Original Article

# Impact of E-Learning with Stress Perception Among Undergraduate Medical Students in COVID19 Pandemic: A Cross-Sectional Study at a Tertiary Care Centre

**Arpita Maitra[1], Shouvik Choudhury[2], Sabyasachi Mukhopadhyay[3], Abhijit Das[4]**

[1]Associate Professor, Department of Pharmacology, Burdwan Medical College, Burdwan, West Bengal
[2]Assistant Professor, Department of Pharmacology, Burdwan Medical College, Burdwan, West Bengal
[3]Consultant Pediatrician, Department of Neonatology, Desun Hospital, Kolkata, West Bengal
[4]Professor & Head, Department of Pharmacology, Burdwan Medical College, Burdwan, West Bengal

## Abstract

**Background:** In Medical education, most immediate change during COVID 19 pandemic was implementation of online-learning. Most of students have been staying at home since lockdown. Perceived stress scale (PSS) may reflect the stress condition of individual student and may enlighten some relation with usage of e-learning. We have conducted this study to assess the attitude, self-assessed impact and practice of e-learning and perception of stress in COVID 19 situation. **Material and Methods:** The study was designed as an online observational, cross-sectional questionnaire based survey targeting undergraduate medical students. A total of 650 students were contacted. Voluntary consent was taken during filling of online form. Anonymity was completely maintained. **Results:** Total 386 completed responses were analyzed. Most of students expressed e-learning as audiovisual contents (50.8%), practice session, assignments (50%) or interactive discussion (47.4%) through web. Most common medium was Smartphone (95.9%). >50% of students either agreed or strongly agreed about the advantages of e-learning while >80% of students either agreed or strongly agreed regarding the disadvantages and limitations. Among respondents, 20 (5.19%) were from low stress, while 279 (72.47%) from moderate and 86 (22.34%) from high stress group. **Conclusion:** Most of the students had basic idea about e-learning. Overall mostly they have accepted the primary advantages of e-learning especially in COVID 19 situation; but somehow disagree that it can solely replace physical class. E-learning can be an essential supplement also in future. But for better outcome, proper module and training for digital learning along with adequate affordable internet access has to be available.

**Keywords:** Medical education, Online learning, Pandemic, COVID 19, Depression.

**Received: 25 June 2025** **Revised: 10 July 2025** **Accepted: 24 August 2025** **Published: 25 September 2025**

## Introduction

Impact of COVID 19 pandemic is widely distributed in all aspects of human life and activities. In Medical education, most immediate change was implemented by broad cancelling of in-person classes and replacement by online classes. In United States, these loss of physical classes have already created loss of collaborative experiences as cancellation of clerkships, conferences etc. Long lasting extensive impact is yet to be analyzed.[1] Since, March 2020 in India due to implementation of lockdown and social distancing norms, routine didactic lecture classes, practical classes, tutorials, seminars, clinical (ward, outpatient department [OPD], and Operation Theatre) postings and internal assessment examinations were disrupted in major way. Multiple Medical institutions all over the country have initiated teaching using various available online platforms. Various publishing houses have also started providing free access to e-resources materials, including e-books, e-journals, and databases during this pandemic period.[2]

Medical education is an ever changing ongoing process which must never halt due to any reasons. In India, new competency-based curriculum for the undergraduate students has just been launched. For the past decade, the medical fraternity has been trying to improvise medical teaching by introducing technology-based novel concepts such as flipped lectures and simulation-based learning. Enforcement of technology based learning has become a necessity in this hour.[3] On positive note, it will allow students to develop collaborative skills and improve adaptability, work ethics, team works.[1]

According to Ellaway & Masters, "e-learning encompasses a pedagogical approach that typically aspires to be flexible, engaging and learner–centered; one that encourages interaction

**Address for correspondence:** Dr. Shouvik Choudhury
Assistant Professor, Department of Pharmacology, Burdwan Medical College, Burdwan, West Bengal, India
E-mail: shvk.choudhury@gmail.com

**DOI:**
10.21276/amit.2025.v12.i3.90

**How to cite this article:** Maitra A, Choudhury S, Mukhopadhyay S, Das A. Impact of E-Learning with Stress Perception Among Undergraduate Medical Students in COVID19 Pandemic: A Cross-Sectional Study at a Tertiary Care Centre. Acta Med Int. 2025;12(3):330-336.

(staff–staff, staff–student, student–student), and collaboration and communication, often asynchronously (though not exclusively so)." The three primary characteristics of e-learning are the nature of the learning experience, synchronicity of participation, and presence or absence of face-to-face instruction.[4] It can be synonymously called in various other names as Web-based learning, Online learning, Distributed learning, Computer-assisted instruction, or Internet-based learning.[5] Few remarkable advantages of e-learning may be highlighted as flexibility and ease of access, time saving, uniformity, stop-gap approach, cosmopolitan nature. But there are some limitations or barriers also like connectivity issues, software problems, financial issues, data security issues, language barriers, staff shortage, lack of human face to face interaction, psychological issues etc.[6] The use of emergent technology for education, such as artificial intelligence for adaptive learning and virtual reality, are very likely to be essential components of the transformative change and the future of medical education.[7] Most of students have been staying at home since lockdown period with all sorts of restriction in daily activities. E-learning may engage them into some productive activities, release some stress and increase human interactions. Perceived stress scale (PSS) may reflect the stress condition of individual student and may enlighten some relation with usage of e-learning with it.[8] There is scarcity of data regarding the impact and usefulness of e-learning and perception of mental stress among the students in this COVID situation in Indian population. In our Institution as we are continuously conducting the e-learning since last 12 months. We intend to conduct an online questionnaire based study over the undergraduate students to assess the attitude, self-assessed impact and practice of e-learning. We have also tried to capture the perception of stress according to PSS scale due to COVID 19 pandemic and its relation to e-learning.

## Materials and Methods

**Study design:** The study was designed as an online observational, cross-sectional survey targeting undergraduate medical students enrolled in a tertiary care teaching hospital. The project was duly approved beforehand by the Institutional Ethics Committee.

**Study population and sampling strategies:** Eligible participants of this survey were ≥ 18 years old undergraduate medical students, pursuing academic course at Burdwan Medical College and Hospital, Burdwan. The email id and contact mobile numbers of enrolled students were collected either from the administrative office or during interactions after the classes. A total of 650 students were contacted either by sending form through e-mail or whatsapp message. Voluntary consent was taken during filling of online form from each respondent. The weblink was kept 'live' for 2 months (September to October) from starting of study. Respondents were requested to submit responses within the stipulated time frame along with regular reminders. Anonymity was completely maintained and no personal information was disclosed. The survey link was open but exclusively shared to target recipients only. The investigators and supervisors had access to the database. Any individual respondent was not able to access other respondent's information.

**Sample size:** The sample size was calculated assuming the number of students using e-learning method. Taking a population size of 2000, it was estimated that data from 323 students would have to be collected (considering 95% confidence level with 5% margin of error). Response distribution is assumed as 50%. Expecting a responder rate of about 45-50%, the recruitment target was fixed at 650 whom we have emailed or sent the questionnaire.

**Study Tool:** The online survey form was a structured, self-administered, peer-validated web-based questionnaire which has been prepared using Google-Forms in English. The survey questionnaire had both open and closed ended questions to capture information. Multiple entries from a single respondent were prohibited by online data check. Face and construct validity has been done by peers like Pharmacologist and Community medicine expert. Initially, the pilot version was tested among 20 volunteers. Completion time, survey question acceptability, feedbacks were recorded and changed accordingly. In accordance with the Checklist for Reporting the Results of Internet E Surveys,[9] both the usability and technical functionality of the online survey were assessed. All study related data was collected in an anonymous fashion so that the identity of the subjects kept strictly confidential. The finally prepared questionnaire was then uploaded after checking satisfactory internal consistency (Cronbach's alpha: 0.857). It contains total 34 questions distributed in five sections. An online informed consent (Q1) was taken as a provision in the questionnaire. Then the first section (Q2-Q5) captured socio demographic details. The next part assessed the concept and usage of e-learning (Q6-Q8). Where Q9-Q14 was for assessment of their opinions regarding different advantages of e-learning, Q15-Q21 was regarding limitations of e-learning. Lastly the rest of the questions were regarding their perception about stress regarding e-learning in COVID situation. This self perceived impact was assessed through PSS (Perceived Stress Scale).8 It is a globally accepted psychological instrument for measuring the perception of stress consisting of 10 questions. Each question has five options with scoring system and total score is assessed finally.

**Data analysis plan:** The data was extracted on Microsoft Excel spreadsheet by investigators. Continuous numeric variables were summarized as Mean with SD, or Median with IQR as per their distribution patterns. Categorical variables were expressed as percentages. Subgroup analysis of the different types of students and their usage pattern was undertaken to explore any significant differences. For inferring statistical significance p values <0.05 was considered as significant. 95% CI of test statistics was also computed. Pearson's Chi square test (or Fisher's exact test) was employed for subgroup comparisons.

## Results

Total 386 completed responses were obtained and analyzed among 650 students (59.23% usable response rate). Incomplete responses were excluded from analysis. Respondent details are

summarized in [Table 1]. Majority of respondents belong to nuclear family (73.4%) and socioeconomically most of the participants were from either Class I (46.9%) or Class II (29.3%) of Modified BG Prasad social classification.[10]

In response to their understanding about what e-learning is, most common reply was 'online lecture class' (n=303, 78.5%), followed by self learning through internet (n= 224, 58%). A large proportion of students also expressed e-learning as demonstration or audiovisual contents through web (n=196, 50.8%), practice session, assignments through web (n=193, 50%) or interactive discussion through web (n=183, 47.4%) etc. Other responses were like e-conference, e-seminar, discussions etc (n=152, 39.4%), creating reports, building skill through web (n=118, 30.6%). Most common medium for access was Smartphone (n=370, 95.9%) followed by Laptop (n=87, 22.5%), tablet (n=42, 10.9%), Desktop (n=13, 3.4%). It was quite obvious that almost every student uses smart phone for e-learning purpose due to easy accessibility, simple usage pattern and less costly. Majority of students preferred online lecture class (n=277, 71.8%) as their choice of mode in e-learning. Other preferred modes were recorded video materials (n=207, 53.6%), PDF study materials (n=152, 39.4%), powerpoint presentation with or without audio (n=140, 36.3%), e-books (n=63, 16.3%), voice messages (n=34, 8.8%). [Figure 1] Perception about the benefits of e-learning was analyzed in Likert scale. Responses are summarized in [Table 2].>50% of students either agreed or strongly agreed about the advantages of e-learning regarding easy accessibility at own time, meeting individual needs, updated information, good interactions, helping in diverting attention from pandemic etc. But in some cases like whether it could replace physical classes or if it helps building skill and knowledge, >50 % students either disagreed or strongly disagreed. In response to Q1 and 5, p value became statistically very significant (<0.001) in chi square for trend analysis as most students agreed positively regarding the benefits. Similarly the responses regarding the perceived limitations are summarized in [Table 3]. In few question >80% of students either agreed or strongly agreed regarding the disadvantages of e-learning like absence of human touch and hands on training, less group activity, lack of attention, stress on eye etc. Again almost 90% respondents agreed about the technical limitations as lack of equipments or internet, high cost or small living places of e-learning. In each question, p value was statistically significant in chi square for trend analysis. The most common answers regarding how to overcome the limitations of e-learning the commonest answers were proper module development for e-learning (n=247, 64%) and provision of free internet from institute (n=244, 63.2%). Some participants also opted for regular training programs (n=161, 41.7%), incorporation of hands on training, human touch in e-learning (n=110, 28.5%) to make e-learning better. According to 83.8% (n=361) students' view, in COVID 19 pandemic situation, hands on training and ward clinical classes are grossly affected. In response to question whether stress due to pandemic and uncertain future has grossly affected overall academic performances, 151 (39.2%) students strongly agreed and 172 (44.7%) agreed to it. Where 52.4% students opined that assessment through e-learning was not satisfactory and more stressful in COVID 19 situation, 23.1 % disagreed to it and 21% remained undecided.

Assessment of perception of stress in this pandemic situation was done using 10 item PSS questionnaire. Response is summarized in Table 4. PSS ask about feelings and thoughts during the last one month. Score is finally obtained by reversing responses of four positive questions (Q 4,5,7,8). Final score of 0-13 is considered as low stress, 14-26 as moderate stress and 27-40 as high stress.8Among the respondents, 20 (5.19%)of them were from low stress group, while 279 (72.47%) were suffering from moderate stress and 86 (22.34%) were from high stress group. It was quite clear that majority of the students were feeling moderately stressed during the COVID 19 pandemic.(Figure 2) Mean score of PSS among all respondents was 22.05 ± 5.83. The data was not distributed normally (Shapiro-Wilk test). In Low stress, Moderate and High stress group, the respective PSS median score was 10.5 (IQR 7.25-12), 21 (IQR 19-24) and 29 (IQR 28-32). Correlation between low and moderate stress (r= 0.023) or moderate and high stress group (r=0.144) score were not statistically significant. Comparison of mean scores in different stress categories are shown in [Figure 3].

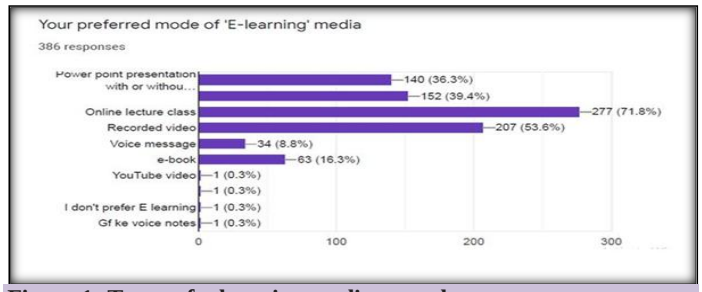


**Figure 1: Types of e-learning medium used**

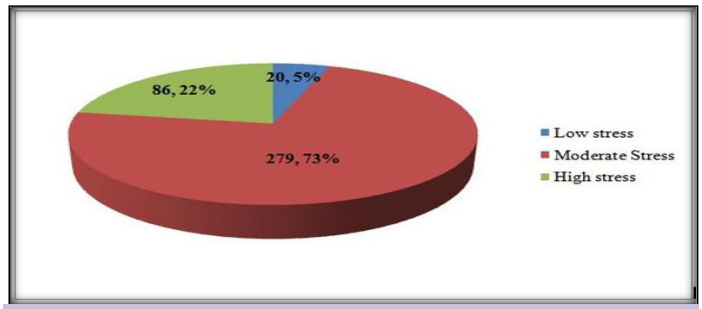


**Figure 2: Categories of stress according to PSS**

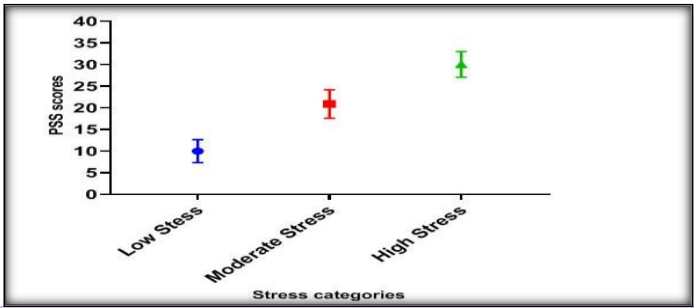


**Figure 3: Comparison of mean PSS scores in different stress group**

**Table 1: Demographic details of participants**

| Variables | N (%) |
|---|---|
| Age (in Years)<br>18-21<br>21-25<br>>25 | <br>211 (54.7)<br>153 (39.6)<br>22 (5.7) |
| Gender<br>Male<br>Female<br>Transgender | <br>225 (58.4)<br>160 (41.6)<br>0 (0)<br>* Total 385 responses |
| Family structure<br>Nuclear<br>Joint<br>Extended<br>Living alone | <br>281 (73.4)<br>88 (23)<br>8 (2.1)<br>6 (1.5)<br>* Total 383 responses |
| Socioeconomic status<br>(Modified BG Prasad social class)<br>Class I<br>Class II<br>Class III<br>Class IV<br>Class V | <br><br>181 (46.9)<br>113 (29.3)<br>41 (10.6)<br>22 (5.7)<br>29 (7.5) |

**Table 2: Perceived benefits of e-learning in COVID situation**

| Parameters | Strongly disagree – n(%) | Disagree-n(%) | Undecided –n(%) | Agree-n(%) | Strongly agree-n(%) | P value |
|---|---|---|---|---|---|---|
| Easy accessibility from anywhere, at own time, without transport cost | 18 (4.66) | 39 (10.1) | 48 (12.44) | 228 (59.07) | 53 (13.73) | <0.001 |
| Meets individual needs, gives updated information, lots of choices and frequent interaction with faculties and colleagues | 31 (8.03) | 81 (20.98) | 56 (14.51) | 195 (50.52) | 23 (5.96) | 0.006 |
| Helps to build skill, knowledge; can replace physical classes; effective method for both learning and assignment submission | 78 (20.21) | 121 (31.35) | 49 (12.69) | 118 (30.57) | 20 (5.18) | 0.002 |
| Helps to overcome the shyness of students to raise question or clear doubts more than the physical class | 45 (11.66) | 114 (29.53) | 64 (16.58) | 137 (35.49) | 26 (6.74) | 0.678 |
| Helps to divert attention from pandemic; keep engaged in constructive works | 21 (5.44) | 50 (12.95) | 63 (16.32) | 219 (56.74) | 33 (8.55) | <0.001 |

**Table 3: Perceived limitations of e-learning in COVID situation**

| Parameters | Strongly disagree – n(%) | Disagree-n(%) | Undecided –n(%) | Agree-n(%) | Strongly agree-n(%) | P value |
|---|---|---|---|---|---|---|
| Lack of equipment, internet connection, cost, small living place, family distractions | 6 (1.55) | 11 (2.85) | 22 (5.7) | 173 (44.82) | 174 (45.08) | <0.001 |
| Lack of computer skill, poor knowledge about e-learning, time wastage | 14 (3.63) | 68 (17.62) | 68 (17.62) | 175 (45.33) | 61 (15.8) | <0.001 |
| Absence of human touch, hands on training, group activity, doubt on authenticity | 9 (2.33) | 26 (6.74) | 36 (9.33) | 202 (52.33) | 113 (29.27) | <0.001 |
| Distractions, lack of attention, stress on eye on long duration use, language problems | 11 (2.85) | 27 (6.99) | 37 (9.59) | 193 (50) | 118 (30.57) | <0.001 |
| No extra benefit than regular teaching methods | 15 (3.89) | 92 (23.83) | 77 (19.95) | 154 (39.9) | 48 (12.44) | <0.001 |

**Table 4: PSS 10 comparison of responses**

| Parameters | Never-n(%) | Almost never-n(%) | Sometimes- n(%) | Fairly often-n(%) | Very often-n(%) |
|---|---|---|---|---|---|
| In the last month, how often have you been upset because of something that happened unexpectedly? | 7 | 31 | 164 | 110 | 73 |
| In the last month, how often have you felt that you were unable to control the important things in your life? | 25 | 48 | 155 | 94 | 63 |
| In the last month, how often have you felt nervous and “stressed”? | 13 | 33 | 59 | 107 | 73 |
| In the last month, how often have you felt confident about your ability to handle your personal problems? | 9 | 42 | 195 | 98 | 41 |
| In the last month, how often have you felt that things were going your way? | 30 | 82 | 200 | 62 | 11 |

| | | | | | |
|---|---|---|---|---|---|
| In the last month, how often have you found that you could not cope with all the things that you had to do? | 19 | 41 | 189 | 90 | 46 |
| In the last month, how often have you been able to control irritations in your life? | 11 | 55 | 209 | 86 | 21 |
| In the last month, how often have you felt that you were on top of things? | 54 | 130 | 152 | 37 | 12 |
| In the last month, how often have you been angered because of things that were outside of your control? | 10 | 50 | 158 | 116 | 51 |
| In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? | 22 | 53 | 193 | 75 | 42 |

## Discussion

Medical science is being updated regularly and medical education cannot be halted due to any cause. But due to pandemic and lockdown, physical classes had to be replaced with online classes throughout the country. Our study represents the perception about e-learning with its pros and cons among the undergraduate medical students of a tertiary centre of Eastern region of India. The study included a substantial number of e-learning user students in this COVID 19 pandemic situation. The data revealed that most of the students had basic idea about e-learning and different components, methods of e-learning.

Overall mostly they have accepted the primary advantages of e-learning especially in COVID 19 situation; but somehow disagree that it can be solely replace physical class. They are also very much aware about the limitations also.

Some studies have been already performed to assess the knowledge, attitude and skill towards e-learning in medical students across the globe including India. Hiwarkar et al conducted one such cross-sectional questionnaire based study over 236 first year students. It revealed that >90% students feel e-learning is helpful in understanding of topic. It also shows that >90% of respondents suggest having free internet from institute and proper e-learning portal where our study showed 60% response. Majority of students opined e-learning should be supplemented with conventional teaching, which is in concordance to our study.[11]Visalam et al, has also published one such pilot KAP study done on 21 medical undergraduates. 76% respondents strongly agreed in favor of e-learning as teaching medium and 81% supported to encourage this medium. Here also most of the students agreed to various limitations as lack of internets or equipments, absence of human touch, distractions, authenticity of information etc like that of our study.[12] Recently, one scientific letter by Agarwal et al, described the collected feedback responses of mostly postgraduate students (67) regarding online studies.[13]Verma et al, has also described feedback taken from130 undergraduate students during online classes. Here also 99% students supported online classes as a substitute in COVID 19 situation. But similarly most of them agreed to the usual limitations. 47% students recommended e-learning to be made a part of syllabus after COVID situation also.[14]

A similar large study on 983 medical undergraduate was published by Kaur et al, regarding effectiveness of e-learning amid COVID pandemic. The result was analyzed in 5 point Likert scale similar to our study. It showed in some parameters like communication, better understanding, assignment submission, and building skill e-learning seems to be equally effective. But individual need, interaction level, balancing practical and theory e-learning is less effective way.[15]

Another study on undergraduate medical and dental students of a South Indian Tertiary Care University by Omprakash et al was published. Here also >80% students preferred e-learning in respect of time saving, convenience, easy availability, updated information. Again, 70-80% responders agreed about the limitations as lack of internet, equipment, training, more distractions. Both of these data are in concordance to our result also.[16] On the contrary, a study by Singh et al done over 208 medical undergraduates showed that 50% of students voted in favor of physical classes rather than e-learning. But here also 90% students accepted the usefulness of e-learning materials and good interaction.[17] Among the studies outside India, one survey on 545 students in Indonesia done by Daroedono et al highlighted the similar benefits and limitations.[18] One study done in Iran by Ganizadeh et al showed only 30.7% students were familiar to e-learning, 21.3% found it beneficial and 43.4% considered it useful in medical education.[19] Results are not comparable to us may be due to different background, less sample size and done before pandemic when it was only an optional tool.

Overall it appears that e-learning is an effective alternate way of continuing medical education with numerous advantages but with some limitations. Subramanium et al, has demonstrated web-based learning as a novel approach with improved retention rates compared to traditional lecture format. But it is not superior in all aspects of teaching for every individual student.[20] A large comprehensive review article by Bettinger et al was published discussing every aspects of virtual classrooms. It highlighted some advantages like flexibility of time, change interaction pattern (less pressure on student) etc. But it also showed to extent, online learning might not compete with aspects of other learning, such as interactive knowledge building between teacher and students or poor time management due to liberty of access.[21] One large meta-analysis on undergraduate medical students by Pei et al also concluded that no evidence of offline learning to work better. Online learning can be used as a potential method for medical teaching with some distinct advantages and limitations.[22]

Our study indicated that majority of students (n=279, 73%) was suffering from moderate stress according to PSS scoring category. Our aim was to evaluate if the pandemic itself, nation

wise prolonged lockdown and uncertainty about future have imposed stress on the mind of students and whether e-learning help to divert the stress from life. A study by Dwivedi et al has compared PSS score between e-learning users and non-users among medical students, which showed significant reduction of stress level amongst digital learning users. Study participants were comparable to our study according to age, gender.[23] A large population based study in China with 52730 valid responses done by Qiu et al during pandemic described significant psychological stress among people. COVID-19 Peritraumatic Distress Index (CPDI) was measured and found to be higher in 18-30 yr age group. The cause may be due to more internet use and data from social media or more self awareness and mostly working age group.[24] A similar study like us done by Duraku et al on 78 psychology students during COVID 19 pandemic using same PSS 10 scale revealed that 65.4% students were suffering from moderate stress, 26.9% from high stress. This is in concordance to that of our result. The students have also opined that e-learning in this period help them to distract attention from COVID, help in constructive interactions and also save money, time.[25] One recently published study among the first to fifth year 719 undergraduate medical students of Kazaksthan revealed that despite of pandemic fear, mental health has improved during online learning compared to traditional learning. They have studied Burnout syndrome, depression, anxiety, somatic symptoms, and satisfaction with academic performance in different methods.[26]

Our study has some limitations also. This was a cross-sectional study. If follow up would have been done, it could reveal the change of stress level along with continuation of e-learning. Our study was a single centre experience, where e-learning is used for first time due to absence of physical class. So the results may vary with some study where e-learning was being used from before.

## Conclusion

To conclude, COVID 19 has changed a lot of traditional practices in every aspect of human life. Clinical classes, hands-on demonstration classes, 'live' patients and bedside teaching are indispensible part of medical teaching. But in current situation e-learning method is being adapted in most of the institutions to maintain physical distance. E-learning is just not the online lecture class; it has many more integral components like self learning from web, assignment, interaction, skill and knowledge building, e-seminars etc. It is mostly beneficial in current condition to continue the medical education with some limitations. Overall though it cannot totally replace the traditional physical teaching, but can be an essential supplement to it also in future. But for better outcome, proper module and training for digital learning along with adequate affordable internet access has to be available. Finally, this e-learning can also help to decrease the psychological stress level among the students also by engaging them in constructive works and diverting the mind from pandemic.

**Acknowledgement:** The authors express their gratitude to all the participating students and all faculties and staffs of Dept of Pharmacology for their support and technical helps required for successful completion of the study.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

## References

1. Ferrel MN, Ryan JJ. The impact of COVID-19 on medical education. Cureus. 2020;12:e7492.
2. Pattanshetti VM, Pattanshetti SV. The impact of COVID-19 on medical education in India. J Sci Soc 2020;47:1-2
3. Sahi PK, Mishra D, Singh T. Medical Education Amid the COVID-19 Pandemic [published online ahead of print, 2020 May 14]. Indian Pediatr. 2020; S097475591600181.
4. Ellaway R, Masters K. AMEE Guide 32: E-Learning in medical education Part 1: Learning, teaching and assessment. Med Teach. 2008;30:455-73.
5. Ruiz JG, Mintzer MJ, Leipzig RM. The impact of e-learning in medical education. Acad Med. 2006;81:207-12.
6. Dhir SK, Verma D, Batta M, Mishra D. E-Learning in Medical Education in India. Indian Pediatr. 2017;54(10):871-877. doi:10.1007/s13312-017-1152-9
7. Goh PS, Sandars J. A Vision of the use of Technology in Medical Education after the COVID-19 Pandemic. MedEdPublish; 2020.p. 9.
8. Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. Journal of Health and Social Behavior, 24, 386–396
9. Eysenbach G. Improving the quality of web surveys: The checklist for reporting results of internet E surveys (CHERRIES). J Med Internet Res 2004;6:e34.
10. Debnath DJ. Kakkar R. Modified BG Prasad Socio-economic Classification, Updated – 2020. Indian J Comm Health. 2020;32(1):124-125
11. Hiwarkar Monali; Taywade Onjal. Assessment of knowledge, attitude and skills towards e-learning in first year medical students. International Journal of Research in Medical Sciences, [S.l.], v. 7, n. 11, p. 4119-4123, oct. 2019.
12. Visalam, Kumar AP, Prakash AO, padmavathi R. Knowledge, Attitude and Practice towards E – Learning Among Medical Undergraduate Students.IOSR Journal of Applied Physics (IOSR-JAP). 2015;7(4):1-4.
13. Agarwal S, Kaushik JS. Student's Perception of Online Learning during COVID Pandemic. Indian J Pediatr. 2020;87(7):554. doi:10.1007/s12098-020-03327-7
14. Verma, A., Verma, S., Garg, P. et al. Online Teaching During COVID-19: Perception of Medical Undergraduate Students. Indian J Surg. 2020;82, 299–300.
15. Kaur N, Dwivedi D, Arora J, Gandhi A. Study of the effectiveness of e-learning to conventional teaching in medical undergraduates amid COVID-19 pandemic. Natl J Physiol Pharm Pharmacol 2020;10(07):563-567
16. Omprakash A, Kumar AP, Sagar V, Sathiyasekaran BWC, Ramaswamy P. Needs Assessment Among Students of Health Professions Education for the Introduction of E-learning in a South Indian Tertiary Care University. Indian J Physiol Pharmacol 2019; 63(1) : 42–48
17. Singh K, Srivastava S, Bharadwaj A, Dixit A, Mishra S. Indian Pediatr. 2020;4:epub
18. Daroedono E, Siagian FE, Alfarabi M, Cing JM, Arodes ES, Sirait

RH, et al. The impact of COVID-19 on medical education: our students perception on the practice of long distance learning. Int J Community Med Public Health 2020;7:2790-6.Xx
19. Ghanizadeh A, Mosallaei S, Sharifian D M., Sahraian A., Yazdanshenas P. Attitude and Use of E-Learning, education by medical students in Shiraz, Iran. Internal Medicine and Medical Investigation Journal, 2018; 3(3), 108-111
20. Subramanian A, Timberlake M, Mittakanti H, Lara M, Brandt ML. Novel educational approach for medical students: improved retention rates using interactive medical software compared with traditional lecture-based format. J Surg Educ.2012;69(2):253-6.
21. Bettinger, Eric P., Lindsay Fox, Susanna Loeb, and Eric S. Taylor. 2017. "Virtual classrooms: How online college courses affect student success". American Economic Review 107 (9):2855-2875.
22. Pei L, Wu H. Does online learning work better than offline learning in undergraduate medical education? A systematic review and meta-analysis. Med Educ Online. 2019;24(1):1666538.
23. Dwivedi D, Kaur N, Shukla S, Gandhi A, Tripathi S. Perception of stress among medical undergraduate during coronavirus disease-19 pandemic on exposure to online teaching.
24. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. Gen Psychiatr. 2020;33(2):e100213
25. Duraku ZH, Hoxha L.The impact of COVID-19 on higher education: A study of interaction among students' mental health, attitudes toward online learning, study skills, and changes in students' life.
26. Bolatov, A.K., Seisembekov, T.Z., Askarova, A.Z. et al. Online-Learning due to COVID-19 Improved Mental Health Among Medical Students. Med.Sci.Educ. 2020.