Original Article

Impact of COVID-19 Pandemic on Sleep Quality in Medical Students

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Abstract

Background: Medical students are already under extreme academic pressure which causes disruption in their sleep patterns. Due to the COVID-19 pandemic, though they have been relieved of their hectic schedules this has also led to complete lack of hands-on training and bedside clinical teaching which might have given rise to increased anxiety in this population. **Aims:** To assess the sleeping pattern and determinants of poor sleep quality among medical students during the COVID-19 pandemic. **Materials and Methods:** A cross-sectional study was conducted among 343 undergraduate medical students of a tertiary care teaching hospital from August 17, 2020, to September 17, 2020, via an online questionnaire containing questions on sociodemographic parameters, lifestyle factors, Pittsburgh Sleep Quality Index, COVID-19-related stress and academic delay-related stress. **Statistical Analysis:** Analysis was done with the Statistical Package for the Social Sciences (SPSS) Version 20.0. **Results:** About 52.47% had a poor sleep quality; 92.4% had a high level of academic uncertainty-related stress and 64.7% experienced a high level of COVID-19-related stress. Significant association was found between Poor Sleep Quality (PSQI score) and urban residence, nuclear family, smoking, excessive caffeine consumption, and high levels of COVID-19 stress. **Conclusion:** Although poor sleepers had decreased in number from before the COVID-19 pandemic, they were still much higher than the general population. This might be due to high levels of academic delay-related stress present virtually in the entire population. This can be circumvented by proper counseling of the students and sensitive planning of the academic activities once the pandemic will over.

Keywords: *Academic stress, COVID-19 pandemic, medical students, PSQI, sleep quality*

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Introduction

The coronavirus emerged as a highly infectious disease in Wuhan province in China,[1] which was later declared a global pandemic by WHO on the March 11, 2020.[2] As of 15th September, it has affected 29,322,262 people worldwide including 5,016,854 in India and 207,255 in West Bengal.[3]

COVID-19 brought with it a mass quarantine, and months of statewise lockdown in India. The psychological effects of such a quarantine include increased levels of depression, anxiety, and insomnia among other problems.[4] The pandemic has also given rise to stigma against doctors and medical students-all of which could adversely affect the sleep quality of medical students. Studies done in Greece[5] and Italy[6] showed an increase in the prevalence of clinical insomnia during the pandemic. A study[7] done on Indian adults to find out the changes in sleep pattern during the COVID19 lockdown showed that a quarter of their study population reported a worsening of sleep quality.

Poor sleep quality has a wide array of both short-term and long-term adverse effects including but not limited to-less work productivity with decreased cognitive function, mood disorders, poor quality of life, and increased incidence of metabolic diseases.[8] While

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around one-third of the adult general population experiences poor sleep quality,[9] the prevalence of poor sleep quality among medical students has been reported to be higher.[10-14] Risk factors for sleep disorders include emotional exhaustion and stress[15] both of which are high among medical students. Other causes of the high prevalence of poor sleep quality may be their highly demanding lifestyle, long hours of study, lack of a fixed schedule, and compulsion to work at night due to hectic clinical duties.

Medical students are already under extreme academic pressure which causes adverse lifestyle changes, including a disruption in their sleep patterns. The academic burden of medical students has only increased during the lockdown due to the shift from hands-on learning to online learning-hampering the essential practical education unique to medical students. Therefore, this might lead to an increase in anxiety due to academic delays even though the stress from hectic college hours and clinical duties have decreased. These stresses and resulting in consistent poor sleep quality might have far-reaching effects in terms of future performance both as students and doctors.

Thus identification of poor sleep quality, its causative factors during the COVID-19 lockdown, and addressing the aforementioned is essential in medical students. For this reason, we selected medical students as the subjects of our study to provide further insight into the ways medical students have been affected by this pandemic. While studies have been done on sleep quality and its changes in the general population during the pandemic in India,[7,16] and in nursing students in Greece,[5] Italy,[6] Spain[14] and France[17] no studies have been done on medical students in India. With this background, a study was conducted to explore the sleeping pattern and determinants of poor sleep quality during the COVID-19 pandemic among medical undergraduate students of a tertiary care teaching Hospital of Kolkata, India.

Materials and Methods

Study design, study setting, study population

An institution-based descriptive observational study, cross-sectional in design was conducted from August 17, 2020, to September 17, 2020, for 1 month among undergraduate medical students of a tertiary care teaching hospital of Kolkata, West Bengal, India.

Inclusion criteria

Medical students of all ages and both gender, who study in that tertiary care teaching hospital of Kolkata, West Bengal and agreed to participate in the study via informed online consent.

Exclusion criteria

- Preexisting sleep disorders
- Incomplete responses to the questionnaire provided.

Study tools

A predesigned pretested structured online questionnaire via the platform of Google Forms containing questions pertaining to sociodemographic details, lifestyle factors, The Pittsburgh Sleep Quality Index,[18] questions on COVID-19 stress, and academic uncertainty stress.

The questionnaire consisted of five parts:

- Part I consisted of questions on the sociodemographic profile
- Part II consisted of questions on lifestyle factors
- Part III consisted of questions of the Pittsburgh Sleep Quality Index (PQSI[18]
- Part IV contained questions assessing COVID-19 stress[4]
- Part V contained questions assessing academic stress.

The questionnaire was designed in consultation with three experts; one from the Department of Community Medicine, one from the department of psychiatry and one from the department of respiratory medicine; it was pretested on fifty undergraduate medical students of the same institution; then modified; necessary changes were done and validated by another 3 experts. Pittsburg Quality of Sleep Index (PQSI) scale was already validated in the Indian setting.

Study variables

Sociodemographic profile (age in completed years, gender, year of study, current residence, type of family, body mass index (BMI) according to WHO classification, per capita monthly income), lifestyle questions (current smoker, regular alcohol consumption, excessive caffeine consumption, habit of daily exercise, duration of exercise, screen time per day), 9 Questions of PSQI, 10 questions on COVID stress, 6 questions on Academic Stress.

Sample size and sampling technique

Taking proportion of poor sleep quality (p) as 63.48% from a previous study,[10] q = 1-p, $\alpha = 0.05$, confidence interval = 95% and absolute precision (L) = 5%, Sample size was calculated using formula = $(Z\alpha^2\ pq)/(Lp)^2 = [(1.96)^2 \times 63.48 \times 36.52]/(0.1 \times 0.58)^2 = 357$. After adding 5% nonresponse, final total sample size was taken as (357 + 18) = 375.

375 undergraduate medical students were selected using nonrandomized snowball sampling technique. About 32 questionnaires were incomplete, so data of (375-32) = of 343 were entered and analyzed. Thus, the response rate was 91.46%.

Data collection technique

Informed electronic consent was obtained from the study population after explaining the purpose and nature of the study and ensuring their anonymity and confidentiality. An online survey was conducted using Google forms over 7 days. The questionnaire was designed with the help of experts. After the questionnaire was designed, it was pretested among 20 undergraduate medical students of the same institution. Minor corrections were made in the questionnaire. The Google form was designed in a way to avoid multiple entries from the same respondent.

Statistical analysis

Data were entered in Microsoft Office Excel 2010; analysis was performed with the IBM Corp. Released 2011. IBM SPSS Statistics for windows, Version 20.0 Armonk, NY:IBM Corp. Descriptive results were expressed by frequency and percentages. Global PSQI scores of the participants were calculated.

COVID-19-related stress and academic stress-Questions on COVID-19-related stress were adapted from the paper by Grover *et al*.[4]

Stress scores from COVID 19 related and academic questions were calculated in the following way-the responses to the questions were recorded on a 5-point Likert scale, having the options strongly agree, agree, neutral, disagree, and strongly disagree. The options were ascribed 5,4,3,2 and 1 marks, respectively. The minimum and maximum marks for 10 COVID-19 stress (10 and 50, respectively) and six academic stress questions (6 and 30 respectively) were calculated and the median of each range was determined. Participants having a score of more than or equal to the median were taken to have a high-stress score and those less than the median, to have a low-stress score. Finally, the association between the Global PSQI scores and the socio-demographic characteristics, lifestyle factors, COVID-19 related, and academic stress scores were determined using the Chi-square test and odds ratio. $P < 0.05$ was considered statistically significant.

Operational definitions

- Current smoker[19] If the person has smoked 100 cigarettes in their lifetime and currently smoke cigarettes (occasionally or regularly)
- Regular alcohol consumer[20]- Drinking alcohol most days and weeks
- Excessive caffeine intake[21]- Excessive caffeine is more than 4 cups (each cup containing 150–200 ml of beverage) of tea/coffee per day
- Pittsburgh Sleep Quality Index[18]- The Pittsburgh Sleep Quality Index[18] has been used in this study as a tool to assess sleep quality over the last 1 month. A global PSQI score of greater than 5 has a high diagnostic sensitivity and specificity (89.6% and 86.5% respectively) to determine poor sleepers. This tool has sufficient measures of consistency (test-retest reliability), validity and internal homogeneity and has been validated in the Indian population. The Pittsburgh Sleep Quality Index (PSQI) is a self-rated survey which evaluates sleep quality and disturbances over the last 1 month.

Nineteen unique items generate seven "component" scores: (1) Subjective sleep quality, (2) Sleep latency, (3) Sleep duration, (4) Habitual sleep efficiency, (5) Sleep disturbances, (6) Use of sleeping medication, and 7.daytime dysfunction; each of which has a range from "0" to "3," "0" indicates no difficulty, and "3" indicates severe difficulty. The sum of scores for these seven components yields one global score which is in between 0 and 21, zero indicating that the person is having a very good quality sleep and 21 indicating that the person is having a very poor quality sleep.

A score of >5 indicates that the person, in general, is having a poor sleep quality.

Ethics committee approval

Approval from Institutional Ethics Committee was taken (Institutional Ethics Committee, IPGME&R, Research Oversight Committee, Letter Number: IPGME&R/IEC/2020/634 Date September 09.,2020.

Results

Table 1 depicts the distribution of the study population as per their sociodemographic and lifestyle variables. About 59.1% of the study population were in the age group of 18–21 years followed by 22–26 years (40.2%) and only 0.6% belonged to 27–30 years; 58% were male; 29.4% belonged to the final year; 57.7% were residing in the rural area and rest 42.3% in urban areas during the study; majority (87.5%) lived in a nuclear family, whereas 12.5% belonged to a joint family. A normal BMI (according to the WHO classification) was seen in more than half of the participants (59.8%). However, about one-fourth (26.5%) were overweight. Regarding socioeconomic status, majority (72.3%) of the study population belonged to the upper socioeconomic class as per the Modified BG Prasad Scale 2020.

Lifestyle factors of the study population were demonstrated in the same table which revealed that among 343 medical students, 28/343 (8.16%) were current smokers, 4/343 (1.17%) reported regular alcohol consumption, 33/343 (9.62%) consumed excessive caffeine, 126/343 (36.73%) had a habit of daily exercise of whom 82 (65.08) exercised for at least 30 min/day;

Table 1: Distribution of the study population as per sociodemographic factors, lifestyle factors, COVID-19 related stress and academic stress (*n*=343)

Sociodemographic profile	*n* (%)
Age (completed years)	
18-21	203 (59.1)
22-26	138 (40.2)
27-30	2 (0.6)
Gender	
Male	199 (58)
Female	144 (42)
Year of study	
First year	87 (25.4)
Second year	93 (27.1)
Third year	62 (18.1)
Final year	101 (29.4)
Current residence	
Urban	145 (42.3)
Rural	198 (57.7)
Type of family	
Nuclear	300 (87.5)
Joint	4 (12.5)
BMI (WHO classification) (kg/m^2)	
<18.5 (underweight)	30 (8.8)
18.5-24.9 (normal)	205 (59.8)
25-29.9 (overweight)	91 (26.5)
30-34.9 (obesity class 1)	15 (4.4)
35-39.9 (obesity class 2)	2 (0.6)
Socioeconomic status (As per Modified BG Prasad Scale, 2020)	
Upper (class 1): Rs 7533 and above	248 (72.3)
Upper middle (class 2): Rs 3766-7532	40 (11.7)
Middle (class 3): Rs 2260-3765	25 (7.3)
Lower middle (class 4): Rs 1130-2259	25 (7.3)
Lower (class 5): Rs 1129 and below	5 (1.5)
Lifestyle factors	
Current smoker	
Yes	28 (8.16)
No	315 (91.84)
Regular alcohol consumption	
Yes	4 (1.17)
No	339 (98.83)
Excessive caffeine consumption	
Yes	33 (9.62)
No	310 (90.37)
Habit of daily exercise	
Yes	126 (36.73)
No	217 (63.27)
Duration of exercise (min) (*n*=126)	
≥30	82 (65.08)
<30	44 (34.92)
Screen time per day (h)	
<5	107 (31.20)
6-10	183 (53.35)
11-15	48 (13.99)
COVID-19 related stress	
High	222 (64.7)
Low	121 (35.3)
Academic stress	
High	317 (92.4)
Low	26 (7.6)

BMI: Body mass index, WHO: World Health Organization

and 107/343 (31.20%) students reported <5 h of screen time/day. However more than half (53.35%) had screen time for 6–10 h/day, even 1.46% spend more than 15 h of screen time daily.

Almost all of the students (92.4%) had a high level of academic uncertainty-related stress. Similarly, majority of the students (64.7%) also experienced high levels of COVID-19 related stress.

Table 2 shows the distribution of the study population as per the components of PSQI and global PSQI scores of the study population. About 35.27% of students fell asleep within 15–30 min; 34.69% slept for 6–7 h; most of them (79%) had a good sleep efficiency of more than 85%; very few students (9.03%) took medications for sleep; 64.43% believed that they had a fairly good subjective sleep quality and majority (79.3%) experienced daytime dysfunction. However, it was seen that more than half (52.47%) of the students had poor sleep quality as per the Global PSQI score.

Table 3 outlines the distribution of the study population with regards to their opinions on COVID-19-related stress and academic stress, showing that nearly two-thirds of the population (63.6%) agreed or strongly agreed that they spent most of their free time looking up COVID-related information, which was the most common way COVID-19 related stress manifested itself. About 58.9% of the population agreed or strongly agreed that they wore a mask or protective equipment even in open spaces. However, only 28.9% of the population agreed or strongly agreed that they avoided COVID-19-related information. With regards to academic stress, 93% of the study population felt uncertain about the timing of their final exams and 82.2% missed the learning opportunities provided to them by peer interactions. However, only 48.6% felt anxious that they might miss a postgraduate entrance exam because of the change in final examination timings.

Association of Global PSQI score with socio-demographic parameters and lifestyle factors is shown in Table 4 which described that there

was a significant association between Poor Sleep Quality (PSQI) with urban residence, nuclear family, current smoker, excessive caffeine consumption, and high levels of COVID-19 stress ($P < 0.05$).

Aafter checking for multicollinearity (VIF <10), Binary Logistic Regression model was fit to the data, the binary dependant variable being Quality of Sleepers (poor [if Global PSQI Score <6], Good [if Global PSQI Score ≥6]) and the independent variables being age, gender, BMI, study year, current residence, type of family, per capita monthly income, habit of daily exercise, current smoker, excessive caffeine consumption, excessive alcohol consumption, hours of exposure to visual electronic devices, COVID stress score and academic stress score [Table 5]. The factors current residence (odds ratio [OR]– 1.608, 95% confidence interval [CI]– [1, 2.589], $P = 0.050$), type of family (OR-0.491, 95% CI- [0.240,1], $P = 0.050$], COVID stress score (OR-2.595, 95% CI- [1.573,4.283], $P = 0.00019$) and the covariate Age[OR-0.772,95% CI-(0.617,0.965), P value-0.023] were significantly associated with Quality of Sleepers.

Table 2: Distribution of the study population as per components of Pittsburgh sleep quality index and global Pittsburgh sleep quality index scores (*n*=343)

Variable	*n* (%)
Sleep latency average time to fall to sleep (min)	
<15	74 (21.57)
15-30	121 (35.27)
31-60	92 (26.82)
>60	56 (16.32)
Sleep duration average duration of sleep (h)	
>7	99 (28.86)
6-7	119 (34.69)
5-6	101 (29.44)
<5	23 (6.70)
Habitual sleep efficiency	
>85%	271 (79.00)
75-84%	50 (14.57)
65-74%	8 (2.33)
<65%	3 (0.87)
Medication used during sleep	
Yes	31 (9.03)
No	312 (90.96)
Subjective sleep quality	
Very good	68 (19.82)
Fairly good	221 (64.43)
Fairly bad	43 (12.53)
Very bad	11 (3.20)
Daytime dysfunction	
Yes	272 (79.30)
No	71 (20.69)
Global PSQI	
>5 (poor sleep quality)	180 (52.47)
≤5 (good sleep quality)	163 (47.52)

PSQI: Pittsburgh sleep quality index

Figure 1 assess the severity of COVID-19-related stress and academic stress. While COVID-19 stress scores ranged from a minimum of 10 to a maximum of 50 with a median score of 32 in the survey participants, academic stress scores ranged from 6 to 30 with a median of 25. COVID Stress Score was more dispersed (interquartile range = 11) than Academic Stress Score (interquartile range = 5.5). The distribution of Academic Stress Score is more negatively skewed than COVID Stress Score, as in the former the median line is closer to the upper quartile than in the latter, in the respective box plots. The distribution of both Academic and COVID Stress Scores are platykurtic as the length of the whiskers is more than the length of the boxes. However, the distribution of Academic Stress Scores has slightly lighter tails and higher peak than the COVID Stress Scores, as the length of the whiskers is much more than the length of the box in the former than in the latter.

Discussion

In the present study, we found that more than half of the study population of medical students (52.47%) had poor sleep quality (PSQI >5). Medical students usually carry an extremely large academic load which could potentially contribute to poor sleep quality. This is observed from high percentages of poor sleepers

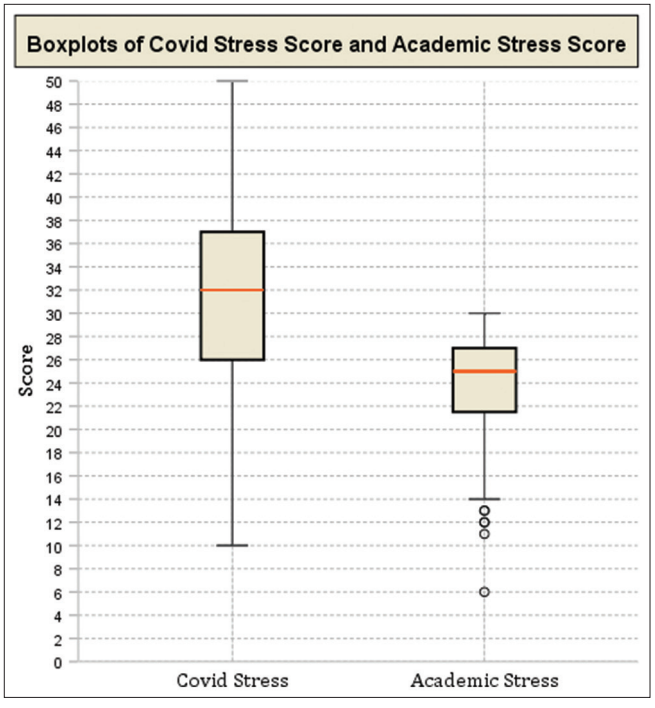

Figure 1: Boxplot showing distribution of the study population as per COVID-19 related stress and academic stress (*n* = 343)

Table 3: Distribution of the study population according to their opinion on various COVID-19 related stress and academic stress questions (*n*=343)

Variable	Grading				
	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
Questions on COVID-19 related stress					
Have you been afraid of getting severely infected with coronavirus?	27 (7.9)	42 (12.2)	99 (28.9)	133 (38.8)	42 (12.2)
Have you been feeling pessimistic or hopeless about the future?	39 (11.4)	56 (16.3)	85 (24.8)	114 (33.2)	49 (14.3)
Have you been feeling emotionally exhausted or numb *i e*., no happiness or sadness?	25 (7.3)	45 (13.1)	82 (23.9)	110 (32.1)	81 (23.6)
Have you been feeling detached from others?	28 (8.2)	43 (12.5)	78 (22.7)	119 (34.7)	75 (21.9)
Have you feel feeling dazed, confused or unable to think clearly?	39 (11.4)	54 (15.7)	94 (27.4)	110 (32.1)	46 (13.4)
Do you avoid corona related information?	62 (18.1)	73 (21.3)	109 (31.8)	52 (15.2)	47 (13.7)
Have you had anxiety or palpitations when thinking about coronavirus?	75 (21.9)	95 (21.7)	91 (26.5)	63 (18.4)	90 (26.2)
Have you had difficulty concentrating or making decisions?	33 (9.6)	58 (16.9)	88 (25.7)	111 (32.4)	53 (15.5)
Do you invest most of your free time looking up coronavirus related information?	21 (6.1)	29 (8.5)	76 (22.2)	64 (18.7)	154 (44.9)
Do you wear mask or protective equipment even in open spaces?	29 (8.5)	50 (14.6)	62 (18.1)	83 (24.2)	119 (34.7)
Academic stress related worries					
I have the following concerns about my academics/career being affected by COVID pandemic					
I'm uncertain about the timing of the final examination	2 (0.6)	3 (0.9)	19 (5.5)	84 (24.5)	235 (68.5)
I am not getting any bedside clinical training which will not be compensated later on	10 (2.9)	8 (2.3)	61 (17.8)	101 (29.4)	163 (47.5)
I am having to understand topics by myself due to inadequacies inherent to online teaching	8 (2.3)	23 (6.7)	58 (16.9)	110 (32.1)	144 (42)
I miss the learning opportunity through interaction with my peers	14 (4.1)	16 (4.7)	31 (9)	107 (31.2)	175 (51)
Our batch will be discriminated as the "COVID batch" in future	32 (9.3)	37 (10.8)	117 (34.1)	83 (24.2)	84 (24.5)
We may miss a postgraduate entrance examination due to the change in timings of our final examinations	19 (5.5)	35 (10.2)	122 (35.6)	77 (22.4)	90 (26.2)

among medical students in studies conducted before the COVID pandemic in India and abroad by Basu *et al*. at Kolkata (63.48%),[10] Shad *et al*. at Delhi (62.6%),[11] Almojali *et al*. at Saudi Arabia (76%),[12] Preišegolavičiūtė *et al*. at Lithuania (59.4%),[13] and in Nursing students in Spain by Romero-Blanco *et al*. (60.4%).[14]

The general population comprises a far fewer percentage of poor sleepers, as is evidenced by studies conducted by Gualano *et al*. in Italy (40.5%),[6] and Okubo *et al*. at Hirosaki, Japan (23.8%).[9]

Academic demands of medical training can cause significant stress and sleep disturbances demonstrated in a study by Abdulghani *et al*. in Saudi Arabia.[22]

As the COVID-19 pandemic resulted in the cessation of the academic curriculum of the medical students, the main factors which discriminate the medical students from the general student population (i.e., academic load, attitude towards study, and lifestyle),[13,23] also changed; resulting in decrease in the proportion of bad sleepers among medical students (from 63.48%to 52.47%).[10] This is in contrast to the general population in a study by Gualano *et al*. in Italy where the proportion of poor sleepers increased from 40.5% to 52.4%.[6]

While there is a decrease in the percentage of bad sleepers among medical students, the percentage is still higher than the general population which could be potentially due to stress relating to COVID-19 and the fear of missing out on essential clinical skills.

Several studies.[16,24-26] have shown an increase in the sleep duration in the general population after the advent of the pandemic like the study by Sinha *et al*. in a national survey,[16] Wright *et al*. in Colorado University,[24] Yang *et al*. in China,[25] and Advai *et al*. in California.[26] This might be due to a change in work-home life leading to a lack of structure.[26]

Studies in Saudi Arabia,[12] Spain,[14] Hong Kong by Huen *et al*.[27] including ours revealed that the average duration of sleep among medical students has slightly increased during the pandemic, this is less than that of the general population both during and before the pandemic.[16,24]

Table 4: Association of global Pittsburgh sleep quality index score with sociodemographic factors, lifestyle factors, COVID-19 stress, and Academic stress (*n*=343)

Co-variable	Group	PSQI score			χ^2	*P*
		Poor, *n* (%)	Good, *n* (%)	Total, *n* (%)		
Age	≤21	111 (54.68)	92 (45.32)	203 (59.18)	0.96	0.32
	>21	69 (49.29)	71 (50.71)	140 (40.82)		
Gender	Male	102 (51.3)	97 (48.7)	199 (58)	0.28	0.59
	Female	78 (54.2)	66 (45.8)	144 (42)		
Current year of schooling	First and second year	95 (52.8)	85 (47.2)	180 (52.5)	0.01	0.90
	Third and final year	85 (52.1)	78 (47.9)	163 (47.5)		
Current residence	Urban	86 (59.3)	59 (40.7)	145 (42.3)	4.70	0.03
	Rural	94 (47.5)	104 (52.5)	198 (57.7)		
Type of family	Nuclear	164 (54.7)	136 (45.3)	300 (87.5)	4.59	0.03
	Joint	16 (37.2)	27 (62.8)	43 (12.5)		
BMI (WHO classification) (kg/m^2)	<25	128 (54.47)	107 (45.53)	235 (68.51)	1.18	0.27
	≥25	52 (48.15)	56 (51.85)	108 (31.49)		
Socioeconomic status (Account to Modified BG Prasad Scale, 2020)	Classes 1 and 2	151 (52.43)	137 (47.57)	288 (83.97)	0.00	0.96
	Classes 3,4 and 5	29 (52.73)	26 (47.27)	55 (16.03)		
Habit of daily exercise	Yes	62 (49.2)	64 (50.8)	126 (36.7)	0.85	0.35
	No	118 (54.4)	99 (45.6)	217 (63.3)		
Duration of exercise (min) (*n*=126)	≥30	36 (43.9)	46 (56.1)	82 (65.1)	2.64	0.10
	<30	26 (59.1)	18 (40.9)	44 (34.9)		
Current smoker	Yes	20 (71.4)	8 (28.6)	28 (8.2)	4.39	0.03
	No	160 (50.8)	155 (49.2)	315 (91.8)		
Excessive caffeine consumption	Yes	23 (69.7)	10 (30.3)	33 (9.6)	4.34	0.03
	No	157 (50.6)	153 (49.4)	310 (90.4)		
Regular alcohol consumption	Yes	2 (50.0)	2 (50.0)	4 (1.2)	0.00	0.92
	No	178 (52.5)	161 (47.5)	339 (98.8)		
Screen time (h per day)	<11	150 (51.7)	140 (48.3)	290 (84.5)	0.42	0.51
	≥11	30 (56.6)	23 (43.4)	53 (15.5)		
COVID-19 related stress	High	132 (59.5)	90 (40.5)	222 (64.7)	12.30	0.00
	Low	48 (39.7)	73 (60.3)	121 (35.3)		
Academic stress	High	166 (52.4)	151 (47.6)	317 (92.4)	0.02	0.89
	Low	14 (53.8)	12 (46.2)	26 (7.6)		

BMI: Body mass index, PSQI: Pittsburgh sleep quality index, WHO: World Health Organization

A study[12] conducted on medical students before the pandemic showed that it took an average of 32 min (standard deviation [SD]-33 min) to fall asleep, which was found to have improved to 20.85 min (SD-2.44 min) during the pandemic, which was similar to our study.

The improvement in sleep latency and sleep duration in medical students may be attributed to a lack of hectic schedules during home quarantine and lockdown.

In this study, a similar proportion of males and females were poor sleepers, which was in line with some previous studies globally[10,11] but in contrast to the study done by Kumar *et al*. in Chennai[28] where they found that male students were worse sleepers. However, a study done by Ibrahim *et al*. in King Abdulaziz University[29] found a significant association between female sex and poor sleep quality.

Although no significant association was found between the year of schooling and poor sleep quality in the study done in Delhi,[11] a higher prevalence of poor sleep quality was found among 1st-year students as compared to other years in our study and others.[10,29] This might be due to high academic anxiety in the 1st year of medical schools since the students are less adapted to the stresses of medical school and both the training for the 1st year M. B. B. S examination and the examination itself were unable to take place this year.

In the present study and study by Voitsidis *et al* at Greece,[5] medical students residing in urban areas had a significantly poorer quality of sleep than in the rural areas, which was in contrast to the study Cao *et al* at China where college students from rural areas had poorer sleep quality than students from urban areas.[30] This can be explained by the fact that in India the incidence of COVID-19 infection is much higher in metropolitan cities as compared to rural areas, leading to anxiety.

Table 5: Binary logistic regression of sleep quality on independent variables (*n*=343)

Parameters	OR	95% CI for OR		Significance
		Lower	Upper	
Age	0.772	0.617	0.965	0.023
Gender				
Male	1.083	0.662	1.771	0.750
Female	1	-	-	
BMI	0.972	0.915	1.032	0.350
Year of study				
First year	0.683	0.279	1.668	0.403
Second year	0.546	0.263	1.133	0.104
Third year	0.691	0.335	1.428	0.318
Final year	1			
Current residence				
Urban	1.608	1.000	2.589	0.050
Day scholar	1			
Type of family				
Joint	0.491	0.240	1.000	0.050
Nuclear	1			
Per capita monthly income	1.000	1.000	1.000	0.352
Daily exercise				
Yes	0.846	0.523	1.369	0.496
No	1			
Current smoker				
Yes	2.648	0.931	7.531	0.068
No	1			
Excessive caffeine consumption				
Yes	2.176	0.902	5.248	0.083
No	1			
Regular alcohol consumption				
Yes	0.312	0.028	3.522	0.347
No	1			
Hours of exposure to visual electronic devices	1.015	0.946	1.089	0.679
COVID-19 stress score				
≥30	2.595	1.573	4.283	0.00019
<30	1			
Academic stress score				
≥18	0.559	0.232	1.346	0.194
<18	1			
Constant	442.236			0.027

BMI: Body mass index, OR: Odds ratio, CI: Confidence interval

The difference in the poor quality of sleep distribution from the Chinese population can be explained by the differences in demographics of infection, study tools used, and stressors in that population.

Participants living in nuclear families had a significantly higher prevalence of poor sleep quality than those living in joint families. This may be due to more social support in joint families which was found to be negatively correlated with insomnia.[5]

This study demonstrated that those who exercised daily were more likely to experience better sleep quality as shown by Wu *et al*. in China.[31] Our study showed a significant association between poor sleep quality and current smokers which was also found by Zunhammer *et al*. in Germany[32] A significant association between excessive caffeine intake and poor sleep quality was observed in this study as well as by Giri *et al*. at Maharashtra[33] but in contrast to studies done by Zunhammer *et al*.[32] and Basu *et al*.[10]

Those who consumed alcohol regularly were more likely to experience poor sleep quality, corroborative with the findings by Zunhammer *et al*.,[32] Basu *et al*.,[10] and Giri *et al*.[33]

A decrease in alcohol, caffeine, and cigarette consumption during COVID-19 was observed, which may be due to reduced availability and also the current shift of the study population from their prior hostel residences to their homes.

There was no significant association between screen time and poor sleep quality, contradictory to findings by Wu *et al*. in China.[31] This may be due to increased usage of cell phones and other electronic devices during the daytime instead of the night as there is increased free daytime because of the pandemic.

In the present study, about 64.72% of the study population suffered from COVID-19 stress and a significant association was documented between COVID stress and poor sleep quality. Wearing masks in open spaces and feeling detached from others were the main indicators of this stress, found among 58.9% and 56.56%, respectively. A study by Almojali *et al*. in Saudi Arabia[12] among medical students a statistically significant association was found between stress and poor sleep quality. In a study conducted by Grover *et al*. in India[4] on COVID-19 Stress in the general population, the main indicators were fear when dealing with febrile family members (38.8%) and fear of getting infected with Coronavirus (38.5%), whereas only 37.9% of the population wore masks in open spaces and 24.0% felt detached from others. The higher amounts of COVID stress among medical students than the general population may be attributed to a wider medical knowledge among medical students who are less likely to underestimate the disease.

The pandemic has emptied schools and colleges causing a shift to virtual platforms. Though this might, to a large extent, fulfill the academic needs of many other streams, medical students depend heavily on practical teaching. This has created an apprehension among them that they might not be compensated for these invaluable parts of

their course later on because of the uncertainty regarding the reopening of their institutions. This is further evidenced by the three major determinants of academic stress revealed in our study-uncertainty about the timing of final examinations (93%), absence of learning opportunities through interaction with peers (82.2%), and absence of bedside clinical teaching (76.9%). Studies done by O'Byrne *et al*. at Ireland[34] and Chandratre[35] have also highlighted the increased stress among medical students due to inadequate clinical training for prolonged periods during this pandemic. A study in China by Cao *et al*.[30] on the psychological impact of COVID-19 among medical students revealed a positive association between anxiety and stress due to academic delays. A high academic stress score was found in virtually all the students in our study population (92.4%) though it was not significantly associated with poor sleep quality.

In conclusion, in comparison with a similar study[10] done on the same population in pre-COVID times, our study found a decrease in poor sleep quality from 63.48% to 52.47%. This may be due to the shift of students from colleges to home with a relatively low workload despite high levels of academic and COVID stress. Males and females were found to suffer equally from poor sleep quality, in line with the previous study. The sleep quality of first-year students was the worst in both our study and the previous study. In contrast to a study done in the same study population in 2019,[10] regular alcohol intake, smoking, caffeine intake had decreased during the COVID pandemic. In the previous study a significant association was found between PSQI and age, year of study, hostel residence, socioeconomic status, BMI, smoking, alcohol intake, caffeine, exercise, stress, and prolonged screen time while our study found a significant association between PSQI score and urban residence, nuclear family, current smokers, excessive caffeine consumption and high levels of COVID-19 stress.

On binary logistic regression significant association was found between quality of sleepers and age, current residence, type of family, and COVID stress score.

Strengths and limitations

Strengths include

1. Validated tools for measuring sleep quality
2. Good sample size
3. Dearth of data about sleep quality of undergraduate medical students in India including West Bengal and Kolkata during COVID-19 pandemic.

However, like other studies, the results of our study should be interpreted in the context of some limitations. First, as this study followed a cross-sectional data collection design, the temporal relationship between poor sleep quality and sociodemographic and lifestyle factors cannot be determined. A longitudinal study design would be better.

Second, this study was conducted from one medical college, therefore the result cannot be generalized to all medical students. A multi-center study would be better to improve generalizability. Furthermore, if the study questionnaire would have been designed for and distributed among the general population, the results would be generalizable to the population as a whole and not only medical students.

Third, due to lockdown, data collection is done online. The study had all the traditional limitations associated with an online survey. It would be better to collect data offline. Finally, it was based only on subjective assessment by the study population. Incorrect information may be provided by them.

Conclusion

The present study revealed that more than half of the undergraduate medical students (52.47%) had poor sleep quality during the COVID-19 pandemic as per the PSQI scale. As the COVID-19 pandemic resulted in the cessation of the academic curriculum of the medical students, the main factors which discriminate the medical students from the general student population (i.e., academic load, attitude towards study, and lifestyle), also changed; resulting in decrease in the proportion of bad sleepers among medical students (from 63.48% to 52.47%). Almost all (92.4%) had a high level of academic uncertainty-related stress and majority (64.7%) also experienced high levels of COVID-19 related stress. A significant association between Poor Sleep Quality (PSQI) score and urban residence, nuclear family, current smokers, excessive caffeine consumption, and high levels of COVID-19 stress was observed.

To improve the sleep quality of medical students, we should provide a positive environment and greater support. This can be done by establishing online counseling facilities and proper postpandemic scheduling of examinations and bedside teaching which can serve a positive change toward their quality of life and coping with the stressful environment of the pandemic.

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Conflicts of interest

There are no conflicts of interest.

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