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Impact of internet addiction during COVID-19 on anxiety and sleep quality among college students of Bhubaneswar city

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Abstract:

BACKGROUND: COVID-19 initiated in December 2019 in Wuhan, China, and over a period of time, the infection outspread across the world in a rapid pace. To protect the people and to further limit the spread of infection, lockdown was declared in most parts of the world including India. As all people were forced to stay indoors during this pandemic, internet was the only source of entertainment whose overuse has side effects on anxiety and sleep quality. This study is aimed to know the impact of Internet addiction during COVID-19 on anxiety and sleep quality among college students of Bhubaneswar city.

MATERIALS AND METHODS: This was a web-based cross-sectional, questionnaire study. It administered 475 students from six colleges. The students were assessed by a proforma containing demographic details, patterns of internet use, Youngs Internet Addiction Test, Generalised Anxiety disorder score, and the Pittsburgh Sleep Quality Index. Statistical analysis was done using SPSS version 21.0 using Chi-square test and Wilcoxon signed-rank test.

RESULTS: The mean age of the study group was 18.81 ± 1.189. Out of 475 students, 60.6% were female and 39.4% were male. 23.6% and 13.4% of recruited students had severe internet addiction and anxiety disorder, respectively. The mean global PSQI score in the study was 6.356 ± 1.88. About 84.6% of the students had poor global sleep quality score. All components of sleep quality were significantly associated (P = 0.000) with different degrees of internet addiction except sleep duration (P = 0.589) and efficiency (P = 0.767).

CONCLUSION: Females were highly addicted than males. The study findings specified that students' excessive internet usage leads to anxiety, and affects mental health. Monitoring and controlling students' internet addiction through informative sessions on how to use the Internet adequately is useful.

Keywords:

Anxiety, COVID-19, internet, sleep, students

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Introduction

Over the course of life, many people experience mental health problems which affect how we determine to handle stress, communicate with others and make our choices. The ongoing Covid-19 disease and the related home quarantine, lockdown, and social distancing have been acknowledged as one of the reasons for psychological and social consequences among the people. This has led not only to impact the mental health but also disruption in their sleep cycle and create pessimistic emotion in society.[1] In addition, there has also been an exponential increase in the use of internet over the decades and as all

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people were forced to stay indoors during this pandemic, internet was the only source of entertainment, attend online classes, and to connect to their near and dear ones who were in some other parts of the country. The kinship between smartphone use and adaptative functioning has been depicted to be an inverted U-curve.[1]

On December 2019, the WHO learned about a new virus from the pneumonic-like cases which initiated in Wuhan, People's Republic of China. This virus SARS-CoV-2, a respiratory pathogen caused an infectious disease coronavirus 19 later was named as COVID-19 on February 11, 2020.[2-6] On March 11, WHO declared COVID-19 as a pandemic[3-8] and after 5 days, on March 16 the first case was reported in Odisha when an Italy returned student tested positive.[9]

Almost the whole world population was in a state of shock and distress due to the outbreak of COVID-19 and 200 developed and developing countries reported confirmed cases. India reported the first positive symptomatic case on 30th January[10] after which the Indian Government on March 24th ordered a nationwide lockdown for 21 days, confining movement of the intact 1.3 billion population of India as a preventive measure against the virus.[11] It was declared after a 14 h public curfew from 7 am to 9 pm on 22nd of March where people were urged to stay inside their homes. Lockdown has been said as an action when there are restrictions on assembly but essential services are available.[10] As the end of the first lockdown period approached, the Odisha government extended the lockdown till May 1 after which a series of lockdown followed till 30th June.[12]

The fast climbing of cases of COVID-19 worldwide and the rapid changes in people daily living had left people alarmed and frightened. Like in the rest states of the country, life in Odisha had drastically changed during the lockdown period at different levels. Previous studies have established a crystal clear association between a pandemic and symptoms of stress, depression, anxiety, and suicidal tendencies along with excessive internet usage.[13] Various reports were also conducted during the lockdown period that suggested mental health is on a peak since the outbreak of this global pandemic.[10,14,15] Thus, internet was the only means of source to connect with people during the lockdown period.

In the year 1995, Dr. Ivan Goldberg initially suggested the term "internet addiction" (problematic internet use, pathological internet use, and internet dependence)[16] for pathological compulsive internet use which is outlined as an excessive, controlled preoccupations, or psychological dependence on the internet.[17] It is usually defined as a dysfunctional pattern of internet use directing to significant impairment or distress.[18] The influence of problematic internet use is also seen on sleep patterns disrupting the sleep-wake schedule significantly, seen among heavy internet users.[17] According to the report "Internet in India 2017," there were about 500 million internet users in the year 2018, out of which 60 percent were students. And by the end of 2023, it was estimated that the number would be 666.4 million.[19] Since adolescents contribute a significant proportion of the productive life age in India, their involvement with internet overuse or addiction may lead to significant adverse consequences.[17] Its symptom includes the tendency to extend the time spent on internet, imagining about networking, and the emergence of other physical psychological and social problems.[20]

Few peer-reviewed surveys have also assessed emotional distress among Chinese students during Covid 19 and the probable rates vary from 17% to 48% for depression and 23%–28% for anxiety[21] and with lower anxiety rates among college students.[22] In another research among college students of the United States, 71% of the participants were associated with increased stress and anxiety due to outbreak of COVID-19.[23]

To the best of our knowledge, there are no studies in Bhubaneswar city that have investigated how this pandemic may have increased internet addiction and its relationship on anxiety and sleep quality on the college students. Given the above, this current study aims to describe the impact of internet addiction on anxiety and sleep quality among college students during the COVID-19 lockdown, using a web-based assessment. The main hypothesis was that the addiction of internet may be consistent and increased among the college students during the lockdown. Additionally, another purpose was to explore the factors associated with problematic internet use in this unique context. The objectives were mostly to identify the potential gender group or possible factors to reduce the internet addiction due to COVID-19 global pandemic.

Materials and Methods

Study design and setting

A web-based cross-sectional, questionnaire study was conducted among the students of six colleges of Bhubaneswar city for 3 months (October 2020–December 2020).

Study participants and sampling

A sample of 480 was derived from the formula $n = z^2pq/d^2$ where n is sample size, p is prevalence of disease, q is free from disease, d is an allowable error and z is the point on normal deviation. A stratified random sampling technique was followed, as illustrated in Figure 1. Students between the age group of 16–21 years

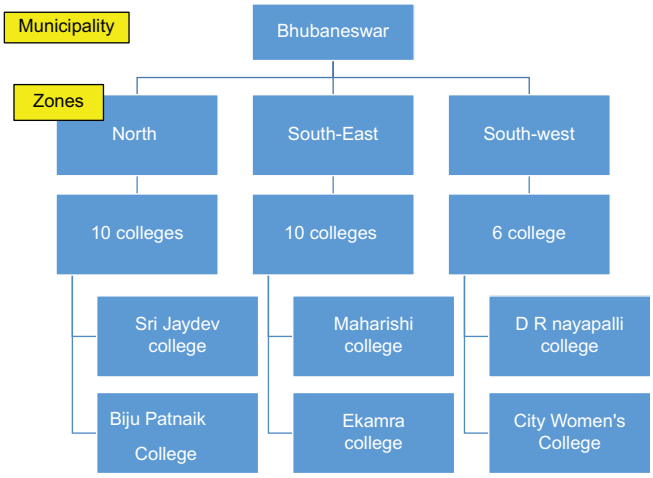

Figure 1: Sampling technique

and those who gave digital informed consent in the beginning of the questionnaire were the targeted group in the study. Students who did not give consent or were more than 21 years were excluded from the study. Five students did not give consent for which the total sample size was 475.

Data collection tool and technique

A self-structured questionnaire [Annexure 1] of 39 items consisting of demographics (age, sex, stream, year of studying, family income, marital status), pattern of internet use before and during lockdown, short and modified form of Youngs Internet Addiction Test (IAT),[24] Generalised Anxiety Disorder Scale[25] and Pittsburgh Sleep Quality Index (PSQI)[26] were developed. The construct of the questions was checked by five subject experts. The content validity was tested by a panel of six experts, including four public health dentists, a biostatistician, and another external dental professional. Corrections and modifications were done according to the expert's panel. Before data collection, a pilot study was conducted and questions that were reported to be difficult were re-framed. The reliability coefficient (Cronbach's alpha– α) was found to be 0.821. The questionnaire was prepared in Google form (https://docs.google.com/forms/d/e/1FAIpQLSdbguvwB4zbqsbBmxrC2mSONfQYf-lBAnVpa-ZGubVJrqo8fQ/viewform?usp=pp_url) and shared via social media applications such as Whatsapp and E-mails of known contacts.

IAT by Young (Widyanto and McMurran, 2004; Young, 1998a) is one of the most frequently used questionnaires. It operationalizes the degree of subjective complaints in day-to-day life in the course of excessive usage of the Internet and is supported by diagnostic criteria for pathological gambling.[27] The IAT consists of 20 items with 5-point Likert scale but in this study, the shortened (12 items) and modified version of the original IAT was applied.[28] The IAT total score is the sum of the ratings given by the examinee for the 12-item responses. The maximum score is 60 points. The content validity index was 1. The IAT total score ranges, with the higher the score represented the higher level of intensity of Internet compulsivity and addiction. Total scores that range from 0 to 15 points were considered to reverberate a normal level of Internet usage; scores of 16–30 indicated a mild level of Internet addiction; 31–45 reflected the presence of a moderate level; and scores of 46–80 indicated severe dependence upon the Internet.

The Generalized Anxiety Disorder Scale-7 (GAD-7) is a 7-item with 4-point likert scale ranging from 0 (never) to 3 (nearly everyday) developed by Spitzer as a screening tool and severeness indicator for detection of anxiety disorders.[25] For this study, the items were shortened (2items) and modified. Scores of 2,4 and 6 were taken as cut off points for mild, moderate, and severe anxiety, respectively.

For sleep quality shortened and modified PSQI was used.[29] 19-item PSQI survey was reduced to 13-item survey and subdivided into five components-sleep latency, sleep duration, sleep efficiency, sleep disturbances, and daytime dysfunction. A total global score >4 indicated poor sleep quality.

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 21.0, IBM, USA. Categorical values were described using frequency and percentages. Chi-Square test was used for measuring the association between two independent groups. The confidence interval was kept at 95% and the level of significance was set at 0.05. Wilcoxon rank-sum test was used to analyze the patterns of internet use before and during lockdown.

Results

The descriptive information of different sociodemographic variables among gender of the college students in Bhubaneswar has been elaborated in Table 1. Results show that 288 (60.6%) were females and 49% females were between 18 and 19 years. 41.2 percent of the participants were males aged 20 years. 268 (56.4%) of students had opted Arts as their stream among whom 191 (66.3%) were females and more than 257 (54%) of the students were in 2nd year. The parental income of 184 (38.7%) students was <10000 per month. Parents of 202 students had only higher education (42.5) and around 12% of the total students were married.

The distribution of patterns of internet use and the association of different variables before and during lockdown is shown in Table 2.The use of mobile

Table 1: Distribution of sociodemographic variables among gender

Variables	Female, *n* (%)	Male, *n* (%)	Total
Total sample (*n*)	288 (60.6)	187 (39.4)	475
Age (years)			
16-17	44 (15.3)	34 (18.2)	78 (16.4)
18-19	141 (49)	76 (40.6)	217 (45.7)
20-21	103 (35.8)	77 (41.2)	180 (37.9)
Stream			
Arts	191 (66.3)	77 (41.2)	268 (56.4)
Science	47 (16.3)	47 (25.1)	94 (19.8)
Commerce	50 (17.4)	63 (33.7)	113 (23.8)
Year of studying			
1st year	67 (23.3)	42 (22.5)	109 (22.9)
2nd year	148 (51.4)	109 (58.3)	257 (54.1)
3rd year	73 (25.3)	36 (19.3)	109 (22.9)
Family income*			
≤10,001	126 (43.8)	58 (31.0)	184 (38.7)
10,002-29,972	97 (33.7)	72 (38.5)	169 (35.6)
29,973-49,961	34 (11.8)	35 (18.7)	69 (14.5)
49,962-74,755	13 (4.5)	6 (3.2)	19 (4.0)
74,755-99,930	6 (2.1)	9 (4.8)	15 (3.20)
99,931-199,861	7 (2.4)	7 (2.4)	14 (2.9)
≥199,862	5 (1.7)	0	5 (1.7)
Parent education			
10th pass	136 (47.2)	66 (35.3)	202 (42.5)
12th pass	49 (17.0)	41 (21.9)	90 (18.9)
Graduate	54 (18.8)	50 (26.7)	104 (21.9)
Postgraduate	49 (17.0)	39 (16.0)	79 (16.6)
Marital status			
Unmarried	260 (90.3)	157 (84.0)	417 (87.8)
Married	28 (9.7)	30 (16.0)	58 (12.2)

*Modified kuppuswamy socioeconomic scale[30]

decreased from 96% to 81.3% (P = 0.000) but the use of laptop increased from 3.2% to 18.5% (P = 0.000). Approximately 42% (P = 0.000) of students spent 5–10 h daily online and around 10% (P = 0.000) of total students spent more than 15 h online. 65.5% of the participants used social media which significantly decreased during lockdown to 25.5% (P = 0.000).49.5% (P = 0.000) students attended online academic classes. 15.8% of students spent more than 300 rupees before the pandemic for assessing the internet. However, during the lockdown, 42.7% (P = 0.000) of students spent three hundred rupees for internet usage. 46.3% of students preferred using internet during the afternoon which decreased to 30.1% during the pandemic (P = 0.000). Interestingly the usage of internet also increased during night time from 2.7% to 25.9% (P = 0.000).

Table 3 depicts the association between different of internet addiction and GAD scores with various socioeconomic variables. 23.6% females were found to be severely addicted to internet (P = 0.24) where as only 11.8% of girl students had anxiety disorder (P = 0.025). The monthly income (P = 0.000) and education of parents (P = 0.000) along with the year (P = 0.005) in which the students studied and marital status (P = 0.034) had shown significant association with internet addiction scores. The generalised anxiety scores were significantly associated with the gender (P = 0.025), year of studying (P = 0.000), monthly parental income and education (P = 0.000) and marital status (P = 0.023).

One hundred and twelve (23.6%) students were severely addicted to internet as shown in Table 4. Sixty-four students had moderate to severe internet addiction with severe anxiety disorder and 16 students had severe internet addiction with minimal anxiety disorder. 107 students had mild to moderate internet addiction with mild anxiety. IAT scores were significantly associated with GAD scores (P = 0.000). Students with different degrees of internet addiction revealed significant associations with different components of PSQI except sleep duration and efficiency as shown in Table 5.

Discussion

The present study is an attempt to understand the relative pattern of internet use before and during the lockdown and its impact on anxiety and sleep quality among the college students. The mean age of the study group was 18.81 ± 1.189.

One unique finding of the present study was that 16% of boys were married below the Indian legal age of 21 years. This shows that despite belonging from the capital city, child marriage is being followed. About three-fourth of the students (76%) used to spend <5 h online before the pandemic but during the lockdown period, 41.7% of the students reported spending 5–10 h daily online. The main device to access internet was mobile (81.3%) followed by laptop (18.5%). This is in line with other findings of the studies which suggest that increase in internet penetration among youth in India is due to rapid expansion of mobile broadband, smartphone applications and cheaper data packs.[19]

Our study showed 23.57% of students with severe internet addiction out of which 50.5% used different sources of internet usage in the form of social media, over the top (OTT media), online shopping, online music, and games. In another study only 15.5% of students were addicted to the internet which was comparatively less than our study.[16] So this shows that there was an increase in the use of internet during lockdown time. Similar differences were also reported in Europe ranging from 1.2%–11.8%.[31] Another study among Indian adolescents, the prevalence of addicts was reported to be 0.7%.[32] Veisani *et al*. also revealed that 5.5% of the participants had a severe level of internet addiction.[33]

In the present study, females were more addicted to internet than males. About 47.9% of the recruited female

Table 2: Distribution of patterns of internet use and its association before and during lockdown

	Before lockdown, *n* (%)	During lockdown, *n* (%)	*P**
Device for using internet			
Mobile	456 (96)	386 (81.3)	0.000
Laptop	15 (3.2)	88 (18.5)	0.000
Tablet	2 (0.4)	1 (0.2)	0.564
Desktop	2 (0.4)	0	0.157
Time spent online/day (h)			
≤5	361 (76)	122 (25.7)	0.000
5-10	102 (21.5)	198 (41.7)	0.000
10-15	9 (1.9)	107 (22.5)	0.000
≥15	3 (0.6)	48 (10.1)	0.000
Usual purpose of using internet			
Social media	311 (65.5)	121 (25.5)	0.000
OTT-Netflix, Amazon prime, hotstar etc	36 (7.6)	69 (14.5)	0.000
Gaming	28 (5.9)	34 (7.2)	0.355
Shopping	18 (3.8)	4 (0.8)	0.003
Music	48 (10.1)	12 (2.5)	0.000
Academic online classes	34 (7.2)	235 (49.5)	0.000
Cost of internet use per month (Rs.)			
50-100	84 (17.7)	30 (6.3)	0.000
100-200	218 (45.9)	106 (22.3)	0.000
200-300	98 (20.6)	136 (28.6)	0.002
≥300	75 (15.8)	203 (42.7)	0.000
Predominant time of use of internet			
Day (6 am-12 pm)	102 (21.5)	71 (14.9)	0.004
Afternoon (12 pm-6 pm)	220 (46.3)	143 (30.1)	0.000
Evening (6 pm-12 am)	140 (29.5)	138 (29.1)	0.883
Night (12 am-6 am)	13 (2.7)	123 (25.9)	0.000

*Wilcoxon rank-sum test

college students were at moderate to severe levels of internet addiction. The preceding phenomenon was correspondent to a report in former studies which was conducted on 503 female Taiwan female students.[34] This may be due to frequent use of social media, short video-making apps like TikTok (banned on June 29, 2020 in India), no demarcation of time and space, and low-level risk offer an idealistic way of amending solitariness and establishing social networks. Besides, college students tend to socialize themselves through online games, chatting which provides them joy and resort from daily pressure.[35] In a study by Karimi *et al*., they concluded that problem-based learning health literacy, and practicing real-life scenarios could improve the adolescent lifestyle.[36] In contrast studies, boys were found to be moreover users[16] as they were given more freedom to have frequent access to use the internet in private than girls. Studies have also shown that boys tend to play more online games and surf adult sites more often than girls.[35]

In our study, the stream and the marital status of the students did not show any significant relationship with internet addiction or anxiety. However, this was not in accordance with a study that showed singles tend to be addicted to internet more than married people do.[37]

The results indicated that female students were associated with increased anxiety levels. This study is analogs with the results of previous studies.[38] This finding may also be linked to the fact that women tend to be more vulnerable to undergo stress and later develop post traumatic symptoms.[39]

This study also revealed a strong positive association between internet addiction and anxiety. Similar results were found by Jain *et al*.[16] and Bhandari *et al*.[40] in their study of 954 students and 984 undergraduate students, respectively. Lebni *et al*., justified the relationship between depression and internet addiction, that the unreasonable use of the Internet can lead to social isolation and depression through reducing familial, social, and local connection. Therefore, depression may occur as a result of internet addiction.[41]

The present and various other studies have shown that fear of COVID-19 and prolonged quarantine period might have impelled people to undergo symptoms of anxiety. Amateur online activities such as online chatting, binge-watching web series, online shopping, games like PlayerUnknown's Battlegrounds, etc., are often a mechanism to deal with anxiety and ameliorate depressed mood. Nevertheless, derogatory usages may

Table 3: Association between internet addiction test and generalized anxiety disorder score with sociodemographic variables

	Internet addiction test					Generalised anxiety disorder				
	Normal, *n* (%)	Mild, *n* (%)	Moderate, *n* (%)	Severe, *n* (%)	*P**	Minimal, *n* (%)	Mild, *n* (%)	Moderate, *n* (%)	Severe, *n* (%)	*P**
Gender										
Female	42 (14.6)	108 (37.5)	70 (24.3)	68 (23.6)	0.240	72 (25)	89 (30.9)	90 (32.3)	34 (11.8)	0.025**
Male	25 (13.4)	85 (45.5)	33 (17.6)	44 (23.5)		55 (29.4)	65 (34.8)	37 (19.8)	30 (16)	
Stream										
Arts	38 (14.2)	106 (39.6)	56 (20.9)	68 (25.4)	0.804	74 (27.6)	83 (31)	79 (29.5)	32 (11.9)	0.716
Science	10 (10.6)	41 (43.6)	21 (22.3)	22 (23.4)		23 (24.5)	31 (33)	23 (24.5)	17 (18.1)	
Commerce	19 (16.8)	46 (40.7)	26 (23)	22 (19.5)		30 (26.5)	40 (35.4)	28 (24.8)	15 (13.3)	
Year of studying										
1st year	21 (19.3)	44 (40.4)	15 (13.8)	29 (26.6)	0.005**	40 (36.7)	34 (31.2)	28 (25.7)	7 (6.4)	0.000***
2nd year	36 (14.0)	93 (36.2)	60 (23.3)	68 (26.5)		57 (22)	82 (31.9)	67 (26.1)	51 (19.8)	
3rd year	10 (9.2)	56 (51.4)	28 (25.7)	15 (13.8)		30 (27.5)	38 (34.9)	35 (32.1)	6 (5.5)	
Parental income										
≤10,001	33 (17.9)	82 (44.6)	43 (23.4)	26 (14.1)	0.000***	59 (32.1)	50 (27.2)	51 (27.7)	24 (13.0)	0.004**
10,002-29,972	23 (13.6)	52 (30.8)	40 (23.7)	54 (32.0)		38 (22.5)	65 (38.5)	47 (27.8)	19 (11.2)	
29,973-49,961	5 (7.2)	35 (50.7)	10 (14.5)	19 (27.5)		17 (24.6)	16 (23.2)	22 (31.9)	14 (20.3)	
49,962-74,755	4 (21.1)	8 (42.1)	1 (5.3)	6 (31.6)		2 (10.5)	7 (36.8)	8 (42.1)	2 (10.5)	
74,755-99,930	2 (13.3)	6 (40)	7 (46.7)	0		7 (46.7)	8 (53.5)	0	0	
99,931-199,861	0	6 (42.9)	2 (14.3)	6 (42.9)		2 (14.3)	8 (57.1)	0	4 (28.6)	
≥199,862	0	4 (80)	0	1 (20)		2 (40)	0	2 (40)	1 (20)	
Parent education										
10th pass	25 (12.4)	99 (49.0)	40 (19.8)	38 (18.8)	0.000***	69 (34.2)	40 (19.8)	68 (33.7)	25 (12.4)	0.000***
12th pass	25 (27.8)	16 (17.8)	25 (27.8)	24 (26.7)		24 (26.7)	31 (34.4)	22 (24.4)	13 (14.4)	
Graduate	9 (8.7)	44 (42.3)	15 (14.4)	36 (34.6)		25 (24.0)	37 (35.6)	22 (21.2)	20 (19.2)	
Postgradate	8 (10.1)	34 (43.0)	23 (29.1)	14 (17.7)		9 (11.4)	46 (58.2)	18 (22.8)	6 (7.6)	
Marital status										
Unmarried	53 (12.7)	169 (40.5)	97 (23.3)	98 (23.5)	0.034**	103 (24.7)	141 (33.8)	113 (27.1)	60 (14.4)	0.023**
Married	14 (24.1)	24 (41.4)	6 (10.3)	14 (24.1)		24 (41.4)	13 (22.4)	17 (29.3)	4 (6.9)	

*Chi-square test, **Significant, ***Highly significant

Table 4: Association of different degrees of internet addiction test scores with generalized anxiety disorder scores

Generalized anxiety disorder scores	Internet addiction				*P**
	Normal, *n* (%)	Mild, *n* (%)	Moderate, *n* (%)	Severe, *n* (%)	
Minimal	43 (33.9)	57 (44.9)	11 (8.7)	16 (12.6)	0.000***
Mild	15 (9.7)	70 (45.5)	37 (24)	32 (20.8)	
Moderate	5 (3.8)	54 (41.5)	39 (30)	32 (24.6)	
Severe	4 (6.3)	12 (18.8)	16 (25)	32 (50)	

*Chi-square test, ***Highly significant

in reality worsen anxiety and strengthen the dependency to use the Internet, developing a dysfunctional coping mechanism. Our study revealed that there was a significant increase of duration of Internet usage from 0.6% to 10.1% during the lockdown period and nearly 81% of students made effective use of mobile phones for accessing the Internet. This finding was in line with an Indonesian study in which there was about 52% increase of internet usage during COVID-19 and almost all respondents used mobile phones for using internet.[42]

In addition, this study also established that being online for over 15 h per day constituted a significant risk for internet addiction. Similar results were found where being online for over 11 h per day possessed risk. Studies in the past have mentioned the bidirectional relationship of being online and internet addiction.[43,44] More studies are required to identify risk factors in respect to time duration.

Besides online continuance, peculiar prevailing motives were recovered to be also related to internet addiction. Social media, OTT media, and online music were three types of particularised addiction.[45] In our study, the use of social media decreased from 65.5% to 25.5% and the usage of web series like netflix, amazon prime, Hotstar, etc., increased from 7.6% to 14.5% during the lockdown period. This could be possibly due to the ban

Table 5: Association of different degrees of internet addiction with the five components of Pittsburgh sleep quality index

Components of sleep quality	Internet addiction category				*P**
	Normal, *n* (%)	Mild, *n* (%)	Moderate, *n* (%)	Severe, *n* (%)	
Sleep latency (min)					
≤15	9 (26.5)	17 (50.0)	4 (11.8)	4 (11.8)	0.002**
16-30	16 (12.6)	67 (52.8)	25 (19.7)	19 (15.0)	
31-60	30 (15.4)	63 (32.3)	48 (24.6)	54 (27.7)	
>60	12 (10.1)	46 (38.7)	26 (21.8)	35 (29.4)	
Sleep duration (h)					
>7	32 (14.9)	87 (40.5)	51 (23.7)	45 (20.9)	0.589
6-7	16 (11.0)	59 (40.7)	29 (20.0)	41 (28.3)	
5-6	13 (20.6)	27 (42.9)	10 (15.9)	13 (20.6)	
<5	6 (11.5)	20 (38.5)	13 (25.0)	13 (25.0)	
Sleep efficiency (%)					
>85	7 (21.9)	14 (43.8)	4 (12.5)	7 (21.9)	0.767
75-84	37 (15.0)	100 (40.7)	51 (20.7)	58 (23.6)	
65-74	14 (10.4)	55 (41.0)	31 (23.1)	34 (25.4)	
<65	9 (14.3)	24 (38.1)	17 (27.0)	13 (20.6)	
Sleep disturbance					
0	22 (40.0)	15 (27.3)	11 (20.0)	7 (12.7)	0.000***
1-9	39 (12.5)	148 (47.4)	78 (25.0)	47 (15.1)	
10-18	6 (5.6)	30 (28.0)	14 (13.1)	57 (53.3)	
19-27	0	0	0	1 (100)	
Daytime dysfunction					
0	30 (24.0)	43 (34.4)	32 (25.6)	20 (16.0)	0.000***
1-2	12 (8.3)	76 (52.4)	24 (16.6)	33 (22.8)	
3-4	14 (12.3)	49 (43.0)	33 (28.9)	18 (15.8)	
5-6	11 (12.1)	25 (27.5)	14 (15.4)	41 (45.1)	

*Chi-square test,**Significant, ***Highly significant

of 59 Chinese apps under section 69 A of the Information Technology Act and relevant provisions under IT rules 2009.[46] Also, around 50% of students used internet for attending online lectures.

The mean global PSQI score in our study was 6.356 ± 1.88. Our study showed 84.6% of the students had poor sleep quality and 15.4% of the students had good quality of sleep [Supplementary Table 1]. Similar findings were found in an Italian study where 42.2% had sleep disturbances and, among them, 17.4% reported moderate or severe insomnia.[47] In a previous study, most students who watched television or checked social networking websites also had sleep disturbances.[48] Moreover, students who abuse the internet have higher chances of experiencing sleep problems. Another study also reported 66% of respondents with poor sleep quality.[49] Contrastingly in a study 23.8% medical students showed poor sleep quality and 76% had good sleep quality.[20]

Regarding the association between components of sleep quality and IAT, our study demonstrated significant associations on its three items except habitual sleep efficiency and sleep duration. This finding is supported by a previous study on correlation between seven items of sleep quality and IAT.[34] The results of the present study also implied that an surplus use of internet could be coupled to diminished sleep quality, elongated sleep latency, shortened sleep duration, sleep disturbances, and daytime dysfunction further highlighting the adverse impact of internet addiction on different parameters regarding sleep quality. On the other hand, a previous study by Peach *et al.,* has shown that sleep quality is related to individual's sleep attitude.[50]

The strengths of this study include its extensive coverage among six-degree colleges across Bhubaneswar city and maintaining the WHO recommended "social distancing" during the COVID-19 lockdown period. Students with different demographic characteristics were recruited. Moreover, the data for the web survey were accumulated by universally validated standardized means for quantitative analysis. It was also considered as a cost-effective conceptualization for data collection. In addition to the best of our knowledge, this is the first study that has systematically investigated the prevalence and patterns of internet use before and during lockdown and its impact on anxiety and sleep quality. This is the novelty of the study.

The present study also had several limitations that have to be taken into account for accurate interpretation of its

findings. First, the study was an online cross-sectional study. Therefore, the results of this study cannot assign casual nature. Second, due to the lockdown, we could not go on to the field to collect data. Electronic means were used to collect data. Hence the results cannot be generalized to the entire population. Third, responses to the survey were self-reported which could have resulted in biases for social desirability that would have altered the results.

Conclusions

The current study identified the rate of severe internet addiction at 23.6% among the female population of the college students during the lockdown period. Our findings showed that internet addiction was significantly related to anxiety and sleep quality of the student highlighting a poorer sleep quality of sleep in those with moderate and severe Internet addiction. Therefore, overuse of internet, loss of self-control, and humoring in online social activities are strongly not recommended among female college students due to all destructive contributors to sleep quality.

Research quality and ethics statement

The authors of this manuscript declare that this scientific work complies with reporting quality, formatting, and reproducibility guidelines set forth by the EQUATOR Network. The authors also attest that this clinical investigation was determined to require Institutional Review Board/Ethics Committee Review, and the corresponding protocol/approval number is (KIMS/KIIT/IEC/556/2021).

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Distribution of sleep quality scores among gender

Gender	Global		Total
	Good, *n* (%)	Bad, *n* (%)	
Female	42 (14.6)	246 (85.4)	288 (100.0)
Male	31 (16.6)	156 (83.4)	187 (100.0)
Total	73 (15.4)	402 (84.6)	475 (100.0)

ANNEXURE I: SCORING QUESTIONNAIRE

Impact of Internet addiction during COVID 19 on anxiety and sleep quality among college students of Bhubaneswar city

Demographics

1. Age
2. Sex
   A. Female B. Male C. Others
3. Stream
   A. Arts
   B. Science
   C. Commerce
   D. Others
4. Parental income per month (in rupees)
   A. ≤10,001
   B. 10,002–29,972
   C. 29,973– 49,961
   D. 49,962–74,755
   E. 74,755 –99,930
   F. 99,931–199,861
   G. ≥199,862
4. Education of father
   A. 10th pass
   B. 12th pass
   C. Graduate
   D. Postgraduate
5. Marital Status
   A. Unmarried
   B. Married

Internet Usage Pattern

6. What device you use for accessing internet?
   A. Mobile
   B. Laptop
   C. Tablet
   D. Desktop
7. How many hours you spend online in a typical day?

Before lockdown (h)	≤5	5-10	10-15	≥15
During lockdown (h)	≤5	5-10	10-15	≥15

8. What is the usual purpose of using internet?

Before lockdown	Social media	OTT-Netflix, amazon prime etc	Online games	Online shopping	Online music	Academic online class
During lockdown	Social media	OTT-Netflix, amazon prime etc	Online games	Online shopping	Online music	Academic online class

OTT=Over the top

9. What is the cost of internet use per month (in rupees) ?

Before lockdown	50-100	100-200	200-300	≥300
During lockdown	50-100	100-200	200-300	≥300

10. What was the predominant time of day for internet use during lockdown?

Before lockdown	day (6 am-12 pm)	Afternoon (12 pm-6 pm)	evening?(6 pm-12 am)	Night (12 am-6 am)
During lockdown	day (6 am-12 pm)	Afternoon (12 pm-6 pm)	evening?(6 pm-12 am)	Night (12 am-6 am)

Youngs Internet Addiction Scale (Short and modified)

During lockdown how often did you	Not applicable	Rarely	Occasionally	Frequently	Often	Always
Find that you stayed online longer than you intended?						
Neglect household chores to spend more time online?						
Grades or school work suffer because of the amount of time you spend online?						
Become defensive or secretive when anyone asks you what you do online?						
Snap, yell, or act annoyed if someone bothers you while you are online?						
Lose sleep due to being online at night?						
Feel preoccupied with the Internet when off-line, or fantasize about being online?						
Find yourself saying "just a few more minutes" when online?						
Try to cut down the amount of time you spend online and fail?						
Try to hide how long you've been online?						
Choose to spend more time online over going out with others?						
Feel depressed, moody, or nervous when you are off-line, which goes away once you are back online?						

Generalized Anxiety Disorder Scale -Short and modified

During lockdown how often did you feel	Not at all	Several days	More than half the days	Nearly everyday
Restless that it was hard to sit still				
Afraid as if something awful might happen				

Pittsburgh Sleep Quality Index(Short form and modified)

11. During the lockdown when you have usually gone to bed?
    Usual Time-
12. During the lockdown how long (in minutes) it took to fall asleep?
    - Less than 15 min
    - 16–30 min
    - 31–60 min
    - More than 60 min
13. During the lockdown, when have you usually got up in the morning?
14. During the lockdown, how many actual hours of sleep did you get at night? (This may be different than the number of hours you spend in bed.)
    - >7 h
    - 6–7 h
    - 5–6 h
    - <5 h
15. During the lockdown, how often have you had trouble sleeping because you……
    (a) Cannot get to sleep within 30 min
    - Not during the lockdown
    - Less than once a week
    - Once or twice a week
    - Three or more times a week

(b) Wake up in the middle of the night or early morning
- Not during the lockdown
- Less than once a week
- Once or twice a week
- Three or more times a week

(c) Have to get up to use the bathroom
- Not during the lockdown
- Less than once a week
- Once or twice a week
- Three or more times a week

(d) Cannot breathe comfortably
- Not during the lockdown
- Less than once a week
- Once or twice a week
- Three or more times a week

(e) Cough or snore loudly
- Not during the lockdown
- Less than once a week
- Once or twice a week
- Three or more times a week

(f) Feel too hot
- Not during the lockdown
- Less than once a week
- Once or twice a week
- Three or more times a week

(g) Had bad dreams
- Not during the lockdown
- Less than once a week
- Once or twice a week
- Three or more times a week

(h) Have pain
- Not during the lockdown
- Less than once a week
- Once or twice a week
- Three or more times a week

16. During the lockdown, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?
- Not during the lockdown
- Less than once a week
- Once or twice a week
- Three or more times a week

17. During the lockdown, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

A. No problem at all
B. Only a very slight problem
C. Somewhat of a problem
D. A very big problem