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Prolonged Lockdown due to COVID-19 Alters Sleep–Wake Timings and Negatively Affects Self-esteem, Personality, Depression and Anxiety in College-Going Indian Students

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Abstract

Purpose COVID-19 forced the shutdown of colleges and socialization around the world including India and prolonged lockdown could have a significant impact on sleep, mood, emotion and anxiety in students. Here, we designed a survey to assess the effect of lockdown on sleep–wake, self-esteem, depression and anxiety via the survey on 321 Indian college-going students.

Methods We assessed the effect of lockdown on sleep–wake (wake up, get up, bed and sleep timing, total time in bed and sleep duration) and self-esteem and depression on students via various questions.

Results We found that students delayed sleep timing by 1 h in lockdown than pre-lockdown days. Specifically, urban male populations were late sleeper than any other group. However, total sleep duration did not differ between groups. In self-esteem questions, most students agreed that they were of no good, felt nervous, displeased, and frustrated about performance in lockdown. Depression and anxiety questionnaire gave more significant results related to mood and mental health. More than 50% of students agreed that they faced a lack of concentration, had been feeling irritated and angry, felt fatigued and tired, and everything had been a failure during lockdown days.

Conclusion Overall, the survey suggests that lack of social life and prolonged lockdown affect the sleep–wake cycle, self-esteem, anxiety and depression of Indian students.

Keywords COVID-19 · Lockdown · Indian student · Sleep–wake · Depression

1 Introduction

Since December 2019, COVID-19 (coronavirus disease) has been a major challenge for students and working citizens across the globe due to limitations in travelling, physical proximity (contact restrictions) and stricter lockdown conditions [1, 2]. As these means are necessary to curb the progression of the disease, however, staying indoors (isolation) and prolonged non-interaction with a social group can affect daily sleep–wake routine and mental health [3–7]. Lockdown enhanced depression, anxiety and stress symptoms in many countries including India, China and Italy with few exceptions like Vietnam [8]. However, even in those

countries, the COVID-19 impacted more than two-thirds of family income and reduced the quality of life among the general population [9]. Along with the lockdown and physical isolation, the use of facemask was and is continue to be the common norm in almost every country. A study on individuals from China and Poland confirmed that the use of face masks is highly effective in the protection of the disease and indirectly its non-usage can affect mental health depending on the awareness and responsibility by which individuals act [10]. Every phase of the pandemic (preparation, punctum maximum and normality phase) [11] has pushed students into extreme social distancing conditions in which only online medium of classes was possible [12–14]. Analysis on students showed that fear of being infected and having a pessimistic attitude towards COVID-19 can significantly influence anxiety and depression as 15.5% showed symptoms of anxiety and 32.4% of depression [15]. A similar study on 1771 adolescents from schools and universities of China concluded that poor sleep quality is one of the most

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significant risk factors for mood disorders among students during this pandemic [16].

India, like any other densely populated country, saw a couple of peaks in the number of individuals infected by the coronavirus which hit both the urban and rural populations and we are also expecting a probable third wave. Many studies have collected and analyzed the effect of the pandemic on various socio-demographics including school and college-going students, working class and pregnant women across the world [11, 17–22]. Studies on working class showed an increase in PTSD and psychiatric symptoms in the initial stages of lockdown, however, good ventilation at the workplace, use of face mask and another psychoneuroimmunity measure decreased the symptoms after returning to work [23]. Another study on 868 pregnant Vietnamese women showed that positive support like sharing feelings, care and concern from parents-in-law and relatives can improve quality of life which has been decreased by the COVID-19 pandemic [24]. Unknown or prolonged duration of lockdown, perpetual fear of disease, dullness and information regarding virus can have large psychological effects [25, 26]. In addition, reduced contact with peers has also been shown to affect anxiety level, emotion recognition and social cognition [14, 27]. Researchers from India, Bangladesh and China surveyed and found that students were suffering from higher anxiety and increased depression as expressed via various questionnaires [18, 20, 22]. A study from Croatia found that 30.7% of respondents gained weight, increased oxidative stress, increased consumption of cigarettes and alcohol and a significant rise in anxiety in women due to sedentary behavior was observed [21]. It has been observed that participants delayed sleep timing as they increased time spent on the bed. A recent study has established that internet usage has a negative impact on sleep and mood in college-going female students [28]. Another study confirmed that the pandemic decreased parental control over phones causing a reduction in focus on academics (loss of concentration) and reduced sleep quality among school-going teenagers [11, 29]. Thus, in the time of the pandemic, it can be hypothesized that dependency on the smartphone, internet and overall screen time has altered sleep timings, leading to mental and physical fatigue in the young population [30]. Similar results were observed using online software 'Sojump' which showed that female adolescents have a higher risk of depression and anxiety during COVID-19 and older adolescents were more depressed than the younger ones [18, 19]. It also indicated that adolescents on workdays were more depressed and anxious when living without any companion and affected the physical exercise during the lockdown period [18, 21]. These studies used various online simple questions to validate questionnaires like Depression Self-Rating Scale for Children (DSRS-C) and Screen for Child Anxiety Related Disorders (SCARED) [18].

While most studies are focused on the vulnerable population (teenagers and old), a limited amount of research is available on college-going students [22]. In all the studies only a few addressed depression and anxiety [18, 22, 26] and a similar study from the Indian population is missing. A machine learning analysis on 478 students of China showed that 15.5% and 32.4% of students are showing symptoms of anxiety and depression, respectively. The study suggested sleep quality, retaining holidays, lockdown restriction, living conditions in schools, taking the final examinations after school are some of the few causes of depression and anxiety [15]. In many countries, medical students have been one of the front-line workers in the pandemic and their task force has made considerable contributions during the COVID-19 pandemic, suggestions are made for universities to improve and incorporate field epidemiological practicum and engage health authorities as supervisors throughout the programs [31]. Since many studies have focused on the effects on lifestyle habits, working schedules and quality of diet, we limited our study to sleep–wake and depression and anxiety. Here, we designed a survey using google form to understand and examine the sleep–wake and mood, anxiety and depression among college-going Indian students with the help of different questions. Our study tried to fill the lacunae and tried to understand the direct effect of COVID-19 using an online questionnaire.

2 Methods

2.1 Study Subjects and Demography

This study was conducted on Indian college-going students to assess the effect of prolonged lockdown due to the COVID-19 pandemic and hence shutting down colleges [13]. A google-based survey form was developed based on similar surveys done across the world [18–20, 22]. The survey questions were designed based on various questionnaires used and validated in multiple studies with some modification. The whole exercise used snowball sampling methods, since lockdown situations do not permit physical interaction, a simple google survey was the best method to get an appropriate answer. This sampling method has been used frequently in COVID-based surveys [20, 21]. The survey was voluntary with consent and proper ethics were maintained and participants were briefed that all the details will be anonymous, would not be shared with anyone and used for scientific purposes of this study only. Since, this study did not require formal ethical approval, for informed consent a principle of Helsinki for human studies was followed as appropriate [32].

A total of 373 undergraduate and post-graduate students of North India participated in the survey which was provided

via email. All students were healthy and did not suffer from any health problems at the time of the survey. We selected an age group (18–25 years old) and removed any incorrect data or half-filled survey from the analysis. Finally, 321 individuals were used to attain the final data (experimental protocol, Fig. 1). We divided our participants based on two categories; (a) gender (male—37%, female—63%) and (b) locality (urban—74%, rural—26%). Recent human studies have also accounted that gender and locality affect various daily lifestyle parameters, such as sleep–wake and internet addiction [28]. The details of individual questions will be addressed in subsequent paragraphs.

2.2 Questionnaires and Measures

2.2.1 Sleep–Wake

Every question on the survey had two columns which were defined as pre-lockdown and lockdown days. Both columns were mandatory to fill as they allow us to compare the effect of normal days vs lockdown days. We restricted our survey to North Indian regions to minimize the effect of culture and different types of lockdown restrictions. Calculations of sleep–wake were done using timings of sleep and waking up. We asked participants to fill bed timing (time to go to the bed to sleep), sleep timing (time of sleep onset), wake up timing (time of sleep offset or wake onset) and get up (time of getting out of the bed). All timings were filled in AM/PM mode which is more common. We calculated three parameters from the provided sleep–wake data—(a) sleep-onset latency, SOL (sleep timing–bed timing), (b) total time in bed (time duration between bed timing and get up timing) and (c) total sleep (time duration between sleep timing and wake up timing). All the details have been provided in Supplementary Data 1.
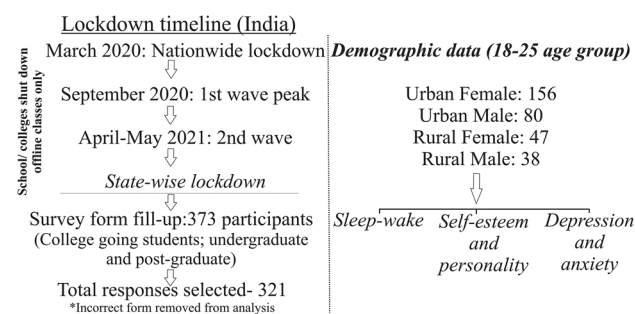

Fig. 1 Experimental protocol: Lockdown in India and participant's recruitment process in this study. In brief, in the middle of second wave of COVID-19 pandemic a survey was developed and in total 321 (correct responses) undergraduate and post-graduate students were selected. The survey asked questions related to their sleep–wake, self-esteem and personality, and depression and anxiety

2.2.2 Depression and Anxiety Questionnaire

We used questions to understand the overall depression and anxiety in our population using selected questions based on previously published literature and sources from the internet. Multiple options were provided for each question (completely agree/somewhat agree/agree/somewhat disagree/completely disagree etc.) (Supplementary Information 1). Since this study was done using google form distributed via email or various social media platforms in a lockdown situation, we selected questions only to observe the trend between pre-lockdown and lockdown periods. We did not aim for any clinical, medical or psychological analysis since a more comprehensive questionnaire and a large number of individuals will be required.

2.2.3 Self-esteem and Personality Questionnaire

We selected self-esteem and personality-related questions from previously validated questionnaires and research articles (a measure of self-esteem, [33, 34]; The Cognitive Failure Questionnaire, [35]. Similar to the depression and anxiety questionnaire, we used questions that were relevant in social isolation situations in our selected population. The participants were asked to select one of the options for each question (strongly agree/agree/disagree/ strongly disagree etc., Supplementary Information 1).

2.3 Statistics

The data have been plotted in bar graphs or histograms using Graphpad prism software version 6.0 (La Jolla, CA, USA). The box and whisker plot depicts the median line, 95% confidence interval box and lines showing the minimum and maximum data point (Fig. 2). For the self-esteem and personality, and depression and anxiety questions histograms show the number of students in percentage (%) of the total number of participants. Data were analyzed using Graphpad Prism software version 6.0 and SPSS Statistics version 20. We used a univariate general linear model (GLM) to analyze different sleep–wake parameters with gender (male vs female), locality (rural vs urban) and lockdown (pre vs lockdown) as main factors. We looked at the main effects as well as two-way interaction (gender × locality, gender × lockdown, locality × lockdown) and three-way interaction (gender × locality × lockdown) effects (Fig. 2). A chi-squared test was performed to compare the population difference between pre-lockdown and lockdown based on answers given in the questionnaire (Figs. 3 and 4). For statistical significance, p was set at 0.05.
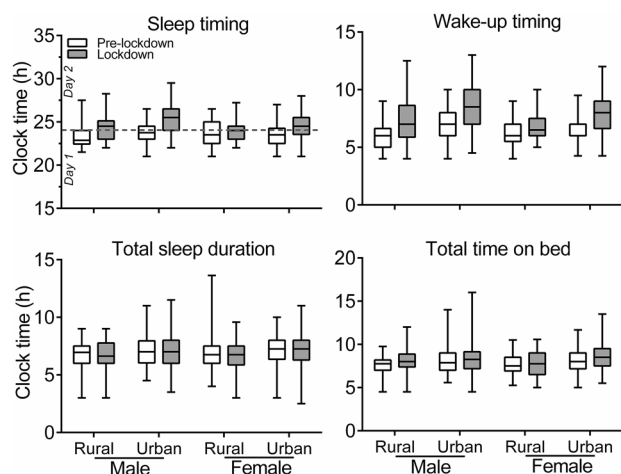
Fig. 2 Box and Whisker plots of sleep and wake parameters of Indian college-going students during pre-lockdown and lockdown days. Left panel shows the sleep timing and total sleep duration in clock time (h) and right panel shows wake-up timing and total time on bed of both sexes (male and female) under different locality (urban and rural) during pre-lockdown and lockdown conditions. The dotted line in sleep timing represents hour 24:00, after that next day starts
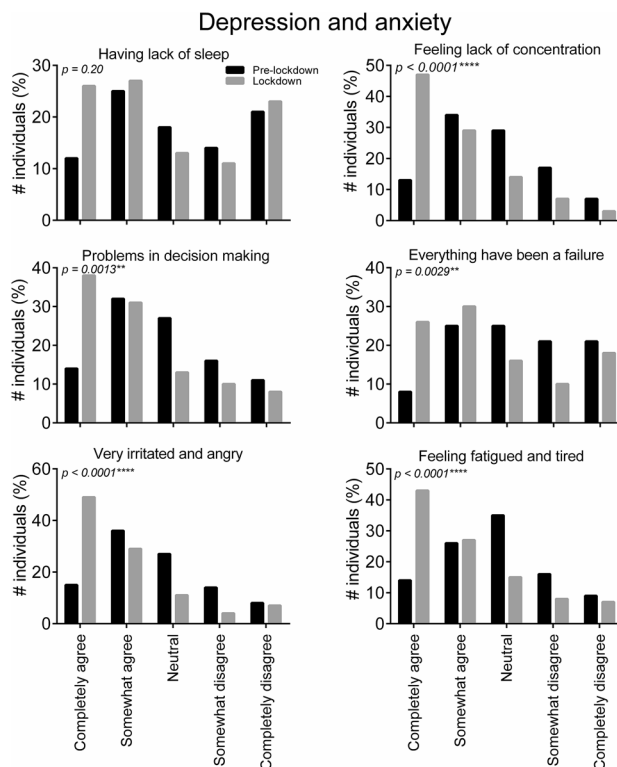

Fig. 3 Frequency distribution of various Depression and Anxiety questions on pre-lockdown and lockdown days of Indian college-going students. For every question, five answers (completely agree, somewhat agree, neutral, somewhat disagree and completely disagree) were provided which are presented via bar graphs. Black and grey bar represents pre-lockdown and lockdown days, respectively. The number of individuals is presented in percentage (%). Chi-squared test was used to determine difference between pre-lockdown and lockdown days. $p < 0.05$ was considered significant

3 Results

3.1 Sleep–Wake

We analyzed the effect of lockdown on sleep timing, wake-up timing, total sleep duration and total time on the bed. There was a significant main effect of lockdown, gender and locality on sleep timing and wake up timing, two-way interaction of gender × locality, gender × lockdown, locality × lockdown and three-way interaction of gender × locality × lockdown ($p < 0.001$; GLM, Table 2). Specifically, all groups irrespective of locality and gender slept before midnight (12:00 AM/2400 h, Fig. 2), however, urban males and females significantly delayed sleep timing during lockdown days by more than an hour as compared to pre-lockdown days. The delayed sleep timings can be the effect of delayed sleep-onset latency (SOL) during lockdown as compared to pre-lockdown days. SOL showed a significant effect of lockdown ($p < 0.01$; GLM, Table 2), but not gender and locality and interactions ($p > 0.05$; GLM, Table 2). Urban and rural males woke up significantly (1.3–1.5 h, Fig. 2) later in lockdown days as compared to pre-lockdown days. There was no significant difference in total sleep duration and total time in bed when lockdown days were compared ($p > 0.05$; GLM, Table 2). Comprehensive detail of each parameter with mean ± SEM values and statistical analysis are provided in Tables 1 and 2.

3.2 Depression and Anxiety

In the depression and anxiety questionnaire, most of the individuals opted for highly agreed options with depression and anxiety questions during lockdown days. In total, ten questions were asked, of which six are plotted in Fig. 3 and all other details are provided in Table 3. There was significant difference between pre-lockdown and lockdown in questions regarding facing lack of concentration ($\chi^2_{(4)} = 30.66$, $p < 0.0001$; Chi-squared test), facing problem with making decision ($\chi^2_{(4)} = 17.85$, $p = 0.001$; Chi-squared test), very irritated and angry ($\chi^2_{(4)} = 31.18$, $p < 0.0001$; Chi-squared test), feeling fatigued or tired ($\chi^2_{(4)} = 25.69$, $p < 0.0001$; Chi-squared test), everything has been a failure ($\chi^2_{(4)} = 16.09$, $p = 0.003$; Chi-squared test). Interestingly, they did not feel a lack of sleep ($\chi^2_{(4)} = 5.982$, $p = 0.200$; Chi-squared test) which was also validated by total sleep duration (Fig. 2, Table 1). 69% individuals agreed that they faced the problem with making decisions, 76% individuals faced lack of concentration, 78% agree of being very irritated and angry, 70%
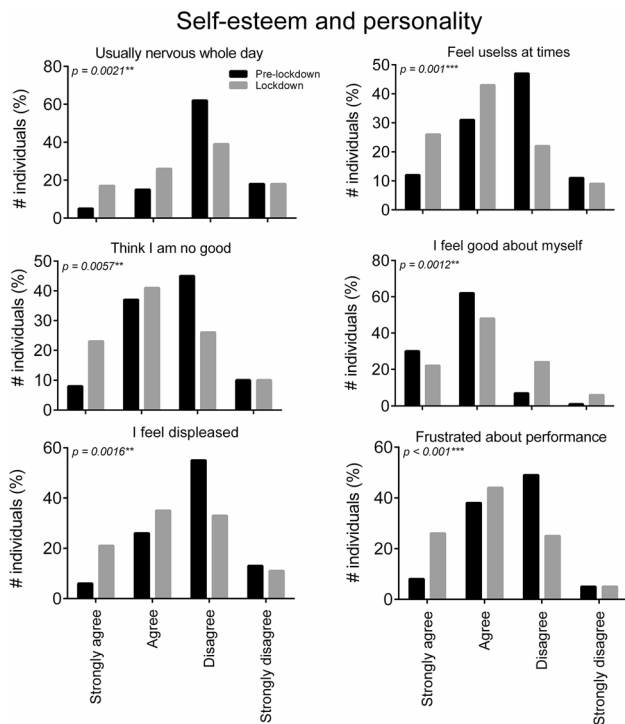
Fig. 4 Frequency distribution of various self-esteem and personality questions on pre-lockdown and lockdown days of Indian college-going students. For every question, four answers (strongly agree, agree, disagree and strongly disagree) were provided which are presented via bar graphs. Black and grey bar represents pre-lockdown and lockdown days, respectively. The number of individuals is presented in percentage (%). Chi-squared test was used to determine difference between pre-lockdown and lockdown days. $p < 0.05$ was considered significant

felt fatigued and tired and 56% agreed that everything has been a failure as compared to 46%, 47%, 51%, 40% and 33%, respectively, under pre-lockdown days (Fig. 3, Table 3).

3.3 Self-esteem and Personality

Similar to depression and anxiety, 11 questions were asked in the self-esteem and personality questionnaire. The details of the percentage of individuals answering different options in each question are mentioned in Table 3. In particular there was a significant difference between pre-lockdown and lockdown days in questions like I usually feel nervous whole day ($\chi^2_{(3)} = 14.73$, $p = 0.002$; Chi-squared test), think I am no good ($\chi^2_{(3)} = 12.55$, $p = 0.005$; Chi-squared test), I feel displeased ($\chi^2_{(3)} = 15.33$, $p = 0.001$; Chi-squared test), feel useless at times ($\chi^2_{(3)} = 16.36$, $p = 0.001$; Chi-squared test), I feel good about myself ($\chi^2_{(3)} = 15.91$, $p = 0.001$; Chi-squared test) and frustrated about performance ($\chi^2_{(3)} = 17.75$, $p < 0.001$; Chi-squared test). Interestingly, 64% of individuals think they were of no-good during lockdown days as compared to 45% on normal days. 56% individuals were displeased about themselves, 30% disagree that they feel good about themselves, 70% were frustrated about performance, 69% felt useless at times and 43% felt usually nervous the whole day as compared to 32%, 8%, 42%, 43% and 20%, respectively, under pre-lockdown days (Fig. 4, Table 3).

Table 1 Sleep (bed timing, sleep timing, total time in bed and total sleep) and wake up (wake up timing and get up timing) parameters in Indian college-going students

Parameter	Condition	Overall ($n=321$)	Rural ($n=85$)			Urban ($n=236$)		
			Over all	Female ($n=47$)	Male ($n=38$)	Over all	Female ($n=156$)	Male ($n=80$)
Wake up timing (h)	Pre-lockdown	6.57 ± 0.07	6.09 ± 0.14	6.22 ± 0.20	5.92 ± 0.20	6.74 ± 0.07	6.70 ± 0.08	6.81 ± 0.14
	Lockdown	7.71 ± 0.10	6.88 ± 1.07	6.71 ± 0.17	7.10 ± 0.31	8.01 ± 0.11	7.84 ± 0.13	8.32 ± 0.21
Get up timing (h)	Pre-lockdown	7.01 ± 0.08	6.57 ± 0.13	6.81 ± 0.16	6.28 ± 0.16	7.17 ± 0.09	7.10 ± 0.09	7.30 ± 0.19
	Lockdown	8.24 ± 0.11	7.38 ± 0.18	7.09 ± 0.18	7.74 ± 0.33	8.55 ± 0.12	8.35 ± 0.14	8.93 ± 0.24
Bed timing (h)	Pre-lockdown	23.01 ± 0.06	22.93 ± 0.13	23.09 ± 0.17	22.73 ± 0.20	23.04 ± 0.07	22.99 ± 0.09	23.14 ± 0.14
	Lockdown	23.79 ± 0.08	23.49 ± 0.16	23.27 ± 0.20	23.79 ± 0.25	23.90 ± 0.10	23.65 ± 0.10	24.39 ± 0.20
Sleep timing (h)	Pre-lockdown	23.65 ± 0.08	23.47 ± 0.14	23.66 ± 0.19	23.25 ± 0.21	23.71 ± 0.10	23.55 ± 0.10	24.03 ± 0.23
	Lockdown	24.66 ± 0.09	24.23 ± 0.16	24.02 ± 0.18	24.49 ± 0.27	24.81 ± 0.10	24.59 ± 0.11	25.24 ± 0.19
Total time in bed (h)	Pre-lockdown	7.99 ± 0.08	7.64 ± 0.13	7.73 ± 0.18	7.54 ± 0.18	8.11 ± 1.09	8.11 ± 0.11	8.10 ± 0.18
	Lockdown	8.44 ± 0.10	7.89 ± 0.16	7.82 ± 0.21	7.99 ± 0.26	8.64 ± 0.12	8.70 ± 0.14	8.53 ± 0.22
Total sleep (h)	Pre-lockdown	7.03 ± 0.07	6.75 ± 0.15	6.82 ± 0.21	6.67 ± 0.20	7.13 ± 0.08	7.15 ± 0.10	7.09 ± 0.15
	Lockdown	7.16 ± 0.10	6.79 ± 0.20	6.94 ± 0.31	6.61 ± 0.23	7.30 ± 0.11	7.41 ± 0.15	7.08 ± 0.16

Data are presented in mean $\pm$ SEM (h)

Table 2 Summary table of the results of General linear model (GLM) analysis of effects of lockdown on sleep–wake parameters in Indian college-going students

Parameters	Lockdown (pre-vs post-lockdown)	Gender (male vs female)	Locality (rural vs urban)	Lockdown × gender	Gender × locality	Lockdown × locality	Lockdown × gender × locality
Sleep timing	$F_{(1)} = 68.156$ $p < 0.0001$	$F_{(1)} = 3.14$ $p = 0.077$	$F_{(1)} = 11.33$ $p = 0.001$	$F_{(1)} = 7.151$ $p = 0.008$	$F_{(1)} = 2.271$ $p = 0.132$	$F_{(1)} = 3.643$ $p = 0.057$	$F_{(1)} = 0.656$ $p = 0.418$
Wake up timing	$F_{(1)} = 68.021$ $p < 0.0001$	$F_{(1)} = 1.664$ $p = 0.197$	$F_{(1)} = 50.964$ $p < 0.0001$	$F_{(1)} = 4.141$ $p = 0.042$	$F_{(1)} = 0.926$ $p = 0.336$	$F_{(1)} = 3.635$ $p = 0.057$	$F_{(1)} = 0.393$ $p = 0.531$
Total sleep duration	$F_{(1)} = 0.302$ $p = 0.583$	$F_{(1)} = 2.470$ $p = 0.117$	$F_{(1)} = 8.956$ $p = 0.003$	$F_{(1)} = 0.605$ $p = 0.437$	$F_{(1)} = 0.033$ $p = 0.857$	$F_{(1)} = 0.114$ $p = 0.736$	$F_{(1)} = 0.017$ $p = 0.896$
Total time in bed	$F_{(1)} = 7.466$ $p = 0.006$	$F_{(1)} = 0.086$ $p = 0.769$	$F_{(1)} = 17.196$ $p < 0.001$	$F_{(1)} = 0.123$ $p = 0.726$	$F_{(1)} = 0.086$ $p = 0.769$	$F_{(1)} = 0.723$ $p = 0.395$	$F_{(1)} = 0.757$ $p = 0.385$
Sleep onset latency	$F_{(1)} = 7.722$ $p = 0.006$	$F_{(1)} = 0.005$ $p = 0.946$	$F_{(1)} = 0.96$ $p = 0.757$	$F_{(1)} = 0.172$ $p = 0.679$	$F_{(1)} = 0.599$ $p = 0.439$	$F_{(1)} = 0.925$ $p = 0.336$	$F_{(1)} = 0.326$ $p = 0.568$

Bold and unbold values indicate the presence and absence of significance, respectively. For statistical significance, the alpha was set at 0.05

4 Discussion

The pandemic affected devastatingly across the world with a high mortality rate and also challenged the mental state of individuals. Several studies have been focused on general health, daily routines and habits during the lockdown, however, very few articles talked about self-esteem, depression and anxiety only [18, 22]. The college-going students are one of the most peculiar groups of students because of their age (generally 18–25) and leaving paternal home for higher studies is also very common. During lockdown (especially, extended lockdown in India) have forced them to stay away from community gatherings and maintain distance in physical proximity. Hence, our main goal was to investigate the self-esteem and personality, and depression and anxiety among Indian college-going students during the COVID-19 pandemic compared to pre-lockdown days.

4.1 Effect on Sleep–Wake

In this study, we demonstrated that lockdown shifted the sleep–wake timing in Indian students. Our finding indicated that during the lockdown period irrespective of the gender (male vs. female) and locality (rural vs. urban) students slept and woke up at least an hour later than the pre-lockdown period. Interestingly, there was a little variation in both sleep and wake-up timing in rural females and most variation was observed in the urban male population which also suggests the effect of gender at both extremes (early risers in rural population for household chores and village work which is mostly absent in urban population with little involvement of male population). The total time on bed and total sleep duration was not affected during the lockdown period which was also confirmed by questions about lack of sleep in which there was no difference in answering pattern in each group.

We discuss that changes in sleep–wake timing can be associated with excessive phone/media usage [36] and decreased effort in parenting (although only speculative at this time) and they are contributing factors in affecting sleep time in young/adult college-going students [11, 36, 37]. Our study did not take account of daytime sleeping or resting data, which could have been provided with the sleep at different phases of day, since many participants were in the lockdown, i.e., relatively more inactive during the daytime. This might be one of the causes of delayed sleep onset during the lockdown, although it is only speculative at this time.

4.2 Depression and Anxiety

Interestingly, as discussed previously, students did not feel a lack of sleep (Figs. 2 and 4) which is also one of the markers of depression or excessive anxiety [38]. The urbanization, dependency on phones and computers, hence, increase in usage of social media has already affected the sleeping pattern in the adult population [28, 39]. However, a drastic shift in depression and anxiety questions was observed when we did a comparison of pre–post-lockdown days. More than 60% of students agreed to the lack of concentration, being irritated and angry, feeling a failure, fatigued and tired and faced problems in making decisions. The high percentage of an agreement to depression questions is similar to various studies done on adolescents and a few studies done on Bangladeshi students [22]. Specifically, 50% of females completely agreed to have faced a lack of concentration during the lockdown period compared to 40% of males and that is also reflected in problems in making decisions (42% females and 32% males). Most students (70%) felt fatigued, tired, very irritated and angry, which is one of the most detrimental mood effects observed in this survey. Depression is associated with irritation and fatigue and it has been shown

Table 3 Effect of lockdown on self-esteem and personality, and depression and anxiety in Indian college-going students

Parameters	Gender	Female (*n* = 203)		Male (*n* = 118)		Total (*n* = 321)	
	Answers	Pre-lockdown	Lockdown	Pre-lockdown	Lockdown	Pre-lockdown	Lockdown
A. Self-esteem and personality questionnaire							
Do you have trouble making up your mind?*	Very often	34 (16.7)	58 (28.6)	11 (9.3)	18 (15.3)	45 (14.0)	76 (23.7)
	Quite often	54 (26.6)	76 (37.4)	16 (13.6)	33 (28.0)	70 (21.8)	109 (34.0)
	Occasionally	70 (34.5)	41 (20.2)	45 (38.1)	37 (31.4)	115 (35.8)	78 (24.3)
	Very rare	35 (17.2)	24 (11.8)	28 (23.7)	15 (12.7)	63 (19.6)	39 (12.1)
	Never	10 (4.9)	4 (2)	18 (15.3)	15 (12.7)	28 (8.7)	19 (5.9)
Do you start doing one thing at home and get distracted into doing something else? **	Very often	36 (17.7)	62 (30.5)	12 (10.2)	19 (16.1)	48 (15.0)	81 (25.2)
	Quite often	53 (26.1)	78 (38.4)	24 (20.3)	42 (35.6)	77 (24.0)	120 (37.4)
	Occasionally	69 (34.0)	40 (19.7)	36 (30.5)	34 (28.8)	105 (32.7)	74 (23.1)
	Very rare	38 (18.7)	19 (9.4)	41 (34.7)	17 (14.4)	79 (24.6)	36 (11.2)
	Never	7 (3.4)	4 (2.0)	5 (4.2)	6 (5.1)	12 (3.7)	10 (3.1)
At times, I think I am no good at all**	Strongly agree	15 (6.9)	58 (28.6)	11 (8.5)	16 (13.6)	26 (7.5)	74 (23.1)
	Agree	81 (39.9)	79 (38.9)	37 (31.4)	53 (44.9)	118 (36.8)	132 (41.1)
	Disagree	90 (44.8)	48 (23.6)	56 (48.3)	34 (28.8)	146 (46.1)	82 (25.5)
	Strongly disagree	17 (8.4)	18 (8.9)	14 (11.9)	15 (12.7)	31 (9.7)	33 (10.3)
I certainly feel useless at times**	Strongly agree	26 (12.8)	54 (26.6)	12 (10.2)	29 (24.6)	38 (11.8)	83 (25.9)
	Agree	65 (32.0)	92 (45.3)	33 (28.0)	48 (40.7)	98 (30.5)	140 (43.6)
	Disagree	94 (46.3)	41 (20.2)	56 (47.5)	29 (24.6)	150 (46.7)	70 (21.8)
	Strongly disagree	18 (8.9)	16 (7.9)	17 (14.4)	12 (10.2)	35 (10.9)	28 (8.7)
I take positive attitude towards myself**	Strongly agree	66 (32.5)	52 (25.6)	47 (39.8)	36 (31)	113 (35.2)	88 (27.4)
	Agree	118 (58.1)	90 (44.3)	65 (55.1)	49 (42)	183 (57.0)	139 (43.3)
	Disagree	19 (9.4)	54 (26.6)	6 (5.1)	27 (23	25 (7.8)	81 (25.2)
	Strongly disagree	0 (0)	7 (3.4)	0 (0)	6 (5)	0 (0)	13 (4.0)
I usually stay nervous whole day**	Strongly agree	9 (4.4)	35 (17.2)	7 (5.9)	21 (17.8)	16 (5.0)	56 (17.4)
	Agree	38 (18.7)	49 (24.1)	11 (9.3)	33 (28.0)	49 (15.3)	82 (25.5)
	Disagree	120 (59.1)	87 (42.9)	77 (65.3)	39 (33.1)	197 (61.4)	126 (39.3)
	Strongly disagree	36 (17.7)	32 (15.8)	23 (19.5)	25 (21.2)	59 (18.4)	57 (17.8)
I feel confident about my abilities (ns)	Strongly agree	62 (30.5)	40 (19.7)	38 (32.2)	24 (20.3)	100 (31.2)	64 (19.9)
	Agree	123 (60.6)	103 (50.7)	69 (58.5)	54 (45.8)	192 (59.8)	157 (48.9)
	Disagree	16 (7.9)	53 (26.1)	11 (9.3)	34 (28.8)	27 (8.4)	87 (27.1)
	Strongly disagree	2 (1.0)	7 (3.4)	0 (0)	6 (5.1)	2 (0.6)	13 (4.0)
I feel frustrated or rattled about my performance***	Strongly agree	18 (8.9)	52 (25.6)	7 (5.9)	30 (25.4)	25 (7.8)	82 (25.5)
	Agree	81 (39.9)	91 (44.8)	41 (34.7)	50 (42.4)	122 (38.0)	141 (43.9)
	Disagree	93 (45.8)	51 (25.1)	64 (54.2)	30 (25.4)	157 (48.9)	81 (25.2)
	Strongly disagree	11 (5.4)	9 (4.4)	6 (5.1)	8 (6.8)	17 (5.3)	17 (5.3)
I feel self-conscious (ns)	Strongly agree	36 (17.7)	57 (28.1)	18 (15.3)	32 (27.1)	54 (16.8)	89 (27.7)
	Agree	101 (49.8)	84 (41.4)	60 (50.8)	52 (44.1)	161 (50.2)	136 (42.4)
	Disagree	59 (29.1)	56 (27.6)	34 (28.8)	30 (25.4)	93 (29.0)	86 (26.8)
	Strongly disagree	7 (3.4)	6 (3.0)	6 (5.1)	4 (3.4)	13 (4.0)	10 (3.1)
I feel displeased with myself**	Strongly agree	12 (5.9)	38 (18.7)	8 (6.8)	29 (24.6)	20 (6.2)	67 (20.9)
	Agree	54 (26.6)	79 (38.9)	30 (25.4)	33 (28.0)	84 (26.2)	112 (34.9)
	Disagree	118 (58.1)	68 (33.5)	59 (50.0)	39 (33.1)	177 (55.1)	107 (33.3)
	Strongly disagree	19 (9.4)	18 (8.9)	21 (17.8)	17 (14.4)	40 (12.5)	35 (10.9)
I feel good about myself**	Strongly agree	61 (30.0)	41 (20.2)	35 (29.7)	31 (26.3)	96 (29.9)	72 (22.4)
	Agree	126 (62.1)	100 (49.3)	74 (62.7)	53 (44.9)	200 (62.3)	153 (47.7)
	Disagree	14 (6.9)	51 (25.1)	9 (7.6)	26 (22.0)	23 (7.2)	77 (24.0)
	Strongly disagree	2 (1.0)	11 (5.4)	0 (0)	8 (6.8)	2 (0.6)	19 (5.9)

Table 3 (continued)

Parameters	Gender	Female (n = 203)		Male (n = 118)		Total (n = 321)	
	Answers	Pre-lockdown	Lockdown	Pre-lockdown	Lockdown	Pre-lockdown	Lockdown
B. Depression and anxiety questionnaire							
You are facing lack of concentration****	Completely agree	23 (11.3)	102 (50.2)	18 (15.3)	50 (42.4)	41 (12.8)	152 (47.4)
	Somewhat agree	76 (37.4)	55 (27.1)	34 (28.8)	37 (31.4)	110 (34.3)	92 (28.7)
	Neutral	63 (31.0)	26 (12.8)	30 (25.4)	17 (14.4)	93 (29.0)	43 (13.4)
	Somewhat disagree	29 (14.3)	14 (6.9)	26 (22.0)	8 (6.8)	55 (17.1)	22 (6.9)
	Complete disagree	12 (5.9)	6 (3.0)	10 (8.5)	6 (5.1)	22 (6.9)	12 (3.7)
You are facing problem with making decisions**	Completely agree	32 (15.8)	85 (41.9)	12 (10.2)	38 (32.2)	44 (13.7)	123 (38.3)
	Somewhat agree	70 (34.5)	65 (32.0)	33 (28.0)	34 (28.8)	103 (32.1)	99 (30.8)
	Neutral	53 (26.1)	20 (9.9)	35 (29.7)	22 (18.6)	88 (27.4)	42 (13.1)
	Somewhat disagree	28 (13.8)	20 (19.9)	24 (20.3)	12 (10.2)	52 (16.2)	32 (10.0)
	Complete disagree	20 (9.9)	13 (6.4)	14 (11.9)	12 (10.2)	34 (10.6)	25 (7.8)
You have been very irritated and angry very often****	Completely agree	35 (17.2)	108 (53.2)	12 (10.2)	49 (41.5)	47 (14.6)	157 (48.9)
	Somewhat agree	80 (39.4)	60 (29.6)	36 (30.5)	32 (27.1)	116 (36.1)	92 (28.7)
	Neutral	51 (25.1)	15 (7.4)	35 (29.7)	21 (17.8)	86 (26.8)	36 (11.2)
	Somewhat disagree	21 (10.3)	7 (3.4)	23 (19.5)	7 (5.9)	44 (13.7)	14 (4.4)
	Complete disagree	16 (7.9)	13 (6.4)	12 (10.2)	9 (7.6)	28 (8.7)	22 (6.9)
You have been feeling very fatigued (tired)****	Completely agree	31 (15.3)	100 (49.3)	13 (11.0)	37 (31.4)	44 (13.7)	137 (42.7)
	Somewhat agree	58 (28.6)	53 (26.1)	25 (21.2)	35 (29.7)	83 (25.9)	88 (27.4)
	Neutral	73 (36.0)	23 (11.3)	41 (34.7)	24 (20.3)	114 (5.5)	47 (14.6)
	Somewhat disagree	27 (13.3)	15 (7.4)	25 (21.2)	11 (9.3)	52 (16.2)	26 (8.1)
	Complete disagree	14 (6.9)	12 (5.9)	14 (11.9)	11 (9.3)	28 (8.7)	23 (7.2)
You are feeling that everything you have done have been a failure**	Completely agree	17 (8.4)	53 (2.16)	10 (8.5)	30 (25.4)	27 (8.4)	83 (25.9)
	Somewhat agree	59 (29.1)	65 (32.0)	20 (16.9)	30 (25.4)	79 (24.6)	95 (39.6)
	Neutral	55 (27.1)	33 (16.3)	24 (20.3)	18 (15.3)	79 (24.6)	51 (15.9)
	Somewhat disagree	31 (15.3)	21 (10.3)	36 (30.5)	13 (11.0)	67 (20.9)	34 (10.6)
	Complete disagree	41 (20.2)	31 (15.3)	28 (23.7)	27 (22.9)	69 (21.5)	58 (18.1)
You are having lack of sleep (ns)	Completely agree	26 (12.8)	52 (25.6)	12 (10.2)	30 (25.4)	38 (11.8)	82 (25.5)
	Somewhat agree	56 (27.6)	58 (28.6)	25 (21.2)	29 (24.6)	81 (25.2)	87 (27.1)
	Neutral	54 (26.6)	28 (13.8)	35 (29.7)	15 (12.7)	89 (27.7)	43 (13.4)
	Somewhat disagree	24 (11.8)	22 (10.8)	21 (17.8)	12 (10.2)	45 (14.0)	34 (10.6)
	Complete disagree	43 (21.2)	43 (21.2)	25 (21.2)	32 (27.1)	68 (21.2)	75 (23.4)
You are having loss of appetite (ns)	Completely agree	14 (6.9)	40 (19.7)	11 (9.3)	20 (16.9)	25 (7.8)	60 (18.7)
	Somewhat agree	40 (19.7)	40 (19.7)	18 (15.3)	17 (14.4)	58 (18.1)	57 (17.8)
	Neutral	69 (34.0)	45 (22.2)	39 (33.1)	23 (19.5)	108 (33.6)	68 (21.2)
	Somewhat disagree	31 (15.3)	23 (11.3)	17 (14.4)	16 (13.6)	48 (15.0)	39 (12.1)
	Complete disagree	49 (24.1)	55 (27.1)	33 (28.0)	42 (35.6)	82 (25.5)	97 (30.2)
You are having gain of appetite (ns)	Completely agree	23 (11.3)	45 (22.2)	19 (16.1)	37 (31.4)	42 (13.1)	82 (25.5)
	Somewhat agree	50 (24.6)	52 (25.6)	26 (22.0)	27 (22.9)	76 (23.7)	79 (24.6)
	Neutral	85 (41.9)	59 (29.1)	45 (38.1)	32 (27.1)	130 (40.5)	91 (28.3)
	Somewhat disagree	19 (9.4)	17 (8.4)	18 (15.3)	9 (7.6)	37 (11.5)	26 (8.1)
	Complete disagree	26 (12.8)	30 (14.8)	10 (8.5)	13 (11.0)	36 (11.2)	43 (13.4)
You are having trust issue with everyone around you (ns)	Completely agree	45 (22.2)	72 (35.5)	17 (14.4)	27 (22.9)	62 (19.3)	99 (30.8)
	Somewhat agree	50 (24.6)	60 (29.6)	28 (23.7)	37 (31.4)	78 (24.3)	97 (30.2)
	Neutral	59 (29.1)	35 (17.2)	33 (28.0)	23 (19.5)	92 (28.7)	58 (18.1)
	Somewhat disagree	23 (11.3)	12 (5.9)	19 (16.1)	10 (8.5)	42 (13.1)	22 (6.9)
	Complete disagree	26 (12.8)	24 (11.8)	21 (17.8)	21 (17.8)	47 (14.6)	45 (14.0)

Table 3 (continued)

Parameters	Gender	Female (n = 203)		Male (n = 118)		Total (n = 321)	
	Answers	Pre-lockdown	Lockdown	Pre-lockdown	Lockdown	Pre-lockdown	Lockdown
You are having trouble in all the relationships (ns)	Completely agree	25 (12.3)	57 (28.1)	13 (11.0)	26 (22.0)	38 (11.8)	83 (25.9)
	Somewhat agree	53 (26.1)	57 (28.1)	26 (22.0)	30 (25.4)	79 (24.6)	87 (27.1)
	Neutral	67 (33.0)	45 (22.2)	29 (24.6)	25 (21.2)	96 (39.9)	70 (21.8)
	Somewhat disagree	25 (12.3)	15 (7.4)	26 (22.0)	10 (8.5)	51 (15.9)	25 (7.8)
	Complete disagree	33 (16.3)	29 (14.3)	24 (20.3)	27 (22.9)	57 (17.8)	56 (17.4)

The data represents number of participants responded to each question. The numbers represented are the actual sample size with percentage (%) in the parenthesis. Italics parameters show presence of significance determined by Chi-squared test (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ and ****$p < 0.0001$; ns—not significant). For significance, alpha was set at 0.05

to affect mental health [40]. The different effect on gender in depression and anxiety is also observed in Croatian adolescents and Egyptian students [21, 41]. However, some studies have shown that there are no significant differences between male and female students with relation to depression or anxiety [22, 42, 43]. Egyptian research remarked that female university students are more likely to suffer anxiety and less prone to depression than male students [41]. Our study clearly shows the association between the locality (rural vs urban) and gender (male vs female) with depression and anxiety.

4.3 Self-esteem and Personality

The findings of the survey indicated that 43% of students during lockdown felt nervous the whole day compared to less than 25% on pre-lockdown days. Additionally, more than 60% of students felt useless and thought they were of no good. This showed the direct effect on self-esteem and personality and can alter the mood state of the young population [44]. The increased frustration about performance and feeling displeased (> 55% compared to < 40% earlier) also confirm that lockdown had serious effects on personality traits. If we compare females with males, a more striking figure was observed. As much as 71% and 58% of female students felt frustrated and displeased during the lockdown, respectively. Can the increased numbers suggesting more effect on females during lockdown attest to the fact that females cope with the extreme situation differently and also have different physiological responses which in turn could change their behavior than males? Also, can the type of society (Indian in this case) play an important role in these types of studies? These questions are still to be answered in this study.

4.4 Limitations of the Present Study

There are a few limitations to the overall study. First, the sample size in the present study is not very effective to

address a population study related to humans, especially in a country like India. Second, due to prolonged restriction, the closing of the university and lack of social interactions forced researchers to stick to the online medium (for both general surveys and questionnaires). Also, many available questionnaires contain surveys or questions which are not applicable during the COVID-19 lockdown situation hence only a few questions were asked to understand accurate mental health and sleep–wake routines in students. The Depression, Anxiety, Stress-21 item or DASS-21 and Insomnia Severity Index are some of the validated questionnaires used to assess mental health during the COVID-19 pandemic [45, 46]. Montgomery–Åsberg Depression Rating Scale (MADRS-S) is also one of the useful questionnaires to address the severity of depression in patients with mood disorders [47]. Future studies should answer deeper questions related to mental health and also remedies to overcome mental challenges, if any, by pandemics.

5 Conclusion

Overall, our survey for the first time provides evidence that the large percentage of Indian students agreed to have faced a lack of concentration, have problems in making decisions, have been feeling irritated, angry, fatigued and tired, and highly agreed that everything has been a failure during lockdown days significantly more than normal days. There can be numerous mental threats associated with pandemics and social isolation and disrupted sleep–wake can bring alterations in the biological clock which govern and regulate almost all physiological processes [27]. The leading evidence suggests that we need to address this subject with proper planning, increase awareness and estimate the benefit/risk of isolation for the future [48]. For example, internet-based cognitive behavior therapy (iCBT) as it is contactless [49], cognitive behavior therapy (CBT) and mindfulness-based cognitive therapy (MBCT) are being to

treat psychiatric symptoms due to COVID-19 [50]. Behavioral therapies in-person or online (Digital cognitive behavioral therapy for insomnia, dCBT-I [51]) can help them to combat anxiety with the use of relaxation techniques and prevent depression onset by altering the schedule of their routine activities and can be effective in treating insomnia. These therapies can alleviate behaviors such as avoidance, antagonistic confrontation and self-blame by enhancing the ability of patients to manage stress. We also need to examine deleterious effects based on gender, locality and age to understand the challenges faced during and after the pandemic.

Data Availability Statement The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors have no conflict of interest.

References

1. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19—11 March 2020, Geneva, Switzerland: World Health Organization. 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-oncovid-19-11-march-2020. Accessed 31 July 2021

2. COVID-19 Worst Crisis Since World War II, Says U.N. Chief. The Hindu; 1 April 2020. https://www.thehindu.com/news/international/covid-19-worst-crisis-since-world-war-ii-says-un-chief/article31223646.ece

3. Vatansever D, Wang S, Sahakian BJ. COVID-19 and promising solutions to combat symptoms of stress, anxiety and depression. Neuropsychopharmacology. 2021;46:217. https://doi.org/10.1038/s41386-020-00791-9.

4. Holmes EA, O'Connor RC, Perry VH, Tracey I, Wessely S, Arseneault L, Ballard C, Christensen H, Silver RC, Everall I, Ford T. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. Lancet Psychiatr. 2020;7:547–60. https://doi.org/10.1016/S2215-0366(20)30168-1.

5. Zhai Y, Du X. Mental health care for international Chinese students affected by the COVID-19 outbreak. Lancet Psychiatr. 2020;7: e22. https://doi.org/10.1016/S2215-0366(20)30089-4.

6. Liang L, Ren H, Cao R, Hu Y, Qin Z, Li C, Mei S. The effect of COVID-19 on youth mental health. Psychiatr Q. 2020;91:841–52. https://doi.org/10.1007/s11126-020-09744-3.

7. Beutel ME, Klein EM, Brähler E, Reiner I, Jünger C, Michal M, Wiltink J, Wild PS, Münzel T, Lackner KJ, Tibubos AN. Loneliness in the general population: prevalence, determinants and relations to mental health. BMC Psychiatr. 2017;17:97. https://doi.org/10.1186/s12888-017-1262-x.

8. Le HT, Lai AJX, Sun J, Hoang MT, Vu LG, Pham HQ, Nguyen TH, Tran BX, Latkin CA, Le XTT, Nguyen TT, Pham QT, Ta NTK, Nguyen QT, Ho RCM, Ho CS. Anxiety and depression among people under the nationwide partial lockdown in Vietnam. Front Public Health. 2020;8(656): 589359. https://doi.org/10.3389/fpubh.2020.589359.

9. Tran BX, Nguyen HT, Le HT, Latkin CA, Pham HQ, Vu LG, Le XTT, Nguyen TT, Pham QT, Ta NTK, Nguyen QT, Ho CSH, Ho RC. Impact of COVID-19 on economic well-being and quality of life of the Vietnamese during the National social distancing. Front Psychol. 2020;11: 565153. https://doi.org/10.3389/fpsyg.2020.565153.

10. Wang C, Chudzicka-Czupała A, Grabowski D, Pan R, Adamus K, Wan X, Hetnal M, Tan Y, Olszewska-Guizzo A, Xu L, Mclntyre RS, Quek J, Ho R, Ho C. The association between physical and mental health and face mask use during the COVID-19 pandemic: a comparison of two countries with different views and practices. Front Psychiatr. 2020;11:901. https://doi.org/10.3389/fpsyt.2020.569981.

11. Fegert JM, Vitiello B, Plener PL, Clemens V. Challenges and burden of the Coronavirus 2019 (COVID-19) pandemic for child and adolescent mental health: a narrative review to highlight clinical and research needs in the acute phase and the long return to normality. Child Adolesc Psychiatry Mental Health. 2020;14:1–1. https://doi.org/10.1186/s13034-020-00329-3.

12. Martinez J. Take this pandemic moment to improve education. EduSource; 2020.

13. UGC. Report of the UGC committee on examinations and academic calendar for the universities in view of COVID-19 pandemic and subsequent lockdown. 2020. https://www.ugc.ac.in/pdfnews/4276446_UGC-Guidelines-on-Examinations-and-Academic-Calendar.pdf. Accessed 31 July 2021

14. Chen L, Yuan X. China's ongoing battle against the coronavirus: why did the lockdown strategy work well? Socio Ecol Pract Res. 2020;2:175–80. https://doi.org/10.1007/s42532-020-00048-1.

15. Ren Z, Xin Y, Ge J, Zhao Z, Liu D, Ho R, Ho CS. Psychological impact of COVID-19 on college students after school reopening: a cross-sectional study based on machine learning. Front Psychol. 2021;12:1346. https://doi.org/10.3389/fpsyg.2021.641806.

16. Ren Z, Xin Y, Wang Z, Liu D, Ho RC, Ho CS. What factors are most closely associated with mood disorders in adolescents during the COVID-19 pandemic? A cross-sectional study based on 1771 adolescents in Shandong province, China. Front Psychiatr. 2021;12: 728278. https://doi.org/10.3389/fpsyt.2021.728278.

17. Bland AR, Roiser JP, Mehta MA, Sahakian BJ, Robbins TW, Elliott R. The impact of COVID-19 social isolation on aspects of emotional and social cognition. Cogn Emot. 2021;25:1. https://doi.org/10.1080/02699931.2021.1892593.

18. Wang C, Pan R, Wan X, Tan Y, Xu L, McIntyre RS, Choo FN, Tran B, Ho R, Sharma VK, Ho C. A longitudinal study on the mental health of the general population during the COVID-19 epidemic in China. Brain Behav Immun. 2020;87:40–8. https://doi.org/10.1016/j.bbi.2020.04.028.

19 Zhang J, Lu H, Zeng H, Zhang S, Du Q, Jiang T, Du B. The differential psychological distress of populations affected by the COVID-19 pandemic. Brain Behav Immun. 2020;87:49. https://doi.org/10.1016/j.bbi.2020.04.031.

20 Datta R, Kundu K. Effects of COVID-19 lockdown on social life and sleep of Indian school going teenagers. Sleep Vigil. 2021;4:1–6. https://doi.org/10.1007/s41782-021-00147-3.

21 Đogaš Z, LušićKalcina L, Dodig IP, Demirović S, Madirazza K, Valić M, Pecotić R. The effect of COVID-19 lockdown on lifestyle and mood in Croatian general population: a cross-sectional study. Croat Med J. 2020;61:309–18. https://doi.org/10.3325/cmj.2020.61.309.

22 Islam MA, Barna SD, Raihan H, Khan MN, Hossain MT. Depression and anxiety among university students during the COVID-19 pandemic in Bangladesh: a web-based cross-sectional survey. PLoS ONE. 2020;15: e0238162. https://doi.org/10.1371/journal.pone.0238162.

23 Tan W, Hao F, McIntyre RS, Jiang L, Jiang X, Zhang L, Xinling Z, Zou Y, Hu Y, Luo X, Zhang Z, Lai A, Ho R, Tran B, Ho C, Tam W. Is returning to work during the COVID-19 pandemic stressful? A study on immediate mental health status and psychoneuroimmunity prevention measures of Chinese workforce. Brain Behav Immun. 2020;87:84–92. https://doi.org/10.1016/j.bbi.2020.04.055.

24 Nguyen LH, Nguyen LD, Ninh LT, Nguyen HTT, Nguyen AD, Dam VAT, Nguyen TT, Do HP, Vu TMT, Trans BX, Latkin CA, Ho CSH, Ho RC. COVID-19 and delayed antenatal care impaired pregnant women's quality of life and psychological well-being: What supports should be provided? Evidence from Vietnam. J Affect Disord. 2021;298:119–25. https://doi.org/10.1016/j.jad.2021.10.102.

25 Ahmed MZ, Ahmed O, Aibao Z, Hanbin S, Siyu L, Ahmad A. Epidemic of COVID-19 in China and associated psychological problems. Asian J Psychiatr. 2020;51: 102092. https://doi.org/10.1016/j.ajp.2020.102092.

26 Gritsenko V, Skugarevsky O, Konstantinov V, Khamenka N, Marinova T, Reznik A, Isralowitz R. COVID 19 fear, stress, anxiety, and substance use among Russian and Belarusian q university students. Int J Ment Health Addict. 2020;21:1–7. https://doi.org/10.1007/s11469-020-00330-z.

27 Bland AR, Roiser JP, Mehta MA, Sahakian BJ, Robbins TW, Elliott R. COVID-19 induced social isolation; implications for understanding social cognition in mental health. Psycholog Med. 2020;8:1–2. https://doi.org/10.1017/S0033291720004006.

28 Singh N, Jha NA, Rani S, Kumar V. The association of internet overuse with sleep and mood in Indian Female University Students. Sleep Vigil. 2021;12:1–3. https://doi.org/10.1007/s41782-021-00129-5.

29 Gruber R, Saha S, Somerville G, Boursier J, Wise MS. The impact of COVID-19 related school shutdown on sleep in adolescents: a natural experiment. Sleep Med. 2020;76:33–5. https://doi.org/10.1016/j.sleep.2020.09.015.

30 Bates LC, Zieff G, Stanford K, Moore JB, Kerr ZY, Hanson ED, Barone Gibbs B, Kline CE, Stoner L. COVID-19 impact on behaviors across the 24-hour day in children and adolescents: physical activity, sedentary behavior, and sleep. Children. 2020;7:138. https://doi.org/10.3390/children7090138.

31 Tran BX, Vo LH, Phan HT, Pha Q, Vu GT, Le HT, Latkin CA, Ho RC. Mobilizing medical students for COVID-19 responses: experience of Vietnam. J Global Health. 2020;10(2): 020319. https://doi.org/10.7189/jogh.10.020319.

32 World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310:2191–4. https://doi.org/10.1001/jama.2013.281053.

33 Heatherton TF, Polivy J. Development and validation of a scale for measuring state self-esteem. J Pers Soc Psychol. 1991;60:895.

34 Crandal R. The measurement of self-esteem and related constructs. In: Robinson JP, Shaver PR, editors. Measures of social psychological attitudes. revised. Ann Arbor: ISR; 1973. p. 80–2.

35 Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The cognitive failures questionnaire (CFQ) and its correlates. Br J Clin Psychol. 1982;21:1–6. https://doi.org/10.1111/j.2044-8260.1982.tb01421.x.

36 Cellini N, Canale N, Mioni G, Costa S. Changes in sleep pattern, sense of time and digital media use during COVID-19 lockdown in Italy. J Sleep Res. 2020;29: e13074. https://doi.org/10.1111/jsr.13074.

37 van Harmelen AL, Gibson JL, St Clair MC, Owens M, Brodbeck J, Dunn V, Lewis G, Croudace T, Jones PB, Kievit RA, Goodyer IM. Friendships and family support reduce subsequent depressive symptoms in at-risk adolescents. PLoS ONE. 2016;11: e0153715. https://doi.org/10.1371/journal.pone.0153715.

38 Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, Huang E, Zuo QK. The prevalence ofdepression, anxiety, and sleep disturbances in COVID-19 patients: a meta-analysis. Ann N Y Acad Sci. 2020. https://doi.org/10.1111/nyas.14506.

39 Gupta R, Grover S, Basu A, Krishnan V, Tripathi A, Subramanyam A, Nischal A, Hussain A, Mehra A, Ambekar A, Saha G. Changes in sleep pattern and sleep quality during COVID-19 lockdown. Indian J Psychiatr. 2020;62:370. https://doi.org/10.4103/psychiatry.IndianJPsychiatry_523_20.

40 Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, Rubin GJ. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet. 2020;395:912–20. https://doi.org/10.1016/s0140-6736(20)30460-8.

41 Wolf MR, Rosenstock JB. Inadequate sleep and exercise associated with burnout and depression among medical students. Acad Psychiatry. 2017;41:174–9. https://doi.org/10.1007/s40596-016-0526-y.

42 Shamsuddin K, Fadzil F, Ismail WS, Shah SA, Omar K, Muhammad NA, Jaffar A, Ismail A, Mahadevan R. Correlates of depression, anxiety and stress among Malaysian university students. Asian J Psychiatr. 2013;6:318–23. https://doi.org/10.1016/j.ajp.2013.01.014.

43 Alim SA, Rabbani MG, Karim E, Mullick MS, Al Mamun A, Khan MZ. Assessment of depression, anxiety and stress among first year MBBS students of a public medical college, Bangladesh. Bangladesh J Psychiatr. 2017;29:23–9.

44 Cheng H, Furnham A. Personality, self-esteem, and demographic predictions of happiness and depression. Pers Individ Differ. 2003;34:921–42. https://doi.org/10.1016/S0191-8869(02)00078-8.

45 Xiong J, Lipsitz O, Nasri F, Lui LM, Gill H, Phan L, Chen-Li D, Iacobucci M, Ho R, Majeed A, McIntyre RS. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. J Affect Disord. 2020;277:55–64. https://doi.org/10.1016/j.jad.2020.08.001.

46 Hao F, Tan W, Jiang L, Zhang L, Zhao X, Zou Y, Hu Y, Luo X, Jiang X, McIntyre RS, Tran B, Sun J, Zhang Z, Ho R, Ho C, Tam W. Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? A case-control study with service and research implications for immunopsychiatry. Brain Behav Immun. 2020;87:100–6.

47 Moreira-Neto A, Martins B, Miliatto A, Nucci MP, Silva-Batista C. Can remotely supervised exercise positively affect self-reported depressive symptoms and physical activity levels during social distancing? Psychiatr Res. 2021;301: 113969. https://doi.org/10.1016/j.psychres.2021.113969.

48. Chaturvedi SK. Covid-19, coronavirus and mental health reha-
    bilitation at times of crisis. J Psychosoc Rehabil Mental Health.
    2020;7:1–2. https://doi.org/10.1007/s40737-020-00162z.

49. Zhang MW, Ho RC. Moodle: the cost effective solution for
    internet cognitive behavioral therapy (I-CBT) interventions.
    Technol Health Care. 2017;25(1):163–5. https://doi.org/10.
    3233/THC-161261.

50. Ho CS, Chee CY, Ho RC. Mental health strategies to combat the
    psychological impact of COVID-19 beyond paranoia and panic.
    Ann Acad Med Singap. 2020;49(1):1–3.

51. Soh HL, Ho RC, Ho CS, Tam WW. Efficacy of digital cognitive
    behavioural therapy for insomnia: a meta-analysis of randomised
    controlled trials. Sleep Med. 2020;75:315–25. https://doi.org/10.
    1016/j.sleep.2020.08.020.

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