



ORIGINAL RESEARCH PAPER

Community Medicine

A CROSS-SECTIONAL STUDY TO KNOW THE EFFECT OF COVID-19 ON UNDERGRADUATE MEDICAL STUDENT'S HEALTH AND STUDY DURING COVID-19 PANDEMIC", INDORE DISTRICT, MADHYA PRADESH

KEY WORDS: Covid-19, Health & Study Impact, Stress, Anxiety, Depression, and Under graduate medical student

Dr. Yesikar Veena	MBBS, MD, Professor, Department of Community Medicine, MGM Medical College, Indore, MP
Dr. Bohare Chhaya*	MBBS, MD, Senior Resident, Departments of Community Medicine, L.N. Medical College, Bhopal, MP *Corresponding Author
Mr. Deepanshu Biniwale	Graduate Student, Indore
Dr. Dinesh Kumar Pal	MBBS, MD, Professor & HOD, Department of Community Medicine, L.N. Medical College, Bhopal, MP

ABSTRACT

Introduction-The end of the year 2019 and beginning of 2020 marked the emergence of novel coronavirus in Wuhan city in China that wreaked havoc globally. Stress, anxiety, depression, were higher among the patients of Covid-19. **Objective:** study to assess To investigate the impact of COVID-19 on the physical, mental, and social health of undergraduate medical students during the pandemic. one of the Districts of MP. Total 259 under graduate medical students were selected by Systematic random sampling method. An online survey was conducted using an online survey questionnaire to collect the information. They were administered pre-design questionnaire and correlated with use of media for assessment of the effect of COVID-19 on undergraduate medical student's health and study by using SPSS 25. **Result-**Anxiety, Stress & Depression sleep cycle disturbance loss of concentration and weight gain and loss of routine exercise was experienced more by under graduate medical students during covid-19 pandemic. **Conclusion-** Findings of our study indicate that The COVID-19 pandemic has provided a unique opportunity to transform the existing medical education scenario by adapting to newer modes of learning like telehealth and online learning. This approach allows for a more flexible and affordable way of learning, making education more accessible to students from all backgrounds.

INTRODUCTION

In December 2019, a pneumonia outbreak of unknown origin, called coronavirus disease 2019 (COVID-19), was discovered in Wuhan, China. Later, the International Committee on Taxonomy of Viruses (ICTV) determined that the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) is the cause of COVID-19^[1,2]. The WHO declared COVID-19 a pandemic on March 11, 2020^[3], as it rapidly spread across the globe, including India, which has the second-highest number of confirmed cases, with 4.2 million cases. Maharashtra, Andhra Pradesh, and Tamil Nadu are the worst-hit states, contributing 21.6%, 11.8%, and 11% of total cases, respectively. The Indian government declared a nationwide lockdown in March 2020, but prolonged lockdowns negatively impacted the economy. On June 1, the government announced a phase-wise uplift, easing restrictions while maintaining lockdown for containment zones.^[4] The WHO estimates that the number of COVID-19 deaths in India is around 4.7 million, which is the highest in the world. However, the Indian government disagrees, claiming that the methodology is defective. The official number of coronavirus-linked fatalities in India is over 500,000. However, it is estimated that there were 481,000 COVID-19 deaths between January 1, 2020, and December 31, 2021, while the WHO estimates the number to be ten times higher^[5].

The global pandemic of COVID-19 severely disrupted medical education and training in 2020^[6]. Due to national lockdowns and social segregation laws, medical students' training has been significantly interrupted^[7]. Medical students experienced exam cancellations and delayed placements, and there were delays in applying for postgraduate studies or residence programs, among other training stages^[8,9]. Moreover, the pandemic has likely affected medical students' physical and mental health, exposing them to the virus and disrupting their training^[10]. The two most important aspects of undergraduate medical education, involvement with patients and bedside clinical training, have suffered due to the lack of non-COVID cases for the students

to study and the availability of personal protective equipment (PPE) kits^[11]. This situation has been in some teaching hospitals dedicated to COVID-19 cases.^[12,13]

Medical students and healthcare workers are at the forefront of the fight against the COVID-19 pandemic, and it poses a serious public health risk. Raising awareness among medical students has become necessary due to their direct or indirect involvement in the COVID-19 pandemic and other pandemics^[14]. Therefore, health workers, governments, and the public must cooperate globally to prevent the spread of the virus^[15].

During the lockdown, technology has played a vital role in education. Online learning has become the go-to solution, with communication primarily conducted through web-based live video conferencing platforms like WebEx, Skype, Zoom, and Microsoft Teams, along with teaching platforms such as Moodle and Google Classrooms. However, to ensure the success of online education, it is crucial to address disparities in access to learning resources, technology, communication tools, and the ability to comprehend information from sources like computers and mobile phones^[16,17].

Therefore, we surveyed Indore undergraduate medical college students to learn how they evaluated the COVID-19 pandemic's overall impact on their education as medical students, including how it affected their clinical responsibilities, teaching methods, and other training experiences. An assessment of the adaptation forced by the pandemic would offer essential information to help design future technology-enhanced or hybrid forms of medical education.

OBJECTIVES

1. To investigate the impact of COVID-19 on the physical, mental, and social health of undergraduate medical students during the pandemic.

2. To describe the socio-demographic profile of COVID-19-affected U.G. Medical Students.

MATERIALS AND METHODS

A cross-sectional survey of a random sample stratified by age and sex was conducted among the cohort of medical students in India from around October 2022 to January 2023. An online questionnaire-based survey was conducted on undergraduate M.B.B.S. students in their 2nd, 3rd, and 4th years enrolled in various professional Medical colleges (one government and three private colleges) in Indore, India. Out of 305 undergraduate M.B.B.S. students who participated in the survey, 259 (75.29%) were deemed suitable for analysis. The remaining 46 (13.37%) were excluded from the analysis due to incomplete responses. Of these, 37 (80.43%) participants did not finish at least 80% of the survey, while 9 (19.56%) declined to participate. Among those who did not complete the survey, 14 (30.43%) signed the informed consent form without answering any further questions, while 30 (69.56%) answered fewer than the first six questions, including their gender, age, college name, qualifications, and health status. As a result, incomplete questionnaires were not used in the analysis.

Types of Studies: Cross-sectional comparative Study
Study Population: MBBS students of 2nd, 3rd, and 4th years
Study Settings: Medical College (Govt. + Private) situated in Indore city
Study Duration: October 2022 to March 2023 - 6 months (24 weeks)
Study Tools: pre-design questionnaire
Sample Size: 259 students

Data Collection

An online survey was conducted using an online survey questionnaire to collect the information. A structural questionnaire link using 'Google Forms' was sent to students through WhatsApp. Participants were provided full consent before participation in the online survey. The data was extracted from Google Forms and analysed using MS Excel to compare the outcomes.

Inclusion Criteria

- MBBS students of:
- 2nd year
 - Pre-final
 - Final year

Exclusion Criteria

- 1st year M.B.B.S. students
- BAMS students
- BHMS students
- BDS students
- Nursing students

Statistical Analysis

The data was initially entered into the Microsoft excel from the customised proforma for analysis. Online software and Excel were used for calculating the p values. Frequency distribution and cross-tabulation were used to prepare the tables. Pearson Chi-square, test/Fisher's Exact, was applied to find the association between variables. Categorical variables were compared by chi-square test. Quantitative variables were expressed as the mean and standard deviation. A p-value of <0.05 is considered as significant. The final data was presented in the form of tables and graphs.

RESULTS

The study was conducted amongst Indian MBBS undergraduate students from 2nd year, pre-final, and final year studying in a medical college (government or private) in Indore, India. A total of 259 responses were taken as valid after excluding those with missing values or incomplete information.

Table 1: Age-wise Distribution According To Gender (18-28)

Age (in years)	Female		Male		Total	
	No.	%	No.	%	No.	%
17-20 years	67	47.5%	30	25.4%	97	37.5%
21-25 years	73	51.8%	87	73.7%	160	61.8%
>25 years	1	0.7%	1	0.8%	2	0.8%
Total	141	100%	118	100%	259	100%

17-20 years	67	47.5%	30	25.4%	97	37.5%
21-25 years	73	51.8%	87	73.7%	160	61.8%
>25 years	1	0.7%	1	0.8%	2	0.8%
Total	141	100%	118	100%	259	100%

Chi square value = 13.402, df = 2, p value = 0.001, Significant

Table 2: Feeling Nervous, Anxious, Or On Edge

Feeling nervous, anxious, or on edge	Female		Male		Total	
	No.	%	No.	%	No.	%
Not at all	38	27.0%	35	29.7%	73	28.2%
Several days	80	56.7%	59	50.0%	139	53.7%
More than half the days	14	9.9%	16	13.6%	30	11.6%
Nearly every day	9	6.4%	8	6.8%	17	6.6%
Total	141	100%	118	100%	259	100%

Chi-square value = 1.457, df = 3, p value = .692, Not Significant

Table 3: Not Being Able To Control Or Stop Worrying

Not being able to control or stop worrying	Female		Male		Total	
	No.	%	No.	%	No.	%
Not at all	48	34.0%	43	36.4%	91	35.1%
Several days	75	53.2%	51	43.2%	126	48.6%
More than half the days	14	9.9%	14	11.9%	28	10.8%
Nearly every day	4	2.8%	10	8.5%	14	5.4%
Total	141	100%	118	100%	259	100%

Chi-square value = 5.418, df = 3, p value = .144, Not Significant

Table 4: Worrying Too Much About Different Things

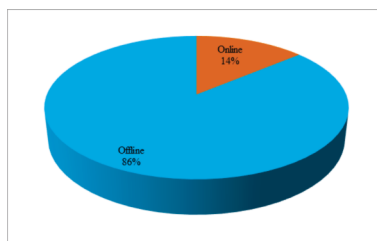
Worrying too much about different things	Female		Male		Total	
	No.	%	No.	%	No.	%
Not at all	37	26.2%	43	36.4%	80	30.9%
Several days	69	48.9%	52	44.1%	121	46.7%
More than half the days	25	17.7%	15	12.7%	40	15.4%
Nearly every day	10	7.1%	8	6.8%	18	6.9%
Total	141	100%	118	100%	259	100%

Chi-square value = 3.546, df = 3, p value = .315, Not Significant

Table 5: Distribution Of Participants Between Anxiety Score And Gender

Anxiety Score	Female		Male		Total	
	No.	%	No.	%	No.	%
Mild anxiety	75	53.2%	51	43.2%	126	48.8%
Minimal anxiety	45	31.9%	46	39.0%	91	35.1%
Moderate anxiety	15	10.6%	13	11.0%	28	10.8%
Severe anxiety	6	4.3%	8	6.8%	14	5.4%
Total	141	100%	118	100%	259	100%

Chi square value = 2.992, df = 3, p value = 0.492, Not Significant



Graph 1: Which Mode Of Learning Is More Beneficial?

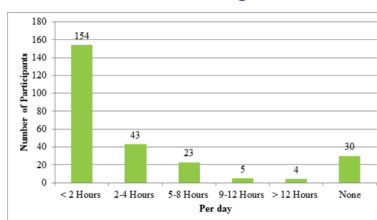


Figure 2: How Much Did You Try To Know About COVID-19 On The Internet?

The study participants were 17–40 years old, with a mean age of 23.86 years. About two-thirds of 160 (61.8%) belonged to the age group of 21–25 years, followed by 97 (37.5%) in the age group of 17–20 years. The minimum percentage was in the > 25-year age group for both males and females. Female respondents were higher (141, 54.4%) than male respondents (118, 45.6%). (Table 1)

The students were distributed among 2nd year 154 (59.45%), pre-final year 86 (33.20%), and final year 19 (7.33%). Out of 259 students, 245 (94.6%) were from Govt. Medical Colleges, MGM Medical College, Indore, while the rest (5.40%) were from various private colleges, i.e., 4 (1.5%) were from Index Medical College, Amaltas Institute of Medical Sciences, Indore, respectively, and 6 (2.3%) were from Sri Aurobindo Medical College, Indore. Among all males and females who participated in the study, the maximum percentage was from MGM Medical College, Indore, and the minimum percentage was from Index Medical College and Amaltas Institute, Indore, for both males and females. (Table 2)

According to mental health status, out of 259 students, 73 (28.2%) were not at all feeling nervous, anxious, or on edge; 139 (53.7%) were feeling it for several days; 30 (11.6%) were feeling it for more than half a day; and 17 (6.6%) were feeling the same nearly every day. 91 (35.1%) were not able to stop or control worrying, 126 (48.6%) were feeling this for several days, 28 (10.8%) were feeling this for more than half a day, and 14 (5.4%) were feeling they were not able to stop or control worrying every day. 80 (30.9%) were not at all worried too much about different things; 121 (46.7%) were feeling this for several days; 40 (15.4%) were feeling this for more than half a day; and 18 (6.9%) were feeling the same nearly every day (Table 5).

Out of 259 students, 45.6% had no trouble relaxing at all, 43.2% had trouble for several days, 8.5% for more than half a day, and 2.7% had trouble relaxing nearly every day.

Out of 259 students, 48.3% were not at all restless, 37.5% were restless for several days, 8.9% were restless for more than half a day, and 5.4% were restless nearly every day.

Out of 259 students, 32.8% were not becoming easily annoyed or irritable, 47.5% were feeling easily annoyed for several days, 12.4% were feeling easily annoyed for more than half a day, and 7.3% were feeling easily annoyed nearly every day.

Out of 259 students, 31.7% were not afraid at all, 46.7% were afraid for several days, 11.2% were afraid for more than half a day, and 10.4% were afraid nearly every day.

Out of 259 students, 126 (48.6%) had mild anxiety, 91 (35.1%) had minimal anxiety, 28 (10.8%) had moderate anxiety, and 14 (5.4%) had severe anxiety. Among all students who participated in this study, the maximum percentage of males and females had mild anxiety (48.80%), and the minimum percentage of males and females had severe anxiety. (Table 6)

Have you felt that you could not cope with everything you had to do? 56.4% were unable to cope, and 43.6% were able to cope with everything.

Out of 259 students, 29.3% were tested COVID-19 positive, and 70.7% were not tested COVID-19 positive. Out of 76 COVID-19-positive students, 64.4% had a low-grade fever, 21% had a high-grade fever, 36.8% had a persistent cough, 10.5% had breathlessness, 42.1% had altered smell and taste, 44.8% had generalised myalgia and malaise, and 43.4% had other symptoms. Out of 259 students, 10.4% had a chronic illness before the COVID-19 pandemic, and 89.6% had no chronic illness. Out of 27 students, 22.2% had an intensified pattern of pre-existing chronic illness, illness subsided in 25.9%, remained the same in 40.7%, and 11.1% had any other

pattern of illness during COVID-19. Out of 259 students, 56.8% had experienced no weight change, 29.7% had gained weight, and 13.5% had lost weight. Out of 259 students, 54.1% have experienced changes in their sleep cycle, and 45.9% have not. Out of 259 students, 56% were doing exercise during COVID-19, and 44% were not doing any exercise. Out of 145 students, 32.4% exercised daily, 40% exercised every other day, and 27.6% exercised weekly.

According to Social Health, out of 259 students, 71.8% felt separated from loved ones or carers, and 28.2% did not feel this way. Out of 259 students, 44.8% felt the deterioration of their social networks and rejection by local communities. Out of 76 students, 34.2% had felt stigmatised during their course of illness, 65.8% had not felt stigmatised 259 students, 43.6% did not affect their relationships, 43.2% had a positive effect, and 13.1% harmed their relationships during COVID-19.

A study by Educational Influence found that most participants reported negative effects on their ability to concentrate and online learning due to the COVID-19 pandemic. Out of the 259 participants, 212 (81.9%) stated that the pandemic significantly impacted their academic performance and daily life. Only 47 (18.14%) participants said the epidemic did not impact their academic performance or daily activities. Because of the poor environment, out of 212 participants, concentration increased in 12.7% of cases, declined in 86.3%, and remained unchanged in 0.9% of cases. In addition, 197 (76.4%) individuals believed online learning impacted their vision.

Out of 259 participants, 57.5% believed that the online learning environment gave them more time for self-study, and 42.5% did not feel that. Out of 259 students, 69.1% modified their learning strategy due to taking classes online, whereas 30.9% did not change their learning approach.

A survey was conducted among 259 students to understand their experience of online classes during the COVID-19 pandemic. Of all the students surveyed, 32.8% reported feeling more responsible towards their studies while taking classes online. However, 67.2% of students did not experience any increase in their sense of responsibility. Of the total students, 41.3% found online learning helpful for revising, recollecting, and reproducing necessary information while studying. On the other hand, 58.7% of students did not find online learning beneficial for these purposes. Only 35.1% of students surveyed understood the subject matter taught in their online classes. The majority, 64.9%, struggled to comprehend the material. Among the 259 students surveyed, 16.6% reported no impact on their practical knowledge and skills due to COVID-19, while 12% reported a positive and 71.4% reported a negative impact.

Among the 259 students surveyed, 13.9% found online learning to be more useful, while 86.1% found offline learning to be more useful (Graph 1)

Out of the 259 students surveyed, 154 (59.5%) spent less than 2 hours daily online. 43 (16.6%) spent 2-4 hours, while 23 (8.9%) spent 5-8 hours. Only 5 (1.9%) of students spent 9–12 hours online, and just 4 (1.5%) spent more than 12 hours a day online. (Graph 2) Moreover, 11.6% of students used the internet to learn about COVID-19.

DISCUSSION

The Indian medical system has undergone significant changes in recent years, including updates to the curriculum. The curriculum now emphasizes competency-based education and has incorporated many relevant topics. However, the COVID-19 pandemic disrupted classroom teaching, forcing most medical colleges to close their doors. Many institutions replaced in-person classes with recorded lectures or videos using Zoom or Microsoft Teams to adapt.

Managing theory-based classes during this transition may be feasible. However, it poses a daunting challenge regarding practical assignments that require hands-on training. Regrettably, India has been lagging in adopting advanced technologies in the healthcare sector. As a result, transitioning to an online system will be difficult, especially for government institutions with limited resources. While some private institutions may be better equipped to handle this change, it will be challenging for the medical community.

The current MBBS curriculum in India does not prioritise disaster management and emergency medicine training. The majority of institutions only provide one or two isolated classes on basic life support and very little more instruction in these areas. Unfortunately, instructors do not assess the effectiveness of these sessions or provide any additional reinforcement.

The COVID-19 pandemic had a profound impact on humanity. Social distancing, next to a vaccine, was deemed the most crucial preventative measure to prevent the virus from spreading.

As a result, many countries enforced complete lockdowns. This led to uncertainty in education at all levels, including the closure of schools and universities. Even medical education was affected. However, ensuring a steady supply of future doctors during these unprecedented times was crucial. While interacting with live patients is essential to clinical teaching, these exceptional circumstances require innovative solutions. In education, it is important to prioritise the use of technology and simulation-based teaching methods, such as online lectures, video case vignettes, virtual simulators, webcasting, and online chat rooms. Medical educators should not only accept this shift towards technology-based learning but also work to assess its effectiveness in pre-clinical and clinical settings. Students impacted by the pandemic and have had to rely on virtual learning should recognise the value of hands-on experience, as they have been witnesses to a historic moment in education.

Medical students can still contribute to the pandemic response despite the challenges. They can assist in clinical settings by completing tasks such as collecting samples, answering patient calls, monitoring physical distancing, creating discharge summaries, screening for symptoms and counselling relatives in COVID-19 care centres. Completing these protocol-based tasks has low legal liability and can be learned by students in just one or two days.

The year 2020 has been marked by the catastrophic impact of COVID-19 on public healthcare and medical education systems worldwide. This deadly disease has caused profound devastation and upheaval, and it's high time that we take it seriously. The World Health Organization declared concern over the situation on January 30, 2020, sounding the alarm on the urgent need for action. We must not rest until we have beaten this pandemic once and for all.^[18]

Despite the availability of vaccines, there is still no definitive cure for the virus. The only way to reduce transmission is through preventive and precautionary measures. Therefore, it is crucial to provide the public with accurate information about the epidemiology and preventive strategies of the disease.^[19]

A study among healthcare workers revealed a significant gap in their information sources, knowledge levels, and perceptions of COVID-19.^[20] Similar studies have shown that increasing preventive behavioural training among healthcare workers can reduce risk perception, stress, and anxiety.^[21]

According to a recent study, it takes longer for younger individuals to recover from stressful situations related to the

COVID-19 pandemic. This may be because younger doctors have less experience dealing with life stressors compared to older age groups. Similar findings were discovered in a 2020 study by Awano et al.^[22] in Japan, which assessed the anxiety, depression, and resilience of healthcare workers during the pandemic. The study concluded that younger age and lower resilience were risk factors for depression. This highlights the importance of addressing the specific psychological needs of younger doctors to improve their resilience. The study also showed that women who took part needed more time to recover from stressful COVID-19 pandemic-related events. This may be explained by the fact that in our nation, female doctors frequently shoulder both domestic and professional responsibilities, which may raise their risk of stress and its negative effects. It was observed that a sizable portion of female respondents recovered more slowly than male respondents. This finding is in line with research by Nathiya et al.^[23] conducted in India to examine healthcare personnel's mental health and professional quality of life during the pandemic. According to the study, women, especially female doctors, are more likely to experience stress and burnout. The demands and responsibilities of being a female healthcare professional can be overwhelming and stressful. In order to help these individuals manage their challenges, it is essential to offer personalised psychological support that considers their unique needs and circumstances. By providing such assistance, we can equip female healthcare professionals with the tools and strategies to navigate their roles and maintain their well-being effectively.

The pandemic has significantly impacted the mental health, training, and educational opportunities of medical students.^[24,25]

The COVID-19 pandemic has highlighted the importance of being ready with practical solutions to such challenges. A competency-based approach to medical education can significantly improve learning outcomes. By adopting such methods, students can develop a comprehensive understanding of the subject matter and a more rational, practical approach. Apart from teaching, we must emphasise research to make teaching more goal-oriented. They need to be encouraged to write academically with the help of senior faculty, who would be more resourceful and guide them in this aspect. Early clinical exposure introduced recently in our curriculum will help us acquire a research and inquisitive mindset. Case-based learning can be given importance in this changing scenario. Medical education has advanced in recent years with the introduction of newer techniques such as small group teaching and problem-based learning. These techniques have been successfully implemented in medical schools abroad, and with appropriate modifications, they can be integrated into the Indian curriculum as well. By incorporating technology in medical education, students can improve their collaborative skills and adaptability.

CONCLUSION

The medical education system in India is constantly evolving, making strides to meet international standards. The COVID-19 pandemic has provided a unique opportunity to transform the existing medical education scenario by adapting to newer modes of learning like telehealth and online learning. This approach allows for a more flexible and affordable way of learning, making education more accessible to students from all backgrounds. Teachers across the medical field in India have an important role to play in advancing medical education by making necessary changes to the curriculum and transforming various disciplines in medicine. These changes will help students develop the skills needed to meet the demands of the healthcare industry in the future. Despite the challenges that students and teachers may face during these difficult times of the pandemic, it could provide a silver lining by improving the face of medical education in the country. The use of technology and innovative approaches to

learning will not only enhance the quality of education but also make it more equitable and inclusive.

REFERENCES

1. Vaes AW, Goërtz YMJ, Van Herck M, et al. Recovery from COVID-19: a sprint or marathon? 6-month follow-up data from online long COVID-19 support group members. *ERJ Open Res* 2021; 7: 00141-2021. doi:10.1183/23120541.00141-2021
2. Nieto-Codesido I, Calvo-Alvarez U, Diego C, et al. Risk factors of mortality in hospitalised patients with COVID-19 applying a machine learning algorithm. *Open Respir Arch* 2022; 4: 100162. doi:10.1016/j.opresp.2022.100162.
3. World Health Organization. Virtual press conference on COVID-19 – 11 March 2020. www.who.int/docs/default-source/coronaviruse/transcripts/who-audio-emergencies-coronavirus-press-conference-full-and-final-11mar2020.pdf?sfvrsn=cb432bb32
4. Saraswathi I, Saikarthik J, Senthil Kumar K, Madhan Srinivasan K, Ardhanaari M, Gunapriya R. Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study. *PeerJ*. 2020;8:e10164. Published 2020 October 16. doi:10.7717/peerj.10164
5. <https://www.moneycontrol.com/news/business/who-covid-19-death-toll-5-healthcare-experts-weigh-in-on-india-figures-8469191.html>
6. Ahmed H, Allaf M, Elghazaly H. COVID-19 and medical education. *Lancet Infect Dis*. 2020;20(7):777–8.
7. Samarasee AA. The impact of the COVID-19 pandemic on medical education. In: *MA Healthcare London*. 2020.
8. Choi B, Jegatheeswaran L, Minocha A, Alhilani M, Nakhoul M, Mutengesha E. The impact of the COVID-19 pandemic on final year medical students in the United Kingdom: a national survey. *BMC Medical Education*. 2020;20(1):1–11.
9. Akers A, Blough C, Iyer MS. COVID-19 implications on clinical clerkships and the residency application process for medical students. *Cureus*. 2020;12:4.
10. Komer L. COVID-19 amongst the pandemic of medical student mental health. *International Journal of Medical Students*. 2020;8(1):56–7.
11. Sahu P. Closure of universities due to coronavirus disease 2019 (COVID-19): impact on education and mental health of students and academic staff. *Cureus*. 2020;12:4.
12. Joseph J. 2020. India COVID-19: Online Survey Shows Not All Is Well on PPE Availability Front - *The Wire Science*. [Internet] *The Wire Science*; 2020 July 5. Available at: <https://science.thewire.in/health/india-covid-19-online-survey-ppe-availability-training-containment-zones/>.
13. Patil P, Chakraborty S. Where Does Indian Medical Education Stand Amidst a Pandemic? *J Med Educ Curric Dev*. 2020 Jan;7:238212052095160.
14. Ikhag, A.; Riaz, H.B.E.; Bashir, I.; Ijaz, F. Awareness and Attitude of Undergraduate Medical Students towards 2019-novel Corona virus. *Pak. J. Med. Sci.* 2020, 36, S32–S36.
15. Yoo J.H. The fight against the 2019-nCoV outbreak: an arduous march has just begun. *J Korean Med Sci*. 2020;35:e56. doi: 10.3346/jkms.2020.35.e56
16. O’Doherty D, Dromey M, Lougheed J, Hannigan A, Last J, McGrath D. Barriers and solutions to online learning in medical education - an integrative review. *BMC Med. Educ*. 2018 June 7;18 (1):130.
17. Kim KJ, Kim G. Development of e-learning in medical education: 10 years' experience of Korean medical schools. *Korean J Med Educ*. 2019 Sep;31 (3):205–214.
18. World Health Organization. COVID 19 Public Health Emergency of International Concern (PHEIC). Global research and innovation forum: towards a research roadmap. Available from: <https://covid19-evidence.paho.org/handle/20.500.12663/714>.
19. Nooh HZ, Alshammary RH, Alenezy JM, Alrowaili NH, Alsharari AJ, Alenzi NM et al. Public awareness of coronavirus in AlJouf region, Saudi Arabia. *J. Public Health*. 2020 Feb 13:1-8. (<https://doi.org/10.1007/s10389-020-01209-y>) Epub ahead of print
20. Bhagavathula AS, Aldhaleei WA, Rahmani J, Mahabadi MA, Bandari DK. Knowledge and Perceptions of COVID-19 Among Health Care Workers: Cross-Sectional Study. *JMIR Public Health. Surveill.* April 30, 2020;6(2):e19160.
21. Taghrir MH, Borazjani R, Shiraly R. COVID-19 and Iranian Medical Students; A Survey on Their Related-Knowledge, Preventive Behaviors and Risk Perception *Arch. Iran. Med.* 2020 April 1;23(4):249-54.
22. Awano N, Oyama N, Akiyama K, Inomata M, Kuse N. Anxiety, depression, and resilience of healthcare workers in Japan during the Coronavirus Disease 2019 outbreak. *Intern Med* 2020;59:2693–9.
23. Nathiya D, Suman S, Singh P, Raj P, Tomar B. Mental health outcome and professional quality of life among healthcare worker during COVID-19 pandemic: A (FRONTLINE-COVID) survey. *Ann Méd Psychol* 2021. doi: 10.1016/j.amp.2020.12.017.
24. Rose S. Medical student education in the time of COVID-19. *Jama*. 2020 March 31. 323(21):2131–2132
25. Liesman DR, Pumiglia L, Kemp MT, Alam HB. Perspectives from rising fourth year medical students regarding strategies to counteract the effects of COVID-19 on medical education *J Med Educ Curric Dev* 2020 Jul;7:2382120520940659.