lacks a positive predictive effect and tends to lead students toward research-oriented activities.[42]

Coping mechanisms refer to the specific efforts, both psychological and behavioral, that humans apply to overcome or minimize stressful events.[63] Two studies investigated the coping strategies adopted by medical students during the pandemic using the brief-COPE inventory, showing a significant correlation of avoidant coping strategies with burnout.[53,62] A study conducted in Saudi Arabia indicated a prevailing tendency toward avoidant coping strategies in the overall scores. Notably, these strategies were more pronounced among female and preclinical students and emerged as a predictor of anger and sadness.[26] A study in Belarus, involving students from different academic fields, also highlighted that medical students tended to prefer avoidance coping mechanisms. While most respondents used active coping methods, future medical professionals frequently adopted avoidance strategies, such as evading the issue and seeking support with emotionally oriented coping. In contrast, avoidance strategies were less common among pedagogical students and rarely seen among student-athletes.[49]

Regarding clinical-year students in Malaysia, they predominantly prefer employing approach coping strategies, such as active coping, seeking emotional support, practicing acceptance, seeking information, positive reframing, and planning. As of avoidant coping strategies, which include behavioral disengagement, self-distraction, denial, venting, substance use, and self-blame, they showed a significant, moderately positive correlation with the presence of both anxiety and burnout. On the other hand, coping methods that were neither approach nor avoidant exhibited a weak, positive correlation with the presence of burnout.[53] Lastly, a Chilian study evaluated the impact of a mindfulness-based self-care program on medical students during the COVID-19 pandemic, emphasizing the significance of transitioning from avoidance to active problem-solving to reduce burnout components and enhance dispositional mindfulness.[62]

Discussion

The already hard path for medical students has become even more complex with the advent of the COVID-19 pandemic. Even before the pandemic, the burnout rates among medical students were significantly higher than those of their peers in other academic disciplines, primarily due to the rigorous medical training.[12] This review examined the prevalence of burnout among medical students prior to and during the COVID-19 pandemic, as well as the factors that may have contributed to its occurrence. It is critical to comprehend the dynamics of burnout in medical education because it can have a significant impact on students' mental and physical well-being, educational outcomes, and, ultimately, patient care. Here, we discuss the key findings and implications of this comprehensive analysis.

Prevalence of Burnout Among Medical Students

Concerns about burnout are not novel among medical students. Even before the pandemic, the academic rigors, high workload, and emotional stressors associated with medical training made students particularly susceptible to burnout. This review confirms the alarming prevalence of burnout in medical students, although the exact rate is hard to determine. In some studies, it is estimated to be around 17-23%,[12,16,53,60] while in others exceeds 50%.[2,20,29,37] It is unclear whether students who are in their preclinical or clinical years are more prone to burnout due to contradictory research findings. This is a complicated matter that is impacted by a number of variables, such as the psychological stamina of each student, their stress management techniques, the amount of support they receive from their family, and their willingness to interact with patients during the pandemic.

Impact of the COVID-19 Pandemic

The COVID-19 pandemic has increased medical students' vulnerability to burnout. The uncertainties, quarantine restrictions, and psychological anguish brought about by the pandemic have intensified the challenges they face. Many students experienced an escalation in burnout levels during the pandemic, with the burden of online learning and reduced clinical exposure taking a toll on their well-being. While some studies reported a decline in burnout levels, the overall prevalence of burnout remained high. Importantly, a substantial proportion of students expressed a strong desire to return to clinical settings, emphasizing the importance of in-person training and its impact on their motivation and professional responsibility.

Factors Influencing Burnout

Numerous factors were found to influence burnout in medical students. Gender, age, and the stage of medical school were identified as potential predictors, though the findings were not consistent. For example, female students were more likely to report poorer overall mental health compared to males. Clinical-year students involved in the COVID-19 response appeared to have lower rates of burnout, depression, and anxiety. Interestingly, a mix of conflicting results emerged when comparing burnout between medical students and undergraduates in other fields, highlighting the complex interplay of factors affecting burnout.

The family environment, particularly the parental status, also played a significant role. Students with divorced or separated parents were more likely to experience burnout. Additionally, students who had experienced COVID-19 infection within their family or close circle exhibited elevated stress, depression, and anxiety scores. This further underscores the need for holistic support systems to address the emotional and psychological challenges that students face during the pandemic.

Interventions and Preventive Strategies

As demonstrated by various studies presented in this review, engaging in voluntary activities has a positive impact on medical students' mental health. Volunteering is associated with lower rates of burnout and greater resilience, highlighting the potential benefits of altruistic and value-centered volunteerism. This suggests that institutions and programs that encourage volunteer activities may contribute to students' well-being. The establishment of a supportive network is also pivotal for mental health, especially during lockdowns and periods of mandatory isolation. Lastly, as mentioned in a Belarusian study, the level of physical activity is directly linked to psychological well-being and life satisfaction,[49] thus medical students should incorporate sports in their program, aiming for a well-balanced routine.

Another effective measure to prevent burnouts is the adoption of dynamic instead of avoidance coping mechanisms. Studies showed that active coping, seeking emotional support, practicing acceptance, seeking information, positive reframing, and planning are more effective strategies in addressing stressful situations. Contrariwise, a significant correlation between avoidant coping and anger, sadness and eventually burnout has been established. Therefore, it is vital to implement programs to teach medical students how to properly implement helpful strategies.

Limitations

While this comprehensive review sheds light on burnout among medical students during and post the COVID-19 pandemic, it is essential to acknowledge its limitations. First and foremost, the narrative synthesis approach that has been elaborated is of subjective nature and may have introduced bias due to reliance on reviewers' interpretations. The inclusion criteria implemented, such as the requirement for studies to be freely accessible and

published in English from January 2020 to September 2023, may have excluded valuable research papers. In order to guarantee objective interpretation of the original text and minimize the risk of potential misinterpretations resulting from translations, the authors' language proficiency constraints led to the decision to limit studies to English publications. It is noteworthy that there were comparatively few studies that were excluded on the basis of language criteria, and most of them had a small participant pool.

The heterogeneity of outcome measures across the included studies introduced variability in the results, rendering it impossible to perform a uniform quantitative analysis. Moreover, the diverse study designs and the inclusion of studies from 25 countries with differing cultural and educational systems contributed to discrepancies in reported prevalence and risk factors for burnout. The quality and methodology of the included studies, as well as potential biases, may have influenced the overall findings. Furthermore, many studies lacked a control group, thus failing to discuss the baseline burnout levels among medical students before the pandemic started. These limitations pinpoint the need for continued research to address these challenges and provide a more comprehensive understanding of burnout among medical students in the context of the pandemic and beyond. More precisely, to fully address the gaps in understanding burnout, we suggest that future research should focus on longitudinal studies investigating the long-term effects of pandemics on burnout in medical students. This approach will help assess how burnout evolves over time and whether it persists after the crisis. Furthermore, studies focused on specific factors contributing to burnout—such as workload, social support, and access to mental health resources—could yield valuable insights. To ensure consistency in measurements across various studies, standardized measurement tools should be employed, enhancing the comparability and reliability of the findings. Finally, specific interventions implemented during disruptions, such as online learning, mental health support, and flexible curricula, should be evaluated to explore which strategies are most effective in mitigating burnout during such periods.

Conclusion and Implications

This review underscores the critical importance of addressing burnout among medical students, both during and beyond the COVID-19 pandemic. It is essential for medical schools and institutions to recognize the unique challenges faced by students and implement strategies to mitigate burnout. These strategies may include facilitating in-person clinical experiences, providing comprehensive support systems, encouraging volunteerism, and promoting active coping mechanisms. By adopting a holistic approach, medical educators and policymakers can contribute to the well-being of future healthcare professionals, ensuring they are better equipped to provide high-quality care to patients.

However, further research is needed to explore the long-term impacts of burnout on the quality of medical education, patient care, and the mental health of healthcare providers. Additionally, studies should continue to investigate the evolving dynamics of burnout, especially as the medical education landscape continues to adapt in response to the ongoing pandemic and other unforeseen challenges. By prioritizing the well-being of medical students, we can foster a flourishing and more resilient healthcare workforce.

Summary – Accelerating Translation

Title: COVID-19 Impact and Burnout Syndrome in Medical Students: A Comprehensive Systematic Review

Main Problem to Solve: Burnout is a common challenge that has long been associated with the rigorous path of medical students. Stressors and uncertainties have intensified due to the COVID-19 pandemic, which has brought new complexities. Understanding the dynamics, prevalence, and contributing factors to medical student burnout in the context of the pandemic is the main concern.

Aim of Study: Our study aims to comprehensively explore burnout among medical students, shedding light on its prevalence, impact, and associated factors, with a specific focus on the challenges posed by the ongoing COVID-19 pandemic. We seek to provide valuable insights for individuals, institutions, and legislators to effectively address and mitigate burnout, contributing to the well-being of medical students and the overall resilience of the healthcare workforce.

Methodology: We adopted a systematic approach using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. Our search strategy covered electronic databases (PubMed, Scopus, APA PsycNET, Google Scholar) from the beginning of the pandemic to September 2023. A range of inclusion criteria was applied to select relevant studies, resulting in a comprehensive analysis of 31 studies encompassing diverse methodologies and outcomes.

Results: The search yielded 579 references, and after meticulous evaluation, 31 studies met our inclusion criteria. Findings consistently revealed a prevalence of burnout exceeding 35% among medical students, with varying estimates due to study heterogeneity. Conflicting evidence emerged regarding changes in burnout levels before and during the pandemic. Factors influencing burnout were multifaceted, encompassing demographic variables, the pandemic's impact on education, social factors, and psychological elements. Notably, interventions like volunteering and dynamic coping mechanisms demonstrated positive impacts on mitigating burnout.

Conclusion: Our research highlights the alarming prevalence of burnout among medical students, with rates consistently exceeding 35%. The pandemic has exacerbated these issues, impacting their educational experience, psychological well-being, and social dynamics. Factors such as demographic variables, academic progression, and family environment contribute to burnout. The pandemic's influence on burnout levels exhibited varied outcomes, with some studies reporting an escalation, others indicating stability, and some even suggesting a decline. Online learning and reduced clinical exposure had both positive and negative effects, while volunteering was found to be a protective factor against burnout. Last but not least, institutions and policymakers must implement strategies to foster a supportive educational environment. By prioritizing the well-being of medical students, we contribute to a flourishing healthcare workforce better equipped to provide high-quality patient care.

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