



Research article

Prevalence and determinants of internet addiction among adults during the COVID-19 pandemic in Bangladesh: An online cross-sectional study

Poly Rani Biswas^a, Benojir Ahammed^{a,*}, Md. Shiafur Rahman^a, Byazid Mahin Nirob^a, Md. Tanvir Hossain^b^a Statistics Discipline, Science, Engineering & Technology School, Khulna University, Khulna 9208, Bangladesh^b Sociology Discipline, Social Science School, Khulna University, Khulna 9208, Bangladesh

ARTICLE INFO

Keywords:

COVID-19
Internet addiction
Prevalence
Adult
Bangladesh

ABSTRACT

Background: Globally, internet use has increased significantly during the COVID-19 pandemic, and internet addiction (IA) has become a severe public health issue. Therefore, this study aimed to assess IA prevalence among adults and identify its determinants during the COVID-19 pandemic in Bangladesh.**Methods:** Using a cross-sectional design, this study recruited 608 participants through a self-administered online-based e-questionnaire. Young's internet addiction test (YIAT) of 20 items was used to assess the prevalence of IA among adults in Bangladesh. Bivariate and binary logistic regression analyses explored the factors influencing IA.**Results:** The overall prevalence of IA was 29.4% among adults during the COVID-19 pandemic. However, the addiction rate was 34.7% among participants under 20 years old. Tobacco smoking (AOR = 1.88, 95% CI 1.15–3.07) and spending more time on the internet during the COVID-19 pandemic (AOR = 2.06, 95% CI 1.08–3.94) were likely the reasons for IA among Bangladeshi adults. Participants aged over 24 years (AOR = 0.39, 95% CI 0.17–0.91), living in rural areas (AOR = 0.51, 95% CI 0.32–0.81), living away from family (AOR = 0.45, 95% CI 0.26–0.79), attached to physical activity (AOR = 0.35, 95% CI 0.24–0.52), and sleeping less than or equal 6 hours (AOR = 0.63, 95% CI 0.42–0.93) had a lower chance of IA during the COVID-19 pandemic.**Conclusion:** This study has shown that the prevalence of IA was comparatively higher among younger participants during the COVID-19 pandemic. Smoking, long-time use of the internet, physical activity status, and sleeping duration were the most significant determinants of IA. Thus, raising awareness among the younger generation is the most important strategy to reduce IA. The findings of this study can be used to support health and educational organizations to design their programs, which will help prevent IA in Bangladesh during the COVID-19 pandemic.

1. Introduction

Internet addiction (IA) refers to an unhealthy and poorly regulated preoccupation with the internet resulting in impulsive behaviors and psychiatric impairments (Shaw and Black, 2008). The concept of IA was brought to light by Griffiths (1996); however, Young (1998) successfully characterized IA as an 'impulse-control disorder' free of intoxication. Due to the realization of the potential adverse impacts, it can have on the behavioral and functional aspects of an individual, IA has been included as a non-substance addictive disorder in the DSM-5 (American Psychiatric Association, 2013). IA may cause difficulties in personal and social life (Diomidous et al., 2016), and its harmful effects may include compulsive behavior, poor sleep quality, reduced food consumption, attention deficit, resistance towards family and academic obligations,

and decreased academic grades, as well as psychological problems, such as depression and anxiety (Alam et al., 2014; American Psychiatric Association, 2013; Bener et al., 2019; Young, 1998).

Despite posing a substantial threat to significant life domains, including interpersonal and intrapersonal relations and physical and mental health (Alam et al., 2014; Young, 1998), reliance on the internet has been increasing worldwide at a dramatic rate. Globally, for example, 64% of people were using the internet in 2020, with a penetration rate of 64.2%. Although Asia has the highest number of internet users in the world (2.7 billion), North America has the highest penetration rate (89.9%) (Internet World Statistics, 2021). This growing internet use among people, particularly the younger population (Zenebe et al., 2021), has contributed to IA. For instance, a meta-analysis comprising 164 studies ($N = 89,281$) from seven world regions estimated a global

* Corresponding author.

E-mail addresses: benojirstat@gmail.com, benojirstat@ku.ac.bd (B. Ahammed).<https://doi.org/10.1016/j.heliyon.2022.e09967>

Received 23 June 2021; Received in revised form 26 June 2021; Accepted 12 July 2022

2405-8440/© 2022 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

prevalence of 6% for IA, with the highest prevalence reported in the Middle East (10.9%), followed by North America (8%) and Asia (7.1%) (Cheng and Li, 2014). Like other countries, Bangladesh has been experiencing IA, especially among its younger population, as they are more exposed to internet-related activities than their older counterparts. Studies suggest that young men, primarily students from economically well-off families living in urban areas, who spend more hours on the internet for academic or non-academic purposes, are more susceptible to IA (Afrin et al., 2017; Hassan et al., 2020).

However, the world may have witnessed an unprecedented spike in IA due to the ongoing novel coronavirus disease of 2019 (COVID-19) pandemic, which originated in Wuhan, in the Hubei province of China (Forster et al., 2020). Unlike its predecessors – severe acute respiratory syndrome (SARS) in 2002 and the Middle East respiratory syndrome (MERS) in 2012 – which had a high-case fatality rate (Deng and Peng, 2020), COVID-19 has an exceptionally high human-to-human transmission rate, thus, compelling the global public health watchdog – the World Health Organization (WHO) – to declare a global pandemic on 11 March 2020 (World Health Organization, 2020). In the absence of specific antidotes or vaccines, it became a global challenge during 2020 for national and international public health agencies to curb the spread and loss of lives. By April 2021, 140 million people were infected with COVID-19, and it had killed over three million people worldwide (World Health Organization, 2021a); there were over 0.7 million confirmed COVID-19 cases in Bangladesh, with around 11,000 resulting deaths (World Health Organization, 2021b). Therefore, the global community implemented a wide range of non-therapeutic measures, including restricting the travel of foreign nationals, closing entire transit systems as well as public spaces, and shutting down educational institutions (Ahmed et al., 2020; Cao et al., 2020) as well as more stringent steps like country-wide lockdowns (Chen and Yuan, 2020; Cohen and Kupferschmidt, 2020). Like other countries, Bangladesh suspended all forms of academic activities from 18 March following the first confirmed case of the COVID-19 on 8 March 2020 and implemented a lockdown in the guise of ‘general holidays’ from 26 March 2020, and this was extended at regular intervals until early September 2020 (Jahid, 2020). This prolonged ‘home confinement’ significantly affected the mental well-being of different cohorts of people, causing intensified anxiety, depression, stress, fear, worsening sleep quality, and increasing substance abuse (Ahmed et al., 2021; Cao et al., 2020; Hossain et al., 2022a; Islam, Barna, Raihan, Khan and Hossain, 2020a; Shovo et al., 2021).

Subsequently, people turned to the internet and other technology-based mechanisms to ‘alleviate negative feelings’ (Kardefelt-Winther, 2014) and cope with the ‘new normal’ by supporting their work, communication, and academic activities (Ela et al., 2021; Hossain et al., 2022b). Exposure to social and mass media through the internet allowed people to receive daily updates on the pandemic situation, which improved public awareness and encouraged ‘social distancing’ and ‘home staying’ (Sakya et al., 2021). However, the sense of loneliness during the prolonged lockdown (Li et al., 2021), together with COVID-19-related anxiety and depression, were significantly associated with over-consumption of the internet and smartphone use (Elhai et al., 2020). This ‘over-exposure’ evidently led to growing anxiety and depression, particularly among the younger population (Hammad and Alqarni, 2021; Hossain et al., 2020).

Studies during the COVID-19 pandemic found heightened IA among people of different age cohorts worldwide and linked it with a wide range of factors. For example, Saralioğlu et al. (2022) noted that more than 80% of Turkish adolescents were using the internet for more than 6 hours a day during the pandemic; this was significantly influenced by parental education, habit of internet use, sense of loneliness, and family income, with the latter showing a negative relationship with internet use. A study in Taiwan noted a 24.4% prevalence of IA among junior high school students; this was significantly associated with increased impulsivity and alexithymia, low subjective well-being, and family function, especially among older students (Lin, 2020). An Indonesian study showed that the

prevalence of IA among the adult population during COVID-19 was 14.4%; this was significantly influenced by increased duration of online use for a specific application, including gaming, information seeking, entertainment, and social media usage (Siste et al., 2020). Li et al. (2021) found that the overall prevalence of IA among the general population in China was 36.7% during the COVID-19 pandemic; the associated risk factors were duration of internet use, lack of social support, growing mental stress and pressure, and addiction to videogames.

In Bangladesh, a few studies addressed IA and related issues in the pre-COVID-19 period (Afrin et al., 2017; Islam and Hossain, 2016; Jahan et al., 2019; Mamun et al., 2019); however, there has only been a single study conducted by Islam et al. (2020b), that has addressed problematic internet use (PIU) during the COVID-19 pandemic. They observed that an individual’s sociodemographic and lifestyle factors, such as online behaviors, significantly determine the presence and absence of PIU. For example, people who are younger, highly educated, living with families, engaging in low or no physical exercise, and with a habit of playing online games or use of social media for recreation are positively associated with PIU (Islam et al., 2020b). However, the authors did not estimate the prevalence rate of PIU among the citizenry of Bangladesh. Hence, this cross-sectional web-based study aimed to estimate the prevalence of IA among the adult population in Bangladesh and to identify the risk factors associated with it during the COVID-19 pandemic.

2. Materials and methods

2.1. Study design and participants

This study was web-based and cross-sectional in nature, and the data were collected online over a period of around one month, starting on 1 January 2021 and ending on 8 February 2021. It is important to note that exposure to social media has increased substantially during the COVID-19 pandemic in Bangladesh, especially among the population between 18 and 30 years in age (Hossain et al., 2020). Among the popular social media platforms, Facebook has been widely used by a mammoth 47.2 million people in Bangladesh, of which 21.2 million users were between 18 and 24 years of age (Prothom Alo, 2021). As such, the participants were recruited randomly through existing social media – i.e., Facebook – and were invited to respond to a self-administered e-questionnaire developed using Google Form. The e-questionnaire contained three separate but interrelated modules, including questions on socio-demographic information, IA measurement, and information relating to the internet and other behavioral issues during the COVID-19 pandemic. The study set out the response range for maximum questions and encouraged the participants to answer intelligently through the e-questionnaire descriptions in order to ensure the survey’s quality. This study considered only adults aged 18 years or above and recorded the participants’ consent during the data collection. A total of 608 responses were recorded, all of which were retained in this study after week-long scrutiny.

2.2. Ethical clearance

The Khulna University Ethical Clearance Committee (KUECC) approved this study (Reference No. – KUECC-2021/04/17). The participants were informed about their anonymity and the non-commercial use of information by an informed consent form attached to the e-questionnaire. Moreover, the participants were able to decline the e-survey without any prior justification. They were also assured of their right to retract the provided information within a stipulated timeline.

2.3. Internet addiction test

The IA of the participants was measured by Young’s internet addiction test (YIAT) (Young, 1998). The YIAT – the most commonly and

frequently used scale measuring the internet addiction of adults – comprises 20 items scored on a 5-point Likert scale ranging from ‘not applicable’ (0) to ‘always’ (5) with a maximum score of 100. Based on the scoring, participants were classified into ‘not internet addicted’ (0–59) and ‘internet addicted’ (60–100) (Mamun et al., 2019). The Cronbach’s alpha (α) for YIAT in this study was 0.965, reflecting an excellent internal consistency.

2.4. Socio-demographic and behavioral characteristics

In this study, a group of socio-demographic and behavioral factors was considered as explanatory variables, based on previous research, to measure effects on IA. Socio-demographic information including gender, age, occupational status, place of residence, educational qualification, and living arrangements (Prakash et al., 2020; Hassan et al., 2020) was collected. Furthermore, to ascertain fundamental behavioral factors, the survey included a few questions relating to lifestyle. The participants were asked if they smoked cigarettes and whether they were involved in physical activities such as exercise, walking, sports, cycling, or any other activities lasting at least 30 min per day (Hassan et al., 2020) during the COVID-19 pandemic. Participants were also asked to report their average, typical sleep duration during the ongoing pandemic as either short or long (Mamun et al., 2019). They were then asked how long they spent online per day, the device they used to access the internet, duration of internet use (Hassan et al., 2020), and status of internet use during the COVID-19 pandemic.

2.5. Statistical analysis

Descriptive analyses were conducted in order to describe the socio-demographic and behavioral characteristics of the participants. The prevalence of IA was stratified by age, gender, educational qualification, occupation, place of residence, living arrangement, smoking status, physical activity status, sleep duration, the device of internet use, length of internet use, status of internet use during the COVID-19 pandemic, and daily internet use duration; Chi-square (χ^2) test was used to compare the differences between the groups at a 5% level of significance. Finally, considering the statistically significant factors from the Chi-square (χ^2) test, a multivariable binary logistic regression model was conducted in order to explore the potential determinants of IA. The results were shown using the adjusted odds ratio (AOR) with 95% confidence intervals (95% CI). The statistical package for the social sciences (SPSS) version 20 (SPSS Inc., Chicago, IL, USA) was used to organize and analyze the data.

3. Results

3.1. Socio-demographic and behavioral characteristics of study participants

Table 1 shows the characteristics of the participants. Of the 608 participants, 419 (68.9%) were male and 189 (31.1%) were female. Among the participants, 58.1% were aged 20–24 years, 78.8% were students, and three out of five participants (66.4%) had completed undergraduate or postgraduate education. Four out of five participants (79.3%) resided with their families, and 66.0% lived in urban areas during the pandemic. Around 80% of participants were non-smokers, and more than half were engaged in regular physical activities (54.9%) and slept less than or equal 6 hours a day (55.3%). Among the participants, 66.4% spent more than 3 hours per day on the internet, and 69.1% admitted that their internet use had increased during the pandemic.

3.2. Prevalence of internet addiction

Table 1 also shows the prevalence (95% CI) of IA in relation to a range of socio-demographic and behavioral characteristics. The overall prevalence of IA was 29.4%. The findings indicate that participants with

distinct characteristics, such as younger people, men, those without undergraduate education, students, those living in urban areas, those living with families, smokers, those who did not engage in any physical activity, and those sleeping more than 6 hours, were more likely to show IA. In addition, Table 1 also shows the association of IA with various explanatory factors using a Chi-square (χ^2) test of independence. The findings indicate that age ($p = 0.007$), education qualification ($p = 0.039$), place of residence ($p = 0.009$), living arrangement ($p = 0.001$), smoking status ($p = 0.001$), physical activity ($p < 0.001$), sleep duration ($p = 0.001$), status of internet use ($p = 0.001$), and duration of daily internet use ($p = 0.005$) were significantly associated with IA.

3.3. Factors associated with internet addiction

Significant factors from the Chi-square (χ^2) test of independence were retained in the multivariable binary logistic regression analysis in order to investigate how these factors have influenced IA in Bangladesh (Table 2). In the multivariable model, after complete adjustments, there was robust evidence for the odds of IA being 1.88 times and 2.06 times higher among tobacco smokers (AOR = 1.88, 95% CI 1.15–3.07) and intensified internet users during the COVID-19 pandemic (AOR = 2.06, 95% CI 1.08–3.94). It is also evident that the odds of IA for older participants (>24 years) and those living in rural areas were 0.39 times (AOR = 0.39, 95% CI 0.17–0.91) and 0.51 times (AOR = 0.51, 95% CI 0.32–0.81) lower than for younger people and those living in urban areas, respectively. The odds of IA for participants living away from family were 0.45 times lower than for those living with family (AOR = 0.45, 95% CI 0.26–0.79). There was compelling evidence that the odds of IA were 65% lower among participants who were engaged in regular physical activities than among those who did not (AOR = 0.35, 95% CI 0.24–0.52). Participants who slept less than or equal 6 hours a day (AOR = 0.63, 95% CI 0.42–0.93) and those who had been exposed to internet use for over 3 years (AOR = 0.41, 95% CI 0.22–0.78) were less likely to be internet addicted than those who slept longer than 6 hours a day and those had used the internet for less than two years, respectively.

4. Discussion

This study aimed to assess the prevalence of IA and the associated risk factors among adults in Bangladesh during the COVID-19 pandemic. The findings indicate that the overall prevalence of IA among adults in Bangladesh was 29.4%, which is higher than the finding of another study (27.1%) conducted on adults during the COVID-19 pandemic (Hassan et al., 2020). Countries other than Bangladesh have also witnessed increased IA among adults during COVID-19. For example, a study in Indonesia reported a 14.4% level of IA (Siste et al., 2020), while it was 36.7% in China (Li et al., 2021). This heightened IA among adults can be attributed to their home confinement, which has led to increased use of social and electronic media for information and entertainment (Hossain et al., 2020; Siste et al., 2020). The higher response from young adults in this study could also be responsible for the higher prevalence of IA. The introduction of online education (OE), particularly in the universities of Bangladesh in late August 2020, may have boosted the use of the internet for academic purposes (Hossain et al., 2022b), thereby, increasing the risks of IA among young adults.

From the binary logistic regression, it is apparent that age, place of residence, living arrangement, tobacco smoking, regular physical activities, sleep duration, internet use, and duration of internet use during the COVID-19 pandemic significantly influenced IA, while tobacco smoking and internet use during the COVID-19 pandemic were positively associated with IA. In this study, it was observed that older people were less likely to be addicted to the internet than younger people. Because older adults in Bangladesh were more engaged in social necessities for their family members, despite the imposition of securing distancing (Hossain et al., 2021), they had relatively fewer chances to become entangled with the internet. In contrast, younger adults have experienced a rapid

Table 1. Distribution of variables of the respondents by internet addiction status.

Variables	n (%)	Internet Addiction		Chi-Square	p value
		Addicted (>60 scores) n (%)	Non addicted (≤60 scores) n (%)		
Overall	608	179 (29.4)	429 (70.6)		
Age					
<20 years	121 (19.9)	43 (34.7)	79 (65.3)	10.01	0.007
20–24 years	353 (58.1)	112 (31.7)	241 (68.3)		
>24 years	134 (22.0)	25 (18.7)	109 (81.3)		
Gender					
Female	189 (31.1)	46 (24.3)	143 (75.7)	3.44	0.645
Male	419 (68.9)	133 (31.7)	286 (68.3)		
Education qualification					
Below Undergraduate	204 (33.6)	71 (34.8)	133 (65.2)	4.25	0.039
Undergraduate and above	404 (66.4)	108 (26.7)	296 (73.3)		
Occupation					
Student	479 (78.8)	145 (30.3)	334 (69.7)	0.75	0.387
Job/Others	129 (21.2)	34 (26.4)	95 (73.6)		
Place of residence during COVID-19					
Urban	401 (66.0)	132 (32.9)	269 (67.1)	6.85	0.009
Rural	207 (34.0)	47 (22.7)	160 (77.3)		
Living arrangement during COVID-19					
Living with family	482 (79.3)	157 (32.6)	325 (67.4)	10.98	0.001
Living without family	126 (20.7)	22 (17.5)	104 (82.5)		
Smoking status during COVID-19					
No	479 (78.8)	126 (26.3)	353 (73.7)	10.68	0.001
Yes	129 (21.2)	53 (41.1)	76 (58.9)		
Physical activity status during COVID-19					
No	27 (45.1)	115 (42.0)	159 (58.0)	37.69	<0.001
Yes	334 (54.9)	64 (19.2)	270 (80.8)		
Sleep duration during COVID-19					
>6 h	272 (44.7)	102 (37.5)	170 (62.5)	15.38	0.001
≤6 h	336 (55.3)	77 (22.6)	259 (77.1)		
Device of internet use during COVID-19					
Mobile/Tab	353 (58.1)	107 (30.3)	246 (69.7)	0.32	0.853
Computer/Laptop	24 (3.9)	7 (29.2)	17 (70.8)		
Both	231 (38.0)	65 (28.1)	166 (71.9)		
Internet use experience					
<2 years	82 (13.5)	28 (34.1)	54 (65.9)	1.97	0.373
2–3 years	91 (15.0)	30 (33.0)	61 (67.0)		
>3 years	435 (71.5)	121 (27.8)	314 (72.2)		
Status of internet use during COVID-19					
Decrease	26 (4.3)	2 (7.7)	24 (92.3)	15.78	0.001
Same	162 (26.6)	34 (21.0)	128 (79.0)		
Increase	420 (69.1)	143 (34.0)	277 (66.0)		
Daily internet use (Hour) during COVID-19					
≤3 h	204 (33.6)	45 (22.1)	159 (77.9)	8.05	0.005
>3 h	404 (66.4)	134 (33.2)	270 (66.8)		

increase in internet use for academic purposes (Ela et al., 2021; Hossain et al., 2022b) as well as for entertainment, including gaming, gambling, and pornography viewing (Gjoneska et al., 2022), due to prolonged home confinement. Hence, age-specific intervention programs should be implemented to reduce the burden of IA among the younger population in Bangladesh.

This study has revealed that place of residence has a strong negative association with IA. The prevalence and risk of IA were significantly lower among rural adults than among their urban counterparts. A possible reason could be that rural people were economically hardest hit by the imposition of regional, national, and international bans on transporting agricultural products, which created an imbalance between demands for daily necessities and earning opportunities (Halim et al.,

2022; Hossain et al., 2021); thus, it would have been nearly impossible for these already marginalized rural people to spend money on the internet over other necessities, especially food and medicine. Frequent load shedding, together with low accessibility and poor online connectivity (Hossain et al., 2022b), might also have affected the possibility of rural people becoming addicted to the internet.

The findings further suggested that living arrangements were a strong determinant of IA among adults in Bangladesh. A pre-COVID-19 study indicated that living with family members reduced the possibilities of PIU (Hassan et al., 2020). In this study, interestingly, it was found that the risk of IA was lower among people living away from families during the COVID-19 pandemic; this could be because people living away from families might have been engaged in

Table 2. Multiple logistic regression analysis of variables associated with internet addiction in Bangladesh.

Variables	Coefficient β	Odds ratio, Exp (β)	95% CI		p value
			Lower	Upper	
Age					
<20 years ^{RC}		1.00			
20–24 years	-0.12	0.89	0.50	1.58	0.694
>24 years	-0.92	0.39	0.17	0.91	0.030
Gender					
Female ^{RC}		1.00			
Male	0.39	1.48	0.94	2.32	0.088
Education qualification					
Below Undergraduate ^{RC}		1.00			
Undergraduate and above	-0.02	0.97	0.62	1.52	0.902
Occupation					
Student ^{RC}		1.00			
Job/Others	0.45	1.56	0.85	2.89	0.154
Place of residence during COVID-19					
Urban ^{RC}		1.00			
Rural	-0.68	0.51	0.32	0.81	0.004
Living arrangement during COVID-19					
Living with family ^{RC}		1.00			
Living without family	-0.79	0.45	0.26	0.79	0.005
Smoking status during COVID-19					
No ^{RC}		1.00			
Yes	0.63	1.88	1.15	3.07	0.012
Physical activity status during COVID-19					
No ^{RC}		1.00			
Yes	-1.05	0.35	0.24	0.52	<0.001
Sleep duration during COVID-19					
>6 h ^{RC}		1.00			
≤6 h	-0.47	0.63	0.42	0.93	0.020
Device of internet use during COVID-19					
Mobile/Tab ^{RC}		1.00			
Computer/Laptop	-0.37	0.69	0.24	1.96	0.485
Both	-0.19	0.83	0.52	1.31	0.421
Internet use experience during COVID-19					
<2 years ^{RC}		1.00			
2–3 years	-0.31	0.74	0.38	1.45	0.374
>3 years	-0.89	0.41	0.22	0.78	0.007
Status of internet use during COVID-19					
Decrease ^{RC}		1.00			
Same	0.06	1.05	0.50	2.22	0.883
Increase	0.72	2.06	1.08	3.94	0.029
Daily internet use (Hour) during COVID-19					
≤3 h ^{RC}		1.00			
>3 h	0.34	1.39	0.85	2.30	0.186

Note: ^{RC}-Reference category.

income-generating activities (IGAs) or alternative livelihood opportunities (ALOs) to survive during the hardship of the pandemic (Ela et al., 2021; Hossain et al., 2021). Some were frustrated over the uncertainty of life and livelihood (Ela et al., 2021), and such a mental state might have reduced the risk of IA among adults living away from families in Bangladesh.

Tobacco smoking has been found to be an important indicator of IA. This study revealed that smoking was positively associated with IA. Studies conducted during COVID-19 suggested an increase in substance abuse, including tobacco smoking, among working and nonworking adults as a means of coping or self-medication when dealing with quarantine, leading to emotional disturbance and exhaustion (Gritsenko et al., 2020; Hanafi et al., 2021). Generally, smokers suffer from different

psychological problems, and they are more likely to be addicted to the internet due to attempts to relieve their mental stress through virtual entertainment.

This study found that IA was significantly lower among adults involved in regular physical activity. A Brazilian research has suggested that when individuals spent more time on physical activity, including walking, jogging, or running, to keep fit or stay healthy during the COVID-19 pandemic, they experienced fewer mental health issues such as anxiety and depression (Puccinelli et al., 2021), as they were pre-occupied with the activity. Moreover, regular physical activity improves self-control, which may reduce the risk of IA (Park et al., 2016). The findings further suggested that the prevalence and risk of IA were lower among adults who slept for less than or equal 6 hours per day. A

previous study on university students in Bangladesh documented a strong association between mental health conditions with poor sleep quality during the COVID-19 pandemic (Ahammed et al., 2021). Uncertainty over academic and professional life (Cao et al., 2020; Ela et al., 2021) together with engagement in IGAs or ALOs (Ela et al., 2021; Hossain et al., 2021) to meet the demands for daily necessities (Halim et al., 2022) might have affected the sleep quality and prevent the Bangladeshi adults from becoming addicted to the internet.

Participating adults with internet use experience of more than two years had a significantly lower risk of being internet addicted. Similar findings appeared in a previous study conducted in Ethiopia (Zenebe et al., 2021). The reason could be that long-time internet users may be busy with online-based work (Hassan et al., 2020). Participants whose internet use had increased during the COVID-19 pandemic were found to have high IA. Social media use has increased during the COVID-19 pandemic (Hossain et al., 2020), people have also been using the internet to pass time and watch different entertainment programs, which may have led to internet addiction.

4.1. Strengths and limitation

This study focused on the prevalence of IA and its determinants among Bangladeshi adults during the COVID-19 epidemic. The target population was young adults from both urban and rural areas of Bangladesh. Our study also included a high number of socioeconomic and demographic variables; this is a characteristic of people-based research in Bangladesh. The present research advances our understanding of the issue under study and has practical implications. Some limitations should be mentioned regarding the generalizability of the present study's findings. The survey was performed online, as online surveys are a popular and effective tool for a quick evaluation of a particular situation such as the COVID-19 pandemic. The data was self-reported; therefore, there was a risk of response-related bias. The selection biases might also have influenced the outcomes. Moreover, the study did not cover a nationally representative sample, as most of the participants were from the southwestern region of Bangladesh. The cross-sectional nature of the study might mean that it does not accurately explain the causal relationship between explanatory variables and internet addiction. The study assessed the presence of internet addiction among people during a sudden emergency without considering their level of internet addiction in pre-COVID-19 conditions. Despite selecting all factors influencing IA among people in an emergency, there may have been some other confounding issues that remained unattended.

5. Conclusion

There is a high prevalence of IA among adults in Bangladesh, especially since the start of the COVID-19 pandemic. IA was found to be strongly linked to socioeconomic factors, such as age, place of residence, and living arrangements, as well as behavioral factors, such as smoking status, physical activity, sleep duration, use of the internet during the pandemic, and duration of daily internet use. This type of study is critical in countries like Bangladesh, where internet use is growing faster than socio-economic development, and it becomes more necessary during unanticipated situations such as the COVID-19 pandemic. The findings of this study have substantiated the necessity and implementation of effective intervention programs. It may assist policymakers in identifying excessive internet users and reducing their overuse of the internet. Appropriate preventive measures, such as teaching students and the public about safe internet use, and counseling those already addicted to the internet, are recommended. More interventions should strengthen self-control, build positive core self-evaluations, and optimize social adjustment, especially during emergencies. Finally, to properly assess IA in Bangladesh, more research is encouraged, particularly a nationally representative sample, in order to minimize non-substance addiction.

Declarations

Author contribution statement

Poly Rani Biswas: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Benojir Ahammed: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Md. Shiafur Rahman; Byazid Mahin Nirob: Performed the experiments; Contributed reagents, materials, analysis tools or data.

Md. Tanvir Hossain: Analyzed and interpreted the data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Acknowledgements

We appreciate all the participants as well as the anonymous reviewers.

References

- Afrin, D., Islam, M.-U., Rabbi, F., Hossain, A., 2017. The school-level factors associated with internet addiction among adolescents: a cross-sectional study in Bangladesh. *J. Addict. Depend.* 3 (2), 170–174.
- Ahammed, B., Jahan, N., Seddeque, A., Hossain, M.T., Shovo, T.-E.A., Khan, B., et al., 2021. Exploring the association between mental health and subjective sleep quality during the COVID-19 pandemic among Bangladeshi university students. *Heliyon* 7 (5) e07082.
- Ahmed, M.Z., Ahmed, O., Aibao, Z., Hanbin, S., Siyu, L., Ahmad, A., 2020. Epidemic of COVID-19 in China and associated psychological problems. *Asian J. Psychiatr.* 51, 102092.
- Alam, S.S., Hashim, N.M.H.N., Ahmad, M., Wel, C.A.C., Nor, S.M., Omar, N.A., 2014. Negative and positive impact of internet addiction on young adults: empirical study in Malaysia. *Intang. Cap.* 10 (3), 619–638.
- American Psychiatric Association, 2013. *Diagnostic and Statistical Manual of Mental Disorders*. American Psychiatric Association. Arlington, Virginia.
- Bener, A., Yildirim, E., Torun, P., Çatan, F., Bolat, E., Aliç, S., et al., 2019. Internet addiction, fatigue, and sleep problems among adolescent students: a large-scale study. *Int. J. Ment. Health Addiction* 17 (4), 959–969.
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., Zheng, J., 2020. The psychological impact of the covid-19 epidemic on college students in China. *Psychiatr. Res.* 287, 112934.
- Chen, L., Yuan, X., 2020. China's ongoing battle against the coronavirus: why did the lockdown strategy work well? *Socio-Ecological Practice Research*, 1–6.
- Cheng, C., Li, A.Y.-I., 2014. Internet addiction prevalence and quality of (real) life: a meta-analysis of 31 nations across seven world regions. *Cyberpsychol., Behav. Soc. Netw.* 17 (12), 755–760.
- Cohen, J., Kupferschmidt, K., 2020. Countries test tactics in 'war' against COVID-19. *Science* 367 (6484), 1287.
- Deng, S.Q., Peng, H.J., 2020. Characteristics of and public health responses to the coronavirus disease 2019 outbreak in China. *J. Clin. Med.* 9 (2), 575.
- Diomidous, M., Chardalias, K., Magita, A., Koutonias, P., Panagiotopoulou, P., Mantas, J., 2016. Social and psychological effects of the internet use. *Acta Inf. Med.: Journal of Academy of Medical Sciences of Bosnia and Herzegovina* 24 (1), 66–68.

- Ela, M.Z., Shohel, T.A., Shovo, T.-E.A., Khan, L., Jahan, N., Hossain, M.T., Islam, M.N., 2021. Prolonged lockdown and academic uncertainties in Bangladesh: a qualitative investigation during the COVID-19 pandemic. *Heliyon* 7 (2) e06263.
- Elhai, J.D., Yang, H., McKay, D., Asmundson, G.J.G., 2020. COVID-19 anxiety symptoms associated with problematic smartphone use severity in Chinese adults. *J. Affect. Disord.* 274, 576–582.
- Forster, P., Forster, L., Renfrew, C., Forster, M., 2020. Phylogenetic network analysis of sars-cov-2 genomes. *Proc. Natl. Acad. Sci. USA* 117 (17), 9241–9243.
- Gjoneska, B., Potenza, M.N., Jones, J., Corazza, O., Hall, N., Sales, C., Grünblatt, E., Martinotti, G., Burkauskas, J., Werling, A.M., Walitza, S., Zohar, J., Menchón, J.M., Király, O., Chamberlain, S.R., Fineberg, N.A., Demetrovics, Z., 2022. Problematic use of the internet during the COVID-19 pandemic: good practices and mental health recommendations. *Compr. Psychiatr.* 112, 152279.
- Griffiths, M.D., 1996. Internet 'addiction': an issue for clinical psychology? *Clin. Psychol. Forum* 97, 32–36.
- Gritsenko, V., Skugarevsky, O., Konstantinov, V., Khamenka, N., Marinova, T., Reznik, A., Isralowitz, R., 2020. COVID 19 fear, stress, anxiety, and substance use among Russian and Belarusian university students. *Int. J. Ment. Health Addiction* 1–7.
- Hanafi, E., Siste, K., Limawan, A.P., Sen, L., Christian, H., Murtani, B.J., Adrian Siswidiani, L.P., Suwartono, C., 2021. Alcohol- and cigarette-use related behaviors during quarantine and physical distancing amid COVID-19 in Indonesia. *Front. Psychiatr.* 12, 622917.
- Halim, S.F.B., Mridha, S., Nasrin, N., Islam, M.K., Hossain, M.T., 2022. Socioeconomic crisis and mental health stress among the middle-income group during the covid-19 pandemic. *Socio. Spectr.* 42 (2), 119–134.
- Hammad, M.A., Alqarni, T.M., 2021. Psychosocial effects of social media on the Saudi society during the coronavirus disease 2019 pandemic: a cross-sectional study. *PLoS One* 16 (3) e0248811.
- Hassan, T., Alam, M.M., Wahab, A., Hawlader, M.D., 2020. Prevalence and associated factors of internet addiction among young adults in Bangladesh. *J. Egypt. Publ. Health Assoc.* 95 (1), 3.
- Hossain, M.T., Ahammed, B., Chanda, S.K., Jahan, N., Ela, M.Z., Islam, M.N., 2020. Social and electronic media exposure and generalized anxiety disorder among people during COVID-19 outbreak in Bangladesh: a preliminary observation. *PLoS ONE* 15 (9) e0238974.
- Hossain, M.T., Lima, T.R., Ela, M.Z., Khan, L., Ahmed, F., Shovo, T.-E.-A., Masud, A.A., Rahman, K., Rahman, S., 2021. Livelihood challenges healthcare seeking behavior of fishermen amidst the pandemic the Sundarbans mangrove forest of. *Aquaculture* 546, 737348.
- Hossain, M., Jahan, N., Ahammed, B., Shohel, T.A., Shovo, T.-E.-A., Khan, B., Islam, M.N., 2022a. A psychometric evaluation of fear of scale (FCV-19s). *Hellenic J. Psychol.* 19 (1), 40–52.
- Hossain, M.T., Nishu, N.A., Jahan, N., Saadia, H., Ela, M.Z., Moshur-Ul-Alam, Q., Hossain, M.Z., 2022b. Challenges of participating in online education/distance learning amidst the COVID-19 pandemic: The response from students and teachers. In: Islam, M.R., Santosh Kumar, B., Lamhot, N. (Eds.), *Handbook of Research on Asian Perspectives of the Educational Impact of COVID-19*. IGI Global, Hershey, PA, USA, pp. 254–281.
- Internet World Statistics., 2021, 31 March. World internet users and 2021 population stats. <https://www.internetworldstats.com/stats.htm>.
- Islam, M.A., Hossain, M.Z., 2016. Prevalence and risk factors of problematic internet use and the associated psychological distress among graduate students of Bangladesh. *Asian J. Gambi Issues Public Health* 6 (1), 1–14.
- Islam, M.A., Barna, S.D., Raihan, H., Khan, M.N.A., Hossain, M.T., 2020a. Depression and anxiety among university students during the COVID-19 pandemic in Bangladesh: a web-based cross-sectional survey. *PLoS One* 15 (8) e0238162.
- Islam, M.S., Sujon, M.S.H., Tasnim, R., Ferdous, M.Z., Masud, J.H.B., Kundu, S., et al., 2020b. Problematic internet use among young and adult population in Bangladesh: correlates with lifestyle and online activities during the COVID-19 pandemic. *Addict. Behav. Reports* 12, 100311.
- Jahan, S.M., Hossain, S.R., Sayeed, U.B., Wahab, A., Rahman, T., Hossain, A., 2019. Association between internet addiction and sleep quality among students: a cross-sectional study in Bangladesh. *Sleep Biol. Rhythm* 17 (3), 323–329.
- Jahid, A.M., 2020, 26 April. Coronavirus pandemic: 45 districts now under complete lockdown. *The Daily Star*. <https://www.thedailystar.net/online/news/coronavirus-pandemic-45-districts-now-under-complete-lockdown-1896967>.
- Karddefelt-Winther, D., 2014. A conceptual and methodological critique of internet addiction research: towards a model of compensatory internet use. *Comput. Hum. Behav.* 31, 351–354.
- Li, J., Zhan, D., Zhou, Y., Gao, X., 2021. Loneliness and problematic mobile phone use among adolescents during the COVID-19 pandemic: the roles of escape motivation and self-control. *Addict. Behav.* 118, 106857.
- Lin, M.-P., 2020. Prevalence of internet addiction during the covid-19 outbreak and its risk factors among junior high school students in Taiwan. *Int. J. Environ. Res. Public Health* 17 (22), 8547.
- Mamun, M.A., Hossain, M.S., Siddique, A.B., Sikder, M.T., Kuss, D.J., Griffiths, M.D., 2019. Problematic internet use in Bangladeshi students: the role of socio-demographic factors, depression, anxiety, and stress. *Asian J. Psychiatr.* 44, 48–54.
- Park, J.A., Park, M.H., Shin, J.H., Li, B., Rolfe, D.T., Yoo, J.-Y., Dittmore, S.W., 2016. Effect of sports participation on internet addiction mediated by self-control: a case of Korean adolescents. *Kasetsart J. Soc. Sci.* 37 (3), 164–169.
- Prakash, S., Yadav, J.S., Singh, T.B., 2020. An online cross-sectional study to assess the prevalence of internet addiction among people staying at their home during lockdown due to COVID-19. *Int. J. Indian Psychol.* 8 (3), 424–432.
- Prothom Alo, 2021, 10 January. Facebook users increase by 10 million in Bangladesh. Prothom Alo. <https://en.prothomalo.com/science-technology/social-media/facebook-k-users-increase-by-10-million-in-bangladesh>.
- Puccinelli, P.J., da Costa, T.S., Seffrin, A., de Lira, C.A.B., Vancini, R.L., Nikolaidis, P.T., Knechtle, B., Rosemann, T., Hill, L., Andrade, M.S., 2021. Reduced level of physical activity during COVID-19 pandemic is associated with depression and anxiety levels: an internet-based survey. *BMC Publ. Health* 21, 425.
- Sakya, S.M., Scoy, L.J.V., Garman, J.C., Miller, E.L., Snyder, B., Wasserman, E., et al., 2021. The impact of COVID-19-related changes in media consumption on public knowledge: results of a cross-sectional survey of Pennsylvania adults. *Curr. Med. Res. Opin.* 1–5.
- Saralioglu, A., Atay, T., Arkan, D., 2022. Determining the relationship between loneliness and internet addiction among adolescents during the COVID-19 pandemic in Turkey. *J. Pediatr. Nurs.* 63, 117–124.
- Shaw, M., Black, D.W., 2008. Internet addiction. *CNS Drugs* 22 (5), 353–365.
- Shovo, T.-E.-A., Ahammed, B., Khan, B., Jahan, N., Shohel, T.A., Hossain, M.T., Islam, M.N., 2021. Determinants of generalized anxiety, depression, and subjective sleep quality among university students during COVID-19 pandemic in Bangladesh. *Dr. Sulaiman Al Habib Med. J.* 3 (1), 27–35.
- Siste, K., Hanafi, E., Sen, L.T., Christian, H., Adrian Siswidiani, L.P., et al., 2020. The impact of physical distancing and associated factors towards internet addiction among adults in Indonesia during COVID-19 pandemic: a nationwide web-based study. *Front. Psychiatr.* 11, 580977.
- World Health Organization, 2020. Who director-general's opening remarks at the media briefing on covid-19-11 march 2020. Retrieved 18 April. <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-11-march-2020>.
- World Health Organization, 2021a. COVID-19 Weekly Epidemiological Update. World Health Organization, Geneva.
- World Health Organization, 2021b. Morbidity and mortality: weekly update (MMWU) no 60. World Health Organization, Dhaka.
- Young, K.S., 1998. Internet addiction: the emergence of a new clinical disorder. *Cyberpsychol. Behav.* 1 (3), 237–244.
- Zenebe, Y., Kunno, K., Mekonnen, M., Bewuket, A., Birkie, M., Necho, M., et al., 2021. Prevalence and associated factors of internet addiction among undergraduate university students in Ethiopia: a community university-based cross-sectional study. *BMC Psychology* 9 (1), 4.