ORIGINAL RESEARCH

How Has the COVID-19 Pandemic Impacted Internet Use Behaviors and Facilitated Problematic Internet Use? A Bangladeshi Study

Israt Jahan[1,2]
Ismail Hosen [ID][3,4]
Firoj al Mamun [ID][3,4]
Mark Mohan Kaggwa [ID][5]
Mark D Griffiths [ID][6]
Mohammed A Mamun [ID][3,4]

[1]Ministry of Health and Family Welfare, Government of People's Republic of Bangladesh, Dhaka, Bangladesh; [2]Department of Public Health and Informatics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh; [3]CHINTA Research Bangladesh, Dhaka, 1342, Bangladesh; [4]Department of Public Health and Informatics, Jahangirnagar University, Dhaka, 1342, Bangladesh; [5]Department of Psychiatry, Faculty of Medicine, Mbarara University of Science and Technology, Mbarara, Uganda; [6]Psychology Department, Nottingham Trent University, Nottingham, NG1 4FQ, UK

Correspondence: Mohammed A Mamun
CHINTA Research Bangladesh, Savar, Dhaka, 1342, Bangladesh
Tel +88-1738592653
Email mamunphi46@gmail.com

Background: The COVID-19 pandemic-related "stay-at-home" and confinement orders has led individuals to be more engaged with technology use (eg, internet use). For a minority of individuals, excessive use can become problematic and addictive. However, the investigation of problematic internet use in the COVID-19 context is only just emerging. Therefore, the present study investigated the changes in internet use behaviors and addiction rates in comparison with prior Bangladeshi studies.

Methods: An online cross-sectional study was carried out among a total of 601 Bangladeshi students between October 7 and November 2, 2020. The survey included questions relating to socio-demographic, behavioral health, online use behaviors, and psychopathological variables.

Results: A quarter of the participants (26%) reported having low levels of internet addiction, whereas 58.6% were classed as having moderate internet addiction and 13% severe internet addiction. A total of 4% of the sample were classed as being at risk of severe internet dependency (ie, scoring over ≥80 on IAT). Risk factors for internet addiction included smartphone addiction, Facebook addiction, depression, and anxiety. However, the final hierarchical regression model comprising all variables explained a total of 70.6% variance of problematic internet use.

Conclusion: Based on the present findings, it is concluded that individuals are at elevated risk of problematic internet use like other psychological impacts that have been reported during the COVID-19 pandemic. Therefore, risk-reducing measures and healthy control use strategies should be implemented for vulnerable individuals.

Keywords: COVID-19 and internet addiction, problematic internet use, online use behaviors, smartphone and Facebook addiction, depression, anxiety, Bangladeshi students

Introduction

The outbreak of the coronavirus disease 2019 (COVID-19) has already spread across the entire world and has curtailed most individuals' daily life activities and movements. In response to mitigate the ongoing pandemic, the authority of Bangladesh (where the present study was carried out) rapidly took some preventive and control strategies such as home confinement, closing down all educational institutions and implementing online learning, closing non-essential businesses, and imposing and mandatory spatial distancing.[1,2] Such measures, such as staying confined at home for a long time, can lead to negative psychological states and psychological vulnerability because of (i) loneliness due to reduced social

interaction, (ii) fear of losing family members or loved ones to the virus, (iii) uncertainty of future or careers, and (iv) despair due to social and economic disruption.[3–5]

Like other psychological impacts, the ongoing "stay-at-home" and confinement situation appears to have facilitated individuals' increased engagement with technology.[6] For example, an Indian study reported that 67.2% of participants reported an increase in their internet use since the start of the pandemic.[7] However, higher engagement with technology use might become problematic or addictive for some individuals.[8,9] Additionally, problematic internet engagement is also associated with loneliness, and various psychological and mental health issues, all of which may be heightened by the ongoing pandemic.[10,11] For instance, a recent case report highlighted uncontrolled PUBG-gaming apparently lead to suicide in Pakistan during the ongoing pandemic.[12] Additionally, previous research has indicated that problematic internet use is associated with mental illness such as depression, anxiety, stress, and sleep problems,[9,13,14] and these mental health disorders have also increased during the ongoing COVID-19 pandemic.[5] Psychoactive substance use and behaviors such as using social media, video gaming, surfing the internet, and watching sexually explicit material are all frequently used for relieving psychological distress (eg, daily life stressors, problems, and difficulties) in the form of "escapism".[15–17]

However, in line with the ongoing stressful situation caused by the COVID-19 pandemic, mental health studies have been conducted mostly assessing psychological disorders and issues. Extreme mental health impacts (ie, suicidal behavior) have been associated with problematic internet use particularly in relation to online gaming,[12] which is also consistent with a few reports prior to the non-COVID-19 pandemic.[18,19] However, only a few studies have examined the impact of problematic internet use in the context of the pandemic. For instance, a Mexican study reported that 2% of those surveyed might have had internet addiction (ie, scoring ≥70 [out of 100] on the Internet Addiction Test),[20] whereas an internet addiction prevalence rate of 14.4% was reported among Indonesian individuals (≥108 out of a total 264 score on a self-developed scale).[21] However, given the low cutoff score reported to indicate internet addiction, the findings do not appear to have good face validity. In China, a prevalence rate of 2.68% for internet addiction was reported (score on the Internet Addiction Test [IAT] ≥ 70).[22] A study was also conducted in Bangladesh during the COVID-19 pandemic

assessing problematic internet use predictors using the nine-item Internet Disorder Scale-Short Form (IDS9-SF), but did not report the prevalence of internet addiction.[23] Therefore, the present study investigated changes regarding problematic internet use comprising a Bangladeshi student's sample. A student sample was used in the present study because all previous studies conducted prior to the pandemic in Bangladesh had used student samples [see Griffiths and Mamun[24] for a very recent review on internet addiction-related studies in Bangladesh], and the present authors wanted to compare the present findings with those of previous studies in the country.

Methods
Study Procedure and Participants
A cross-sectional study was carried out among Bangladeshi students between October 7 and November 2 (2020) utilizing an online-based data collection platform (ie, Google Forms). A structured questionnaire was developed following previous studies conducted in Bangladesh, which were circulated on social media. To participate in the survey, inclusion criteria were being a Bangladeshi student (high school or above), having internet access, and an interest in participating the study. The sample size was calculated based on the following formula which estimated a sample size of 385. Utilizing a convenience sampling approach, a total of 617 individuals initially began completing the survey, and after removing incomplete questionnaires, 601 participants' data were analyzed in the final sample. Therefore, the sample size was more than adequate.

$$Sample\ Size = \frac{\frac{z^2 p(1-p)}{e^2}}{1 + (\frac{z^2 p(1-p)}{e^2 N})}$$

[Here: N = population size, infinite; e= Margin of error, 0.05; z = z-score, 1.96 (95% confidence level)]

Ethics
Study participation was voluntary, and online informed consent was taken from the respondents by exploring the study objectives. Additionally, the confidentiality and anonymity of the data were also assured to them while taking part in the survey. Following the Helsinki Declaration 2013, the study protocol was approved for implementation by the Institute of Allergy and Clinical Immunology of Bangladesh [Reference: IRBIACIB/CEC/ 03202030]).

Measures

Sociodemographic Factors

Basic sociodemographic information was collected in the survey, including gender, educational status (eg, university, medical college, high school), present residence (eg, urban or rural), relationship status (ie, single, in a relationship, married), monthly family income [eg, lower-class = less than 15,000 BDT, middle class = 15,001–30,000 BDT, upper class = more than 30,000 BDT; based on Mamun et al[9]] and type of family (eg, nuclear or extended family). Additionally, participants were also asked if they were currently living with their families or not.

Behavioral Health-Related Measures

The survey included behavioral health-related variables, including cigarette smoking status, drug use status, sleep status, and physical exercise. For assessing sleeping patterns, the study followed prior Bangladeshi studies comprising three categories (eg, normal sleeping status = 6–7 hours[10]). Physical exercise was defined as walking, cycling, swimming, or other activities for at least 30 minutes daily. Perceived health status was assessed by asking participants whether they suffered from a number of illnesses on a list (eg, asthma, heart problems, kidney problems, diabetes, etc.).

Online Use Behaviors

Several online use behaviors were assessed in the present study. Considering the prior Bangladeshi studies, the duration of online use was assessed utilizing categories (eg, less than 2 hours, 2 to 3 hours, 4 to 5 hours, and more than 5 hours). The online activities included educational activities, chatting/texting, online gaming, watching/streaming videos/films, social media browsing, watching sexual materials/pornography, and online shopping.

Smartphone Addiction

The Smartphone Application-Based Addiction Scale was used for assessing the risk of smartphone addiction.[25] The scale comprises six items (eg, "My smartphone is the most important thing in my life"), which are responded based on a 6-point Likert scale from 1 (strongly disagree) to 6 (strongly agree). The total score ranges from 6 to 36. Based on previous recommendations, the risk of smartphone addiction was determined using a cutoff of 21 out of 36.[26] In the present study, the Cronbach's alpha was 0.70.

Facebook Addiction

The Bergen Facebook Addiction Scale was used for assessing the risk of Facebook addiction.[27] The scale comprises six items (eg, "How often in the last year have you spent a lot of time thinking about Facebook or planned use of Facebook?"), which are responded to on a 5-point Likert scale from 1 (very rarely) to 5 (very often). The total score ranges from 6 to 30, where ≥18 was considered as the cutoff point for being at risk of Facebook addiction.[27] In the present study, the Cronbach's alpha was 0.84.

Depression

The two-item Patient Health Questionnaire (PHQ-2) was used for assessing the presence of depression. Participants are asked how often they experienced the two core criteria for depressive disorders over the past two weeks (ie, "Little interest or pleasure in doing things", and "Feeling down, depressed, or hopeless"), which are responded to on a 4-point Likert scale (0= not at all, 1= several days, 2=more than half the days, 3=nearly every day).[28,29] The total score ranges from 0 to 6, where ≥3 was considered as the cutoff point indicating the presence of depression.[28] In the present study, the Cronbach's alpha was 0.77.

Anxiety

The two-item Generalized Anxiety Disorder (GAD-2) scale was used for assessing the presence of anxiety. Participants are asked how often they experienced the two core criteria for anxiety disorders over the past two weeks (ie, "Feeling nervous, anxious or on edge", and "Not being able to stop or control worrying"), which are responded to on a 4-point Likert scale (0= not at all, 1= several days, 2=more than half the days, 3=nearly every day).[28,30] The total score ranges from 0 to 6, where ≥3 was considered as the cutoff point indicating the presence of anxiety.[28] In the present study, the Cronbach's alpha was 0.77.

Internet Addiction

Young's Internet Addiction Test (IAT) was used for assessing the risk of internet addiction. The scale comprises 20 items (eg, "Do you choose to spend more time online over going out with others") which are responded to on a 6-point Likert scale from 0 (Not applicable) to 5 (Always).[31] The total score ranges from 20 to 100. As the prior Bangladeshi studies used different cutoff scores, the present study followed these schemes for a better comparison even though they are not consistent across studies and different operational definitions apply to different cutoffs. At least four cutoff classification systems have been used to assess problematic internet use in Bangladesh. The first set of cutoff scores were those

originally reported by Widyanto and McMurran:[31] <20 [absence of addiction], 20–39 [low level of addiction and average online user], 40–69 [moderate addiction], and 70–100 [severe internet addiction]. The second cutoff score was ≥50 for "problematic internet use".[9] The third cutoff score was ≥60 for "excessive internet use".[32] Finally, the fourth cutoff score was ≥80 for "severe internet dependency".[8] In the present study, the Cronbach's alpha was 0.91.

Statistical Analysis

From the responses in the Google Forms, the data were coded and prepared for final analysis in Microsoft Excel 2019. Formal analyses were performed by the IBM SPSS Statistics version 25. Descriptive statistics such as frequencies, percentages, means, and standard deviations were calculated. One-way ANOVAs were carried-out to identify if there were any significant IAT mean score differences within the studied variables. The p-value for significance was $p<0.01$. Finally, socio-demographic and behavioral health-related variables, online use behaviors, smartphone addiction, Facebook addiction, depression and anxiety were included in the hierarchical regression analyses with problematic internet use as the dependent variable. The normality of distribution (skewness and kurtosis values) and multicollinearity (VIF and tolerance values) were tested, and no issues were found.

Results
Characteristics of the Participants

In the total sample (N=601), more than half of the respondents were male students (57.2%) and 65.2% reported that they were currently studying at university. A larger proportion of the participants came from a nuclear family (78.0%), were single in relationship status (79.5%), and lived with the family (87.0%) during the time of the survey. Additionally, 44.6% belonged to a family having more than 30,000 BDT monthly family income (ie, upper class). Half of the participants performed physical activity, and 10.2% suffered from chronic illnesses. More than half of the participants reported using the internet for more than five hours every day (53.2%). Most participants reported using the internet for texting or communication (96.7%), social media browsing (95.5%), video streaming (92.5%), and engaging in educational purposes (84.2%). Using the thresholds outlined in the "Measures" section, a large proportion of the sample was reported as being at

risk of problematic smartphone use (86.9%) and problematic Facebook use (39.4%) although the cutoffs for both instruments were arguably very low. Finally, approximately one-third of the sample reported as being at risk of probable depression (43.3%) and anxiety (32.6%) (Table 1).

Prevalence Rates of Problematic Internet Use

A total of 4% of the sample were classed as being at risk of internet addiction (ie, "severe internet dependency" scoring over ≥80 out of 100 on the IAT), whereas 49.1% scored as being problematic internet users (scoring ≥50 out of 100 on the IAT).

Problematic Internet Use Within the Studied Variables

Table 1 presents the distribution of the variables with problematic internet use (here, PIU is a continuous variable based on IAT score). There was no significant gender difference in problematic internet use scores ($p=0.653$). In relation to student status, medical students had higher problematic internet use scores compared to university and high school students ($p<0.001$). Similarly, students in a relationship were significantly more likely to be problematic internet users, followed by single and married participants (54.98 [SD±16.70], 50.29 [SD±15.97], and 42.01 [SD±16.17], respectively; $p<0.001$). The problematic internet use score was also reported higher among participants who did not exercise regularly (54.14 [SD±15.40] vs 45.80 [SD±16.18]; $p<0.001$) The more time spent online, the more likely individuals were of being problematic internet users ($p<0.001$). In relation to types of online use, messaging/chatting ($p<0.001$), gaming ($p=0.018$), video streaming ($p=0.051$), social media use ($p<0.001$), news sites surfing ($p=0.003$), and other (eg, job searching, scholarship searching, etc.) ($p=0.047$) were significantly associated with problematic internet use. Additionally, all of the psychopathological variables, including smartphone addiction, Facebook addiction, depression, and anxiety, were significantly associated with problematic internet use (Table 1).

Correlations of the Variables with Problematic Internet Use

Table 2 shows the correlation matrix of the continuous variables with internet addiction. All the variables showed

Table 1 Distribution of the Studied Variables with Problematic Internet Use Score

Variables	n (%)	Mean and SD	p-value
Socio-demographic variables			
Gender			
Male	344 (57.2)	49.79 ± 16.48	0.653
Female	257 (42.8)	50.39 ± 16.13	
Educational status			
University	394 (65.6)	49.11 ± 15.58	<0.001
Medical college	178 (29.6)	54.34 ± 16.21	
High school	29 (4.8)	36.41 ± 17.79	
Current residence			
Rural	149 (24.8)	49.82 ± 16.65	0.847
Urban	452 (75.2)	50.12 ± 16.22	
Monthly family income (BDT)			
<15,000	106 (17.6)	48.28 ± 17.19	0.187
15,000–3000	227 (37.8)	51.51 ± 15.50	
>30,000	268 (44.6)	49.51 ± 16.58	
Family type			
Joint	132 (22.0)	50.53 ± 15.95	0.698
Nuclear	469 (78.0)	49.91 ± 16.43	
Relationship status			
Single	478 (79.5)	50.29 ± 15.97	<0.001
In a relationship	67 (11.1)	54.98 ± 16.70	
Married	56 (9.3)	42.01 ± 16.17	
Currently living with family			
No	78 (13.0)	47.98 ± 16.69	0.232
Yes	523 (87.0)	50.35 ± 16.25	
Behavioral health-related questions			
Daily sleeping hour			
Less than 6 hours	69 (11.5)	50.82 ± 18.08	0.163
6 to 7 hours	324 (53.9)	48.89 ± 15.62	
More than 7 hours	208 (34.6)	51.59 ± 16.70	
Physical exercise			
No	306 (50.9)	54.14 ± 15.40	<0.001
Yes	295 (49.1)	45.80 ± 16.18	
Smoking status			
No	550 (91.5)	50.02 ± 16.10	0.883
Yes	51 (8.5)	50.37 ± 18.67	
Perceived health status			
No	536 (89.2)	49.80 ± 16.25	0.293
Yes	65 (10.2)	52.06 ± 16.84	
Online use behaviors			
Daily internet use time			
Less than 2 hours	23 (3.8)	31.78 ± 11.06	<0.001
2 to 3 hours	114 (19.0)	42.99 ± 13.28	
4 to 5 hours	144 (24.0)	46.06 ± 13.27	
More than 5 hours	320 (53.2)	55.67 ± 16.43	

(*Continued*)

Table 1 (Continued).

Variables	n (%)	Mean and SD	p-value
Purpose of online use (yes)			
Educational	506 (84.2)	49.61 ± 15.87 vs 52.38 ± 18.44	0.128
Messaging	581 (96.7)	50.50 ±16.03 vs 36.90 ± 19.26	<0.001
Gaming	148 (24.6)	52.79 ± 16.68 vs 49.15 ± 16.11	0.018
Video	556 (92.5)	50.41 ± 16.17 vs 45.48 ± 17.53	0.051
Social media	574 (95.5)	50.83 ± 16.01 vs 33.37 ± 13.85	<0.001
Shopping	128 (21.3)	49.52 ± 16.60 vs 50.19 ± 16.25	0.681
News	379 (63.1)	48.54 ± 15.68 vs 52.61 ± 17.08	0.003
Others	405 (67.4)	50.96 ± 16.03 vs 48.15 ± 16.77	0.047
Psychopathological factors			
Smartphone addiction			
Risk of addiction	522 (86.9)	51.07 ± 15.76	<0.001
Normal	79 (13.1)	30.60 ± 14.62	
Facebook addiction			
Risk of addiction	237 (39.4)	62.73 ± 12.74	<0.001
Normal	364 (60.6)	41.79 ± 12.70	
Depression			
Probable depression	260 (43.3)	57.68 ± 16.10	<0.001
Normal	341 (56.7)	44.22 ± 13.91	
Anxiety			
Probable anxiety	196 (32.6)	60.56 ± 15.16	<0.001
Normal	405 (67.4)	44.96 ± 14.31	

Table 2 Correlations Among Selected Continuous Variables

Variables	Mean & SD	1	2	3	4	5
Internet addiction (1)	50.04 ± 16.31	1				
Smartphone addiction 2)	25.10 ± 4.93	0.608***	1			
Facebook addition (3)	16.00 ± 5.71	0.762***	0.556***	1		
Depression (4)	2.37 ± 1.42	0.509***	0.353***	0.411***	1	
Anxiety (5)	2.07 ± 1.57	0.536***	0.383***	0.460***	0.630***	1

Note: ***Correlation is significant at p<0.001 level (2-tailed).

a significant positive correlation. IA was significantly associated with smartphone addiction (r= 0.608), Facebook addiction (r= 0.762), depression (r = 0.509), and anxiety (r= 0.536).

Predictive Models for Problematic Internet Use

Table 3 presents four models predicting problematic internet use, which were analyzed by using multiple hierarchical regression. Model 1 included only socio-demographic variables, whereas behavioral health-related variables were added with socio-demographics in Model 2. Model 3 considered socio-demographic, behavioral health-related variables and online activities, and the final model (ie,

Model 4) additionally added psychopathological variables. All models were associated with problematic internet use except Model 1 (p=0.404). Model 2 explained 8.2% of the variance for problematic internet use. This variance rose to 26.2% in Model 3 after online use behaviors were added. The final model explained 70.6% of the variance for problematic internet use after smartphone addiction, Facebook addiction, depression was added (Table 3).

Discussion

Over the past two decades, the internet has become essential in people's daily lives. In the COVID-19 context, the internet is being used as the main source of COVID-19-related

Table 3 Predictive Models for Problematic Internet Use

Variables	Model 1 [R²=0.012, F=1.037, ΔR²=0.000, p=0.404]			Model 2 [R²=0.082, F=4.773, ΔR²=0.065, p<0.001]			Model 3 [R²=0.262, F=10.291, ΔR²=0.236, p<0.001]			Model 4 [R²=0.706, F=57.558, ΔR²=0.693, p<0.001]		
	B	**S.E.**	**β**	**B**	**S.E.**	**β**	**B**	**S.E.**	**β**	**B**	**S.E.**	**β**
Constant	51.447	4.902		61.238	5.531		21.035	7.226		2.853	4.694	
Gender[a]	0.478	1.389	0.015	−1.087	1.390	−0.033	0.037	1.324	0.001	−0.978	0.846	−0.030
Educational status[b]	−0.233	1.173	−0.008	−0.407	1.146	−0.014	0.621	1.069	0.022	−0.785	0.680	−0.028
Current residence[c]	0.597	1.610	0.016	0.056	1.575	0.001	−0.042	1.435	−0.001	−0.519	0.915	−0.014
MFI[d]	0.259	0.937	0.012	−0.033	0.913	−0.001	−0.626	0.832	−0.028	0.455	0.530	0.021
Family type[e]	−1.200	1.632	−0.030	−1.917	1.582	−0.049	−2.440	1.442	−0.062	−1.513	0.916	−0.038
Relationship status[f]	−2.481	1.072	−0.096	−2.781	1.046	−0.107	−1.681	0.961	−0.065	−0.283	0.612	−0.011
CLWF[g]	2.262	2.055	0.047	1.115	2.011	0.023	−1.575	1.870	−0.032	−0.445	1.187	−0.009
DSH[h]				0.386	1.031	0.015	0.415	0.947	0.016	0.571	0.603	0.022
Physical exercise[g]				−8.679	1.345	−0.266	−5.732	1.252	−0.176	−2.191	0.810	−0.067
Smoking status[g]				1.382	2.385	0.024	1.808	2.203	0.031	2.097	1.401	0.036
Perceived health status[g]				2.208	2.107	0.042	0.915	1.912	0.017	−0.339	1.216	−0.006
DIUT[i]							6.000	0.685	0.330	2.123	0.455	0.117
Educational[g]							−3.757	1.720	−0.084	−0.934	1.095	−0.021
Messaging[g]							9.243	3.773	0.102	0.041	2.461	0.000
Gaming[g]							2.179	1.481	0.058	1.828	0.945	0.048
Video watching[g]							0.933	2.407	0.015	0.313	1.528	0.005
Social media[g]							13.624	3.083	0.173	3.163	2.009	0.040
Shopping[g]							−0.531	1.497	−0.013	−0.459	0.950	−0.012
News[g]							−2.969	1.311	−0.088	−2.199	0.834	−0.065
Others[g]							1.968	1.314	0.057	0.967	0.839	0.028
Smartphone addiction										0.596	0.100	0.180
Facebook addiction										1.417	0.086	0.496
Depression										1.315	0.348	0.115
Anxiety										1.341	0.325	0.129

Notes: [a]1 = Male, 2 = Female; [b]1 = University, 2 = Medical college, 3 = High school; [c]1 = Rural, 2 = Urban; [d]1 = Less than 15,000 BDT, 2 = 15,000 to 30,000 BDT, 3 = More than 30,000 BDT; [e]1 = Joint, 2 = Nuclear; [f]1 = Single, 2 = In a relationship, 3 = Married; [g]1 = Yes, 0 = No;.[h]1 = Less than 6 hours, 2 = 6 to 7 hours, 3 = More than 7 hours; [i]1 = Less than 2 hours, 2 = 2 to 3 hours, 3 = 4 to 5 hours, 4 = More than 5 hours.
Abbreviations: MFI, Monthly family income; CLWF, Currently living with the family; DSH, Daily sleeping hour; DIUT, Daily internet use time.

information and suggests there has been greater engagement with the internet than prior to the pandemic.[33] Additionally, internet engagement has increased among students because face-to-face interaction and activities have been restricted. More specifically, students have had to engage in online teaching, and because of the reduced face-to-face contact, are more likely to be engaging in other online activities such as social media use and online gaming.[16,34] Therefore, problematic internet-related coping behavior appears to have increased during the COVID-19 pandemic, leading to

Table 4 Comparison of Results in the Present Study with the Bangladeshi Studies Carried Out Prior to the COVID-19 Pandemic

Variables	The present study	Mamun et al.[9]	Hassan et al.[37]	Chandrima et al.[8]	Mamun et al[10]
Daily internet use time					
Less than 2 hours	3.8%	30.6%	39.5%	51.8%	–
2 to 3 hours	19.0%	30.6%	25.3%	48.2%; more than 2h	–
4 to 5 hours	24.0%	15.6%	35.2%, more than 3h		–
More than 5 hours	53.2%	20.7%			–
Purpose of online use (yes)					
Educational	84.2%	82.2%	–	92.8%	81.3%
Messaging	96.7%	90.6%	19.6%	68.8%	88.3%
Gaming	24.6%	42.5%	7.5%	61.4%	44.3%
Video	92.5%	87.7%	15.0%	26.3%	86.9%
Social media	95.5%	84.7%	54.4%	–	83.8%
Shopping	21.3%	45.9%	–	–	45.1%
News	63.1%	–	–	50%	–
Other	67.4%	–	3.5%	–	–

a greater risk of internet addiction across different cohorts.[34–36] One study reported that the prevalence of severe internet dependence rose 23% during COVID-19 pandemic.[33]

Table 4 provides a comparison of results in the present study with online use behaviors in previous Bangladeshi studies assessing similar variables. The findings indicate that internet use in the present study appears to have greatly increased during the COVID-19 pandemic. For instance, 53.2% of the participants in the present study reported using the internet more than five hours daily, compared to 20.7% in a previous study.[9] Similarly, using the internet for educational purposes, instant messaging, video streaming, and social media browsing were higher than in previous studies, although the amount of time spent on gaming online and shopping online was lower during the lockdown compared to other studies.[8–10,37] Due to home confinement, there may be increased face-to-face interaction with their family members and/or parents may have monitored their children's online activity more than usual, which may have decreased the amount of time their children spent gaming online. In addition, given the ongoing economic disruption and crisis due to the pandemic, it is not surprising that a lower proportion of the participants spent time online shopping than before the pandemic.

The present study found 49.1% of the participants were classed as being problematic internet users (scoring 50 or more out of 100 on the IAT), and 4% were classed as being at risk of being addicted to the internet (ie, scoring over ≥80 on IAT). The main problem in trying to make comparisons across studies is that all the studies (i) comprise self-selected samples, (ii) comprise different cohort samples, and (iii) even when using the same instrument (mostly the IAT), the study authors used different cutoffs.[24,38] Table 5 provides a comparison of problematic internet use prevalence rates between the present study and the previous ones despite these problems. As aforementioned, based on the present study's findings, internet engagement appears to have been increased as of the ongoing pandemic, and that may have resulted in an increase in problematic internet use.

Problematic use of the internet can disrupt individuals' quality of life and reduce the amount of time spent on offline social activities and educational/occupational duties. Severe dependency on internet use may also lead to adverse psychological consequences.[13,16] The present study found that using the internet for educational purposes was not significantly associated with problematic internet use, which reflects their controlled use. However, other online activities such as texting, social media

Table 5 Comparison of the Problematic Internet Use Rates with the Prior Bangladeshi Studies Prior to the COVID-19 Pandemic (Adapted from Griffiths and Mamun[24])

Authors (Year Published)	Study Population Details; City	Assessment Tool; Cutoff Points	Main Findings
The present study	601 university, medical and high school students (17 to 25 years); entire Bangladesh	Internet Addiction Test; <20 = absence of addiction, 20–39 = low level of addiction and average online user, 40–69 = moderate addiction, 70–100 = severe internet addiction; and (ii) ≥50, ≥60, and ≥80.	26%, 58.6% and 13% had low, moderate and severe internet addiction, respectively; 49.1% problematic users [≥50 IAT]; 30.6% [≥60 IAT]; 4% [≥80 IAT]
Afrin et al (2017)	279 high school students (14–17 years); Chittagong	Internet Addiction Survey (Yes/No; total score 9); <3 = normal internet user; 4 to 6 = moderate internet user; ≤7 = severe user	2.5% severely addicted to the internet, 64.9% moderately addicted to the internet
Hassan et al (2020)	454 adults (19–35 years); Chittagong, Dhaka, Sylhet	Internet Addiction Test; 20–49 = average internet user, ≥ 50 = internet addicted	27.1% prevalence of internet addiction
Islam & Hossin (2016)	573 university students (20–30 years); Dhaka	Internet Addiction Test; ≥50 = moderate, excessive, or problematic internet user	24% problematic internet users
Jahan et al (2019)	390 university medical students (18–26 years); Dhaka	Internet Addiction Survey (Yes/No; total score 9); <3 = normal internet user; 4 to 6 = moderate internet user; ≤7 = severe user	31.5% normal users, 49.2% and 19.3% moderately addicted users and severely internet addicted users, respectively
Karim & Nigar (2014)	177 university students (18–25 years); Dhaka	18-item Bangla Internet Addiction Test (total 90); <36 = minimal internet user, 36–62 = moderate internet user, >62 = excessive internet user	63.95% minimal internet users, whereas 34.3% and 1.7% moderate internet users and excessive internet users, respectively
Khan (2012)	797 high school students (mean age = 16.5 years); Dhaka	Internet Addiction Test; Not reported	20.20% reported as having "internet addiction disorder"
Mamun, Hossain et al (2019)	405 university students (mean age = 20.2 years); Dhaka	Internet Addiction Test; ≥50 = moderate to high or problematic internet user	32.6% problematic internet users
Mamun, Rafi et al (2019)	284 graduate students (mean age = 21.1 years); Rajshahi	Internet Addiction Test; < 60= non-excessive internet users; ≥ 60 = excessive internet users	0% internet addicted, but 3.9% classed to be excessive internet users
Mostafa et al (2019)	379 medical and university students (18–30 years); Chittagong	Internet Addiction Test; <20 = normal internet user; 20–49 = mild internet user; 50–79 = moderate internet user; 80–100 = severe internet user	54.9% mild problematic users, and 1.06% severely internet addicted
Uddin et al (2016)	475 university students (18–25 years); Dhaka	Internet Addiction Test; ≤30 = normal internet user; 31–49 = mild internet user; 50–79 = moderate internet user; ≥80 = severe or excessive internet user	46.1% severely internet addicted, 30.5% moderately addicted and 14.2% mildly addicted
Chandrima et al (2020)	350 high school students (13 to 17); Dhaka	Internet Addiction Test; ≥50 = problematic internet user, ≥80 = severe internet dependency	24.0% problematic internet users and 2.6% severe dependency on the internet

browsing, and watching online videos were significantly associated with problematic internet use. Unsurprisingly, smartphone addiction and Facebook addiction were independently reported to be the significant risk predictors of problematic internet use and is the first time that this has been reported in Bangladesh studies. Other psychological variables, such as depression and anxiety were risk factors of problematic internet use as has been reported in the

previous Bangladeshi studies.[9,39] Such findings were expected given that individuals frequently engage in excessive internet use to cope up with and help alleviate psychological distress.[17,32]

One previous Bangladeshi study examining adolescents, reported that 36% of the variance of problematic internet use was explained by demographic factors (ie, academic performance, pocket money, father's and mother's education, and mother's occupation) and internet use behavior variables (ie, weekly use frequency, daily use frequency, place where internet is used, device on which internet is used, most frequently used apps, and frequent internet activities), and which increased to 43% variance after adjusting for parental mediation.[8] Another study assessing problematic internet use during the COVID-19 pandemic found that only 6% variance of problematic internet use was explained by socio-demographic factors (ie, educational qualification, marital status, and family type), lifestyle factors (ie, smoking status, sleeping hours, physical exercise, doing household chores), online use behavior-related factors (ie, internet using hours, playing online games, social media purposes, and recreational activities).[23] The present study found 26.2% variance of problematic internet use was explained by socio-demographic factors, behavioral health-related variables, and online use behaviors. The variance for problematic internet use was 70.6% when smartphone addiction, Facebook addiction, depression, and anxiety were added to the model.

The present study has a number of limitations that should be considered when interpreting the findings. The study was (i) cross-sectional, (ii) comprised online self-reporting data, and (iii) comprised a non-representative student sample. Additionally, other factors (such as the degree of loneliness due to the lockdown, sleep problems, etc.) were not considered in this study.[40] All of these factors limit the generalizability of the findings. Future research would benefit from longitudinal research using more representative samples.

Conclusion

The present study provides a comparison of Bangladeshi internet use behaviors and problematic internet use prevalence rates during the COVID-19 pandemic with the prior studies. Based on the present findings, it appears that the ongoing COVID-19 pandemic has increased the prevalence of problematic internet use behaviors. Therefore, health-and-control use strategies and programs should be implemented to decrease problematic internet use among vulnerable individuals to problematic internet use.

Educational institutes should implement interventions to reduce problematic internet use among the students.

Disclosure

The authors reported no conflicts of interest for this work.

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