ORIGINAL ARTICLE

The Impact of the COVID-19 Pandemic on Medical Education: a Systematic Review of Distance Learning, Student's Perceptions, and Mental Health

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Abstract

Introduction: the COVID-19 pandemic has impacted on mortality and several adverse health outcomes. It has also affected education as schools and universities had to adapt to remote learning due to social isolation strategies.

Objective: to analyze the pandemic's impact on medical education including undergraduate and graduate students and lecturers, as follow: i) teaching methods adopted by education institutes during shutdown, ii) students and lecturers' perceptions and iii) impacts on students' mental health.

Methods: this systematic review includes the following study designs: cross-sectional, surveys, case-control, cohort, and clinical trials. The literature search was performed in four databases: PubMed, Scopus, Embase, and SciELO . The risk of bias and the quality of the evidence were evaluated.

Results: a total of 1,576 articles were identified through searching databases, and 40 articles were included. We found the use of several teaching methods such as virtual platforms and social media, pre-recorded videos, discussion forums and others. Student's challenges related to interference during online study such as family distractions, lack of a study room, challenges with internet connectivity, difficulties in communication between students and lecturers, gaps encountered during clinical skills learning. Lecturers' challenges were difficulty in grasping students' progress and learning outcomes and the lack of experience in online teaching. Only five studies explored mental health issues of medical students and found the occurrence of depression, anxiety, and stress. However, their prevalence was not comparable due to the use of different diagnostic instruments.

Conclusion: there has been a wide range of teaching methods implemented for distance learning of medical students globally. The perceptions of medical students about these methods and their impact were also varied. Infrastructure, family, and curriculum problems represented the greatest difficulties in adherence and satisfaction with distance learning. However, the flexibility of digital learning was one of the factors that helped reduce these problems. Regarding mental health, the occurrence of anxiety, depression, and stress was reported.

Keywords: Medical education, distance learning, COVID-19, mental health, depression, anxiety.

Authors summary

Why was this study done?
This is systematic review that proposed to analyse the worldwide situation of medical education since the World Health Organization declared COVID-19 as a pandemic. This study was carried out with the aim of understanding the impacts that the pandemic had on the lives of students and teachers, especially regarding medical education.

What did the researchers do and find?
In our study (Systematic Review), we investigated the remote teaching methods and practices implemented in medical courses around the world, including the perceptions of medical students and lecturers about these strategies, describing their advantages and disadvantages. We also investigated the mental health impacts of distance learning on students and lecturers. Infrastructure, family, and curricular problems represented the greatest difficulties in adherence and satisfaction with distance learning. Regarding mental health, the occurrence of anxiety, depression, and stress was reported.

What do these findings mean?
The findings presented in this research has provided an overview of the situation of medical education in different regions/countries around the world. The advantages and disadvantages of the remote teaching were reported in both high- and middle-income countries, showing that learning gaps during the period of remote classes were global and perceptible from the point of view of medical students.

Highlights
- The most common methods used were pre-recorded lectures or in real time, synchronous classes on communication platforms, videos previously recorded by lecturers explaining book contents, and platforms developed specifically for the simulation of contents of practical subjects.
- Infrastructure, family and curricular problems represented the greatest difficulties in adherence or satisfaction with distance learning. However, the flexibility of digital learning was one of the factors that helped reduce these problems. Lecturers complained about problems inherent to working in the digital format, such as exhaustion and overwork
- Concerning the mental health status of the medical students, there was a wide range of methods to measure these outcomes resulting in no comparable prevalence. However, the prevalence reported was higher in women.

INTRODUCTION

In 2020, the world has been impacted by the COVID-19 pandemic which has caused several adverse health outcomes and mortality[1–3]. There have been more than 5.5 million deaths and 328 million confirmed cases in January 2022. The pandemic has also greatly affected the global economy[4], including universities such as undergraduate and graduate teaching. More than 1.5 billion students worldwide, or 91% of global enrollments, were directly affected by school closures at the height of the COVID-19 outbreak in early April 2020[5]. The conventional teaching methods ie face-to-face classes had to be suddenly interrupted due to lockdown or social isolation preventive strategies to prevent the fast spread of SARS-CoV-2[6–8]. Due to the highly contagious characteristic of the disease, mainly through contact between individuals, many social isolation measures were determined by the health agencies of each country, including lockdowns and consequent closure of educational institutions, such as universities, which had to adapt to safety regulations and consider remote teaching as their new reality. In order to mitigate the adverse effects of interrupted face-to-face classes of medical students, teaching was done remotely through the internet[9]. Such adaptation was important to keep the teaching and learning processes of all students going, but especially medical students in the last year of their training[10–13], as they were due to conclude their degree and being qualified to work on the front line of COVID-19.

Computer-assisted instruction and distance learning, also known as e-learning, have already been used as a facilitating tool in medical teaching and learning processes, and can be described as the act of teaching and learning by digital technologies, using a wide range of teaching methods, such as offline learning, online learning, virtual reality and others[14]. Researchers have studied their effectiveness and efficiency, observing better research opportunities for lecturers, as well as the improvement in individual learning and also in the interaction between students[13,15,16]. With the advent of the pandemic, e-learning has ceased to be just a tool and has become a vital method in education in all its stages, including medical teaching which, according to tradition, is characterized by the interaction of students in practical laboratory activities and specific clinical skills[17].

This huge and sudden change in teaching and learning methods possibly brought several challenges both collectively and individually for students, lecturers, members of the staff and educational institutions. Although, some studies[18–20] have analyzed this process generally, little is still known about the impact and consequences of distance learning on medical students. It is also important to have a global perspective of this issue to identify whether there were differences in the challenges faced by medical students and lecturers in different countries.

Therefore, to identify and summarize the knowledge on remote teaching of medical students from published articles across the globe using a systematic review is a helpful way to better understand it and to elaborate strategies to improve the remote medical teaching with positive results. Our aim was to analyze the pandemic's impact on medical education including undergraduate and graduate students. The following research questions guided our systematic review: i) What were the teaching methods and medical education practices during the period which the universities and courses were closed? ii) How medical students and lecturers perceived these new methods i.e. disadvantages and advantages? iii) What was the impact of distance learning on students' mental health during this period?

■ METHODS

Protocol and registration

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guide[21]. The review questions were also detailed by the acronym Population, Exposure, Comparator, and Outcome (PICO), structure recommended for systematic reviews[22]. Accordingly, "P" population represents medical students (undergraduate and graduate); "I" intervention represents medical teaching strategies during the pandemic, "C" is the comparison between groups of teaching methods, graduate and undergraduate' "O" outcome – how the new teaching methods affect the students related to learning and mental health conditions and student's perception. This systematic review has been registered in PROSPERO, number CRD42021257500.

Search strategy and eligibility criteria

The search strategy occurred during April-May 2021 using f our databases: PubMed, Scopus, Embase, and SciELO. Language was restricted to English, Portuguese, and Spanish. The article selection was conducted according to the inclusion criteria: (a) studies published between December 2019 to March 2021, (b) that have investigated the pandemic as the main cause for the change in teaching strategies, (c) medical students, (d)) studies designs: cross-sectional, surveys, case-control, cohort, and clinical trials. Exclusion criteria were: (a) type of studies or publication - systematic or integrative/narrative reviews, case reports, guidelines, or protocols, editorial, notes, letter from the editor, (b) qualitative approaches, (c) population who were not medical students, ie new medical work protocols, (d) studies that compared their results with the period before the pandemic, (e) samples <100 in the studies regarding students' perception. The search strategies are presented in detail in the Supplementary Material. The decision to include articles until March 2021 was made since it was before the massive vaccination programs in many countries[23,24].

Training of the reviewers

AMSR and ACFR participated in eligibility assessments and were trained regarding the study inclusion/exclusion criteria. The authors were also trained in using risk of bias instruments and to use the quality assessment tools, as well as analyzes using the Mendeley and Rayyan software[25] to apply the eligibility criteria.

The review process - study selection

The search strategy on each database was performed by AMSR and ALJ, and duplicates were removed using the EndNote Software. Then, the articles were exported to Rayyan software for the screen process. The eligibly criteria were applied by both researchers independently, through reading titles and abstracts of the literature search to exclude or select the articles. The next step was the full reading of the article and final decision whether to include or not a paper. Potential disagreements were discussed and resolved by the senior researcher, EAS. Finally, all eligible articles were included in the systematic review. The references of each included article were read to see if any study had not been performed by search strategy. All these steps are described on the Prisma Flow Diagram (figure 1).
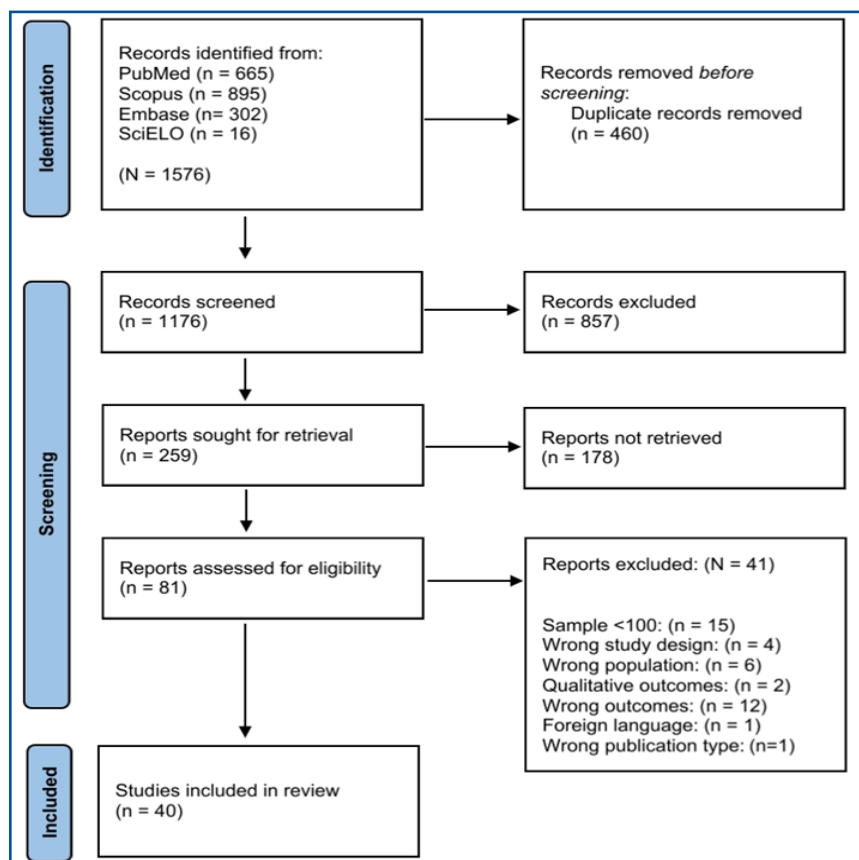

Figure :. PRISMA Flow Diagram.

Data extraction and quality assessment

From the selected articles, the following data were extracted: authors, publication year, location/country, sample size, sex, age, university, study design, research instrument, teaching methods, outcomes - students and lecturers' perceptions, and impacts on mental health. The extraction tools were modified and revised when necessary, during the data extraction process.

The risks of bias in studies addressing the impact of the pandemic on students' mental health were measured using the 27-item Downs and Black instrument, to analyze methodological quality. Papers with scores above 70% were classified as low risk of bias[26]. The quality of the evidence found in this review was assessed using the Grading of Recommendations, Assessment, Development and Evaluations (GRADE)[27] evidence system, in which each study received one of the four grades: high quality, moderate quality, low or low quality[28]. Two researchers (AMSR and ALJ) independently assessed the quality of the articles, and any discrepancies were discussed with the senior reviewer (EAS) until a consensus was reached.

Data synthesis and extraction

The medical students' dissatisfaction, infrastructure challenges and learning perceptions during the COVID-19 pandemic period were summarised , highlighting the disadvantages reported by studies from high- and middle-income countries. Lecturers' perceptions ie positive and negative aspects were also highlighted. The impact of the pandemic on students' mental health (stress, anxiety, and depression symptoms) was also cataloged and organized. The frequency and/or association with mental health were analyzed through reported odds ratios and their confidence interval of 95%.

Data on the types of teaching methods were analyzed descriptively. From the extracted data, in our registered protocol we had planned to perform a meta-analysis if we had enough studies with low risk of bias that have statistical data of the impact on medical students or lecturers' mental health and regarding the advantages and disadvantages of remote teaching methods. Moreover, for the data on impact/association measures we had planned to use forest graphs to show the results found. Unfortunately, due to missing data, we did not have enough data to perform a meta-analysis.

■ RESULTS

Identification of Studies

A total of 1,576 articles were identified through the database searches. After removing duplicates, 1,116 articles were selected for the reading of titles and abstracts, and 857 studies were excluded after the first screening and 81 records were considered for full-text reading. After this step, we have excluded a further 40 articles due to small sample size (<100 students), wrong outcomes, wrong population, wrong study design, qualitative outcomes, foreign language, and wrong publication type.

Study and Participants Characteristics

Regarding the type of country based on their income level, the 40 articles included were from high income countries[29] such as USA, UK, Germany, Poland, Portugal, Spain, South Korea, Saudi Arabia, and Japan and also middle income countries (Libya , Mauritius, China, Philippines, India, Nepal, Pakistan, Iraq, Turkey, Brazil, and Caribbean).

All studies used online questionnaires for data collection, which were sent to students and lecturers during the pandemic period. Regarding the studies that covered medical students' perceptions, in high-income countries, the sample size ranged from 104[30] to 2,913[31] students, most of whom were women, except for two studies in Saudi Arabia[31,32] that had a predominantly male sample . In middle-income countries, the sample size varied from 103[33] to 99,599[20,] predominantly women, with the exception of four studies from Mauritius[34] and India[35–37].

Virtual Teaching Methods

The main teaching methods covered several virtual platforms such as ZOOM platform, YouTube Videos, Google Classroom, and platforms developed by some teaching centers , especially for subjects that required a more practical rigor, such as anatomy and histology classes[38,39]. It was also possible to observe other virtual resources used by professors such as PDF materials, slide presentations, pre-recorded videos, discussion forums, and the use of social applications such as WhatsApp.

Medical students' perceptions

Dissatisfaction with online classes and methods was present in both high-[18,19,30,31,38,40–44] and middle-[10,20,34–37,39,45–51] income countries. Of these, three studies from middle-income countries showed high rates of dissatisfaction with online classes[20,39,49]. Problems related to interference during remote teaching were faced by students in both groups of countries. For example, family distractions were reported by 27% of students[19] and three studies from both groups of countries identified the lack of a study room as a barrier to distance learning[19,30,50]. Challenges due to internet connectivity were present in three studies from high-income countries[19,30,40] and four studies from middle income countries[10,34,45,51]. Gaps encountered during clinical skills learning were identified by six studies[10,19,30,40,46,47], and difficulties in communication between students and lecturers that hindered learning were pointed out by five studies[18,41,42,46,51] (table 1).

Table 1: Main findings on students' perceptions in 34 articles published in high- and middle-income countries regarding pandemic and medical education.

Student's perceptions		Percentage range (min-max)	
		High-income	Middle-income
Dissatisfaction	Online classes	27- 55.8	20 - 74.3
	Online methods	3-9	11.4 - 68.7

Continuation - Table 1: Main findings on students' perceptions in 34 articles published in high- and middle-income countries regarding pandemic and medical education.

Student's perceptions		Percentage range (min-max)	
		High-income	Middle-income
Infrastructure	Family distraction during the online classes	26.8	-
	Lack of study space	11-24.5	31.5-53
	Lack of quality internet connectivity	5.1-72.1	32.6-67.2
Learning	Gap in the remote learning — Clinical learning skills	50.8-82.2	54.8-88.5
	Schedule disorganization	11.5	-
	Difficulty/Issues to use platforms or instructions	17-54	22.2-70
	Reduce of communication between professors and students	45	24.8-67

Source: author.

Lecturers' perceptions

Six studies reported lecturers' perceptions of remote teaching methods during the pandemic[31,42,43,46,48,52], with three studies from high-income countries[31,42,43] and three from middle-income countries[46,48,52]. The samples ranged from 2231 to 35952 lecturers. All studies used virtual platforms for data collection via questionnaires, with three studies[42,46,52] using the 5-point Likert Scale for measuring lecturers' satisfaction levels. Lecturers provided data on positives and negatives aspects of the different online teaching methods. Four articles pointed out that lecturers reported positive points in remote teaching during the pandemic[31,42,43,52]. Some of the benefits listed were the possibility to provide immediate constructive feedbacks to students[31], experience with online learning tools[48] and diversity of teaching methods[52]. The disadvantages, concern with the difficulty in grasping student's progress and learning outcomes[31,42,52] and lack of experience in online teaching/learning[42,43] were mentioned (table 2).

Table 2: Description of cross-sectional studies on remote teaching methods and perceptions of lecturers (n=6).

Author/ Year / Country/ City	Population (sample, sex#, age range#/year of grade)	Research instrument	Teaching methods	Lecturers' perceptions	
				Advantages / Positives	Disadvantages / Negatives
Hanafy et al., 2021 Saudi Arabia	22 Faculty of Medicine, Al-Imam University	Online questionnaire	Zoom video-conferencing application through on-line videos and figures from anatomy and histology textbooks.	22.7% agree that online teaching improve students' skills and their development72.7% can provide immediate constructive feedbacks to students.	90.9% who are in favor of online examinations were concerned about the reception of immediate feedback after and examination86.4% agree the risk of cheating and/or fraud are higher in online teaching.
Rajab et al., 2020 Riyadh, Saudi Arabia	38 Alfaisal University	Online questionnaire	Online teaching/ learning	78.9% reported the online teaching had a positive view of the pandemic's impact	57.9% reported having a little or no experience in online teaching/ learning

Continuation - Table 2: Description of cross-sectional studies on remote teaching methods and perceptions of lecturers (n=6).

Author/ Year / Country/ City	Population (sample, sex#, age range#/year of grade)	Research instrument	Teaching methods	Lecturers' perceptions	
Tuma F et al., 2020 Iraq	81 Wasit University College of Medicine inIraq	Survey questionnaires were distributed electronically via mass e-mail	Virtual lectures 3 h per day;Virtual small group discussions: 2 h per day; Bi-weekly virtual open conference; Bi-weekly MCQs formative assessment and discussion; Bi-weekly virtual assignment presentation	Technical skills to participated/ use online learning:Moderate/ too much: 94%. 90% have excellent/ great/fair quality, clarity audio visual and internet connectivity. 49% online learning activities' expectations and objectives were achieved.	Technical skills to participated/use online learning: Very little: 6%. 10% have poor quality, clarity audio visual and internet connectivity 35% felt tired and lost interest from doing teach online.
Kim J et al., 2020 Republic of Korea	44 From Seoul National University College of Medicine (Republic of Korea)	Questionnaire with 5- point Likert scale.	Online courses:Lecture: online, video clip, live online. Basic science lab: providing PPE, dividing students into small groups, online simulation program. Pathology/Histology lab: online using virtual slide. Medical humanities: online video clip, live online, live online group discussion.	Satisfaction with guide for online lectures (4.05±0.77). Unfamiliar with the computers and related equipment (3.09±1.02).	Taking more time and effort to prepare for the online lecture (2.57±0.86) Difficulty in grasping the students' level of understanding (1.93±0.94).Lack of interaction between professor and student (1.66±0.93).
Cheng X et al., 2020 China	359 Age range:30–39 (30.1%) 40–49 (44.6%) Over 50 (24%) Female: 37% Male: 63%	Questionnaire with 5- point Likert scale.	Theoretical sessions (lecture): MOOCs, synchronous live broadcasting, asynchronous recorded broadcasting, or mixed live and recorded broadcasting, practical sessions, active learning sessions, assessment	About effectiveness:51.0% were very satisfied or satisfied 42.9% were neutral. Top three benefits identified of online learning were:78.8% "diversity of teaching methods;75.2% "development of content materials for teaching"67.1% "good opportunities for developing novel teaching methods"	29.0% estimated that their online teaching during the pandemic allowed students achieve 80%–100% of the intended learning outcomes. For:4.2%: ≤ 30% of learning outcomes were achieved 18.9%: 30-60% of learning outcomes were achieved 46.2%: 60-80% of learning outcomes were achieved 1.7%: ≥ 100% of learning outcomes were achieved Top three difficulties reported were:58.5% "difficulty in grasping student progress and learning outcomes"56.5% "unstable online teaching environments" 29.5% "insufficient online teaching resources"

Continuation - Table 2: Description of cross-sectional studies on remote teaching methods and perceptions of lecturers (n=6).

Author/ Year / Country/ City	Population (sample, sex#, age range#/year of grade)	Research instrument	Teaching methods	Lecturers' perceptions	
Gupta S et al., 2021 India	23 responses from the faculty who had an experience of taking online classes, 13 (56.5%) had more than ten years of teaching experience, 5 (21.7%) teachers had 10 years. 18 (78.3%) teachers fromclinical fields, 4 (17.4%) frompreclinical and 1 (4.3%) from paraclinical subjects.	Questionnaire with 5- point Likert scale (one was unsatisfactory and five was excellent)	E-learning	43.5% recommend use of online platforms for internal assessments in routine curriculum 39.1% were neutral. Overall experience of online class/lecture/ webinar: 21.7% found to be excellent (score=5);30.4% gave a score=4; 39.1% gave a score=3	17.4% did not prefer to use online platforms for internal assessments in routine curriculum. 4.3% found the experience unsatisfactory (score=2 to 1).

MOOC massive online open course, MCQ multiple choice question, PPE personal protective equipment. # Only the study Cheng X et al (2020) presented data referring to sex and age range.

Medical students' mental health

Five studies that measured the impact of the COVID-19 pandemic on the mental health of medical students with distance learning were included[10,44,53–55]. Sample sizes ranged from 97[53] to 3,347[10], with women predominating in three studies[10,44,53] and men in two studies[54,55]. Four studies have medical students' anxiety by the GAD-7 Questionnaire[10,44,53,55], two studies and depression symptoms by the 9-item Patient Health Questionnaire[10,55], and one study examined the stress levels by the Psychological Distress Instrument Kessler-10[54]. The reported prevalence of depression, anxiety, and stress of the included studies showed a wide range and were not comparable due to the different diagnostic tools used. However, the evidence showed a higher prevalence of the mental health conditions in women than in men. There was an association between being a woman and stress[54], depression and anxiety[10]. Some articles reported an association between depression and anxiety and medical students' concerns for their mental and emotional well-being[44,55], due to the change to online learning and also association with depression or anxiety with requested food aid[55] (table 3).

Table 3: Mental health impact on medical students: cross-sectional studies (n=05).

Author/ Year/ Country/City	Population (sample, sex, age range)	Mental health diagnoses — Anxiety/ Depression/ Other	Occurrence of mental health outcomes	Impact on mental health outcomes (frequency and/or association)
Abdulghani H M et al 2020 Saudi Arabi / Riyadh	243 Male: 67.1% Female: 32.9% Mean age: 20.6 ± 1.6 years	Stress: Psychological Distress Instrument Kessler-10	No stress: 44.9%Mild stress: 30.9% Moderate stress: 11.5% Severe stress: 12.8%	Prevalence was significantly higher in female students as compared to the male students (x2=16.3; P=<0.001). Association of stress with:Higher severe stress in groups of age 18 to 21 years' (OR=9.91; P=<0.001). Mild stress in the fifth academic year (OR=4.68; P=0.017);First academic year (OR=2.03; P=0.19); Second academic year (OR=2.03; P=0.007). Moderate stress in the fifth academic year (OR=20.6, P=0.007). Severe stress in the third academic year (OR=13.5, P=0.002). Higher mild stress in the participant who were refusing to accept the COVID situation (OR=10.89, P=<0.001).

Continuation - Table 3: Mental health impact on medical students: cross-sectional studies (n=05).

Author/ Year/ Country/City	Population (sample, sex, age range)	Mental health diagnoses	Occurrence of mental health outcomes	Impact on mental health outcomes (frequency and/or association)
		Anxiety/ Depression/ Other		
Srivastava S et al 2021 India / Tamil Nadu	97

Male: 47.42%
Female: 52.58%

Age range: 17 - 23 years
Mean age: 19.15 | Anxiety: GAD-7 questionnaire.

It consisted of seven questions, each question scored on a four-point scale of 0-3 and totalled.

0-4 minimal; 5 to 9 mild; 10 to 14 moderate; And severe anxiety ≥ 15 of total possible score of 21 | Anxiety levels during the ERL: 43.30% had minimal 31.96% mild 10.31% moderate 14.43% severe | No association investigated.

73.26% students with minimal/mild anxiety, which 43.83% were male and 56.16% were females. 24.74% students with moderate/ severe anxiety, which 58.33% were male and 41.66% were female.

For stress relieving during the lockdown, students felt that activities like reading books (64.95%), video calling family and friends (91.75%), watching movies (84.54%), exercise (87.63%), gaming (42.27%) and following a routine including online classes (65.98%). |
| Cuschieri S et al 2020 Spain | 172
Age: 69.8%: 18-20 years 19.2%: 21-23 years 11%: >24 years Male: 33.7% Female: 66.3% University of Malta | Anxiety: GAD-7 questionnaire.

Scores more than 10 were considered to have anxiety symptoms. | Anxiety symptoms: First academic year: mean score of 9.58 (±5.2) Second academic year: mean score of 9.19 (± 5.3) | Association of anxiety with moderate worry on their own mental, emotional and wellbeing (OR: 7.6 CI 95%: 2–29.3 P < 0.001) and severe worry (OR: 20 CI 95%: 5–80.5 P < 0.001). |
| Alsoufi, A et al 2020 Libya | 3,348 Male: 28.6% Female: 71.4 Mean age: 21.87 ± 5.74 | Depressive symptoms: PHQ-2. Score: 3 indicates high sensitivity in the depressed individual.

Anxiety: GAD-7 questionnaire. Score: ≥15 indicates a high probability of existence of symptoms associated with anxiety disorder. | 31.3% depressive symptoms

10.5% anxiety symptoms | Depression compared with: Female: 779 (32.6%) Male: 269 (28.1%) P = 0.011

Anxiety compared with: Female: 272 (11.4%) Male: 81 (8.5%) P = 0.013 |

Continuation - Table 3: Mental health impact on medical students: cross-sectional studies (n=05).

Author/ Year/ Country/City	Population (sample, sex, age range)	Mental health diagnoses Anxiety/ Depression/ Other	Occurrence of mental health outcomes	Impact on mental health outcomes (frequency and/or association)
Nishimura, Y et al 2021 Japan	473 Mean age: 22.0 ± 3.3 (21.7-22.3) Male: 65.8% Female: 34% Nonconforming: 0.2%	Depression: PHQ-9, ranges from 0 to 27, scores of 10 or more indicates depression. Anxiety: GAD-7 Total score ranges from 0 to 21, scores of 10 or more indicates anxiety.	Depression: 15.9% Anxiety: 7.2%	Association of depression with: Concerns about a shift toward online education (OR 1.97, 95% CI, 1.19-3.28); Request food aid (OR 1.99, 95% CI, 1.16-3.44); Mental health care resources (OR 3.56, 95% CI, 2.07-6.15). Association of anxiety with: Request food aid (OR 2.50, 95% CI, 1.21-5.20); Mental health care resources (OR 3.16, 95% CI, 1.51-6.59).

*Cohort (January 2020 to May 2020). GAD-7: General Anxiety Disorder-7 Assessment, PHQ-9: 9-item Patient Health Questionnaire, SF-36: 36-item Short Form Health Survey, MBI-SS: Maslach Burnout Inventory - Student Survey, OR: odds ratio.

Quality Assessment and Risk of Bias

The risk of bias of the selected studies on mental health[10,44,53–55] were evaluated by the Downs and Black scientific instrument. For the cross-sectional studies, the questions G, K, N and P were annulled for not corresponding to the type of study design. Only one study[54] scored lower than 70, corresponding to a study with high risk of bias. The scientific quality of the studies was assessed by the GRADE quality assessment tool, and all studies showed low quality of scientific evidence (table 4).

Table 4: Methodological quality assessment (Downs & Black and GRADE) and strength of evidence (n=5).

Study (year)	Study Design	Conflict of Interests	Ethical Approval	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Total	Score	GRADE
Alsoufi et al. (2020)	Cross-sectional	No	Yes	1	1	1	1	1	1	-	1	1	0	-	1	1	-	0	-	10/12	77%	● ● ◉ ◉
Abdulghani et al. (2020)	Cross-sectional	No	Yes	1	1	1	0	1	1	-	1	1	0	-	1	1	-	0	-	9/12	69%	● ● ◉ ◉
Cuschieri; Agius (2020)	Cross-sectional	No	Yes	1	1	1	1	1	1	-	1	1	1	-	1	1	-	1	-	12/12	92%	● ● ◉ ◉
Nishimura et al. (2021)	Cross-sectional	No	Yes	1	1	1	2	1	1	-	1	1	1	-	1	1	-	0	-	12/12	92%	● ● ◉ ◉
Srivastava et al. (2021)	Cross-sectional	No	Yes	1	1	1	0	1	1	-	1	1	1	-	1	1	1	0	-	11/13	85%	● ● ◉ ◉

Note: Downs and Black checklist: (A) objective clearly stated; (B) main outcomes clearly described; (C) sample characteristics clearly defined; (D) distribuition of principalconfounders clearly described; (E) main findings clearly defined; (F) random variability in estimates provided; (H) probability values reported; (I) samples target representative of population; (J) sample recruitment representative of population; (L) statistical tests appropriately used; (M) primary outcomes valid/reliable; (N) samples recruited from the same population and (O) adequate adjustment for confunding.
GRADE, Grading of Recommendations, Assessment, Development and Evaluations; one filled circle, very low quality; two filled circles, low quality; three filled circles, moderate quality; four filled circles, high quality.

■ DISCUSSION

This is the first systematic review proposed to analyze the worldwide situation of medical education since the World Health Organization has declared COVID-19 as a pandemic. We investigated the remote teaching methods and practices implemented in medical courses around the world, including the perceptions of medical students and lecturers about these strategies, describing their advantages and disadvantages. We also investigated the mental health impacts of distance learning on students and lecturers to obtain an overall picture of this complex and atypical situation, which impacted on many areas of life. Our key findings showed a high diversity of digital teaching methods replacing the traditional face-to-face lectures in the face of the challenges brought in by the COVID-19 pandemic. Such degree of adaptation could have a positive aspect as an additional tool to medical teaching in the present and in the future. Furthermore, there were advantages and disadvantages of these new teaching approaches. Concerning the mental health status of the medical students, there was a wide range of methods to measure these outcomes resulting in no comparable prevalence. However, the reported prevalence was higher in women.

Given the lack of studies conducted in low-income countries, we can assume that the results found in this study do not accurately reflect the outcomes of interest globally, and that these countries may present contexts that are even more complex, negative, and worrisome than those found in middle- and high-income countries. The existing gap in publications in low-income countries could be attributed to the scarcity of funding allocation to research in these countries, leading to a complete lack of information on the COVID-19 impacts on medical education.

The number of distance learning methods implemented because of social distance/lockdowns was significant, as they were the positive aspects reported by medical students and lecturers. The most common methods used were pre-recorded lectures or in real time, synchronous classes on communication platforms, videos previously recorded by lecturers explaining book contents, and platforms developed specifically for the simulation of contents of practical subjects. The most mentioned advantages were flexibility to study, less commuting time to the educational institution and cost reduction, possibility to learn in one's own pace, comfort, more time to rest and to study. Similar results were found in previous studies with undergraduate students and lecturers from other health related courses[14,56,57].

On the other hand, medical students reported several disadvantages of distance learning compared to the traditional face-to-face method, such as challenges in finding an appropriate place to study without distractions, internet connectivity problems, gaps during clinical and practical learning skills, problems in maintaining lecturer-student dialogue, lack of patient interaction, difficulty concentrating, risk of cheating or fraud on assessments, as observed in other studies[14,56,57]. The main disadvantage mentioned by medical students encompasses internet connectivity problems and difficulty in using electronic devices[10,18,19,32,34,38,41,45–47,49,51].

In this review, we observed that medical students and lecturers recognized the advantages of online teaching to continue with training during the pandemic. Among the advantages pointed out by the lecturers were the diversity of teaching methods and the possibility of providing immediate constructive feedback to students. On the other hand, among the disadvantages mentioned, like students, lecturers showed concern about the greater possibility of cheating and frauds during evaluations 31 and lack of lecturer-students interaction, lack of previous experience in distance education, fatigue, excessive time spent preparing teaching materials, classes and lectures and lack of resources[52]. We have found that the disadvantages reported by lecturers were more related to the excessive workload[42,48], the lack of adequate preparation for remote teaching[43] and the difficulty of getting feedback from students, not being able to know the real quality/level of their learning and level of understanding[42,52]. However, the results showed that the need to implement new distance learning methods due to the context of the COVID-19 pandemic stimulated the development of teaching platforms and methods in an expeditious and satisfactory manner, which were essential for the continuity of classes in medical education courses. Based on our main findings, it is noticeable the technological leap that occurred in education due to the need to implement new methods that would reach as many students as possible. The role of educators was not only helping students adjust to the technological demands of distance learning, but also in acting directly to make remote learning reach the maximum number of students.

While medical students mostly mentioned disadvantages related to internet connectivity issues and access to electronic devices, lecturers focused on overwork and fatigue. Different points that affected the teaching-learning process. Both groups complained about the difficulty of handling technological devices. We could observe that governments have not been able to meet the need for good internet access, even in countries with more developed economies, and education institutions have not been able to adapt workloads to lecturers' new needs and tasks.

Our data pointed out that concerning over the pandemic moment, change from traditional face-to-face to online education, and being a woman were variables associated with stress, anxiety, and depression[10,44,53–55]. The highest impact found was in relation to those medical students having difficulty accepting the new pandemic moment and the level of stress (OR=10.89, P=0.0001)[54]. A study that evaluates the impact of the pandemic on the mental health of adults in 78 different countries, found that social support, education level, and psychological flexibility were predictors of mental health during the COVID-19 pandemic[58].

It is important to highlight some difficulties faced by the research team in the present study such as the heterogeneity of the results and different ways of approaching the theme in the included studies. These have made organizing and presenting the extracted data difficult. The low scientific quality of some articles was also a challenge. We believe that further studies should be

conducted to better understand the mental health status of students and teachers, so severely impacted by the changes imposed by the pandemic. The implications for education in the long term, the damage to learning, the weaknesses caused by methodological and institutional changes, but also changes that can be incorporated into the teaching process, even after the pandemic period, should also be raised. Another limitation of this study was that we were not able to answer the question about teaching methods implemented, modified, or maintained, as none of the included studies mentioned pedagogical methods. We were only able to extract data about methodological resources, such as teaching materials of various formats, platforms and software used during the classes. We expected to find data about the format of the classes in terms of pedagogical approaches, the role of lecturers and students in the classes, whether these classes had a traditional lecture format or not.

One finding that was a surprise to the authors of the present study was the high number of publications on this topic published in a short period of time. This could be considered a strength of our study, since we were able to extract data from research conducted in all continents and, therefore, and mapping the global situation of medical education during the pandemic, identifying local differences, including situations of war, poverty, and poor internet access. Another strength of the present study was the inclusion of only studies with representative samples, supporting the results presented by reflecting the real educational situation in those localities.

The findings presented in this research have provided an overview of the situation of medical education in different regions/countries around the world. There have been many and diverse methods implemented in undergraduate medical teaching. The perceptions of these students about remote teaching and its impact were also diverse. Infrastructure, family and curriculum problems represented the greatest difficulties in adherence or satisfaction with distance learning. However, the flexibility of digital learning was one of the factors that helped reduce these problems. Lecturers complained about problems inherent to working in the digital format, such as exhaustion and overwork. We believe that all those challenges can help to improve medical education with new methods and opportunities to implement innovations.

Regarding the mental health status of the population investigated, we observed occurrence of anxiety, depression, and stress, mainly in women. The occurrence of these mental health outcomes is not comparable between countries due to the varied number of diagnostic measures applied. The mental health impact of remote teaching along with the social, economic, and emotional stress due to the increase number of family members and colleagues developing COVID-19 and dying greatly affected medical students and lecturers and should be analyzed in future studies. Medical schools should promote and improve supporting well-being strategies of medical students and lecturers to prevent or attenuate burnout and associated negative mental health outcomes.

CONCLUSION

Various new challenges were encountered by medical students and lecturers at the beginning of the implementation of remote classes in medical education during the COVID-19 pandemic. Satisfaction, infrastructure, and quality of learning, in addition to their impacts on mental health, influenced the levels of stress, anxiety and depression in this population. The advantages and disadvantages of remote teaching were reported in both high- and middle-income countries, showing that learning gaps during the period of remote classes were global and noticeable from the point of view of medical students.

Author Contributions

All authors contributed to the manuscript. EAS and AMR developed the research project. AMR and MN developed the search strategy. AMR, ALJ and AF performed the searches and selected the articles in the first screening. AMR, ALJ, AF, PMA and PRN selected the articles in the second screening (full reading). ALJ, AMR and AF extracted the data. AMR, EAS and ALJ wrote the article. CO reviewed the study.

Conflicts of Interest

The authors report no conflict of interest.

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Resumo

Introdução: a pandemia de COVID-19 teve impacto na mortalidade e em vários resultados adversos para a saúde. Também afetou a educação, pois escolas e universidades tiveram que se adaptar ao ensino remoto devido às estratégias de isolamento social.

Objetivo: analisar o impacto da pandemia na educação médica, incluindo alunos de graduação e pós-graduação e professores, a saber: i) métodos de ensino adotados pelas instituições de ensino durante a paralisação, ii) percepções de alunos e professores e iii) impactos na saúde mental dos alunos.

Método: esta revisão sistemática inclui os seguintes desenhos de estudo: transversal, surveys, caso-controle, coorte e ensaios clínicos. A pesquisa bibliográfica foi realizada em quatro bases de dados: PubMed, Scopus, Embase e SciELO. O risco de viés e a qualidade da evidência foram avaliados.

Resultados: um total de 1.576 artigos foram identificados por meio de busca em bancos de dados, e 40 artigos foram incluídos. Constatamos a utilização de diversos métodos de ensino como plataformas virtuais e redes sociais, vídeos pré-gravados, fóruns de discussão e outros. Desafios dos alunos relacionados à interferência durante o estudo online, como distrações familiares, falta de uma sala de estudo, desafios com conectividade à Internet, dificuldades de comunicação entre alunos e professores, lacunas encontradas durante o aprendizado de habilidades clínicas. Os desafios dos professores foram a dificuldade em compreender o progresso dos alunos e os resultados de aprendizagem e a falta de experiência no ensino online. Apenas cinco estudos exploraram questões de saúde mental de estudantes de medicina e encontraram a ocorrência de depressão, ansiedade e estresse. No entanto, sua prevalência não foi comparável devido ao uso de diferentes instrumentos de diagnóstico.

Conclusão: existe uma ampla gama de métodos de ensino implementados para o ensino a distância de estudantes de medicina em todo o mundo. As percepções dos estudantes de medicina sobre esses métodos e seu impacto também foram variadas. Problemas de infraestrutura, família e currículo representaram as maiores dificuldades de adesão e satisfação com o ensino a distância. No entanto, a flexibilidade do aprendizado digital foi um dos fatores que ajudou a reduzir esses problemas. Em relação à saúde mental, foi relatada a ocorrência de ansiedade, depressão e estresse.

Palavras-chave: educação médica, ensino a distância, COVID-19, saúde mental, depressão, ansiedade.