



## Problematic internet use in Bangladeshi students: The role of socio-demographic factors, depression, anxiety, and stress



Mohammed A. Mamun<sup>a,b,\*</sup>, Md. Sharif Hossain<sup>a,b</sup>, Abu Bakkar Siddique<sup>a,b</sup>, Md. Tajuddin Sikder<sup>a</sup>, Daria J. Kuss<sup>c</sup>, Mark D. Griffiths<sup>c</sup>

<sup>a</sup> Department of Public Health & Informatics, Jahangirnagar University, Savar, Dhaka, Bangladesh

<sup>b</sup> Undergraduate Research Organization, Savar, Dhaka, Bangladesh

<sup>c</sup> International Gaming Research Unit, Psychology Department, Nottingham Trent University, UK

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### ABSTRACT

Problematic Internet Use (PIU) has become a concern for public mental health across the globe. However, there are few studies assessing PIU in Bangladesh. The present cross-sectional study estimated the prevalence rate of PIU and its associated risk factors among 405 university students in Bangladesh between June and July 2018. The measures included sociodemographic questions, internet and health-related variables, the Internet Addiction Test (IAT) and the Depression, Anxiety and Stress Scale (DASS-21). The prevalence of PIU was 32.6% among the respondents (cut-off score of  $\geq 50$  on the IAT). The prevalence of PIU was higher in males in comparison to females, although the difference was not statistically significant. Internet-related variables and psychiatric comorbidities were positively associated with PIU. From the unadjusted model, more frequent use of the internet and more time spent on the internet were identified as strong predictors of PIU, whereas the adjusted model showed depressive symptoms and stress only as strong predictors of PIU. It is hoped this preliminary study will facilitate further study on PIU along with other psychiatric disorders in Bangladesh.

### 1. Introduction

The internet is one of the most important technological developments worldwide, and has become an integral part of people's daily lives (Bener and Bhugra, 2013; Morrison and Gore, 2010). The phenomenon of the 'global village' where everyone is connected has been enabled by means of the internet. Internet penetration and use are increasing rapidly around the world, and has been facilitated by its accessibility, affordability, and the anonymity that it provides. Recent studies show that 80% of adolescents in the UK, USA, and Asia, and around 50% of adolescents in South America use the internet (Cerniglia et al., 2017). Internet access and portability are increasing with new hand-held devices, including smartphones, tablets, and laptop computers, making it possible to engage in working online and enjoying entertainment activities on the go (Bener et al., 2018). Many aspects of life are touched upon by the Internet, which brings numerous benefits to individuals' quality of life.

Despite its many positive effects, problematic excessive internet use has been associated with symptoms of addiction. Internet addiction (IA), sometimes referred to as pathological internet use or problematic

internet use (Simcharoen et al., 2018). IA is characterized by an individual's inability to inhibit internet use despite the negative impact on their physical, mental, and psychosocial health (Bener and Bhugra, 2013; Cheng and Li, 2014; Ho et al., 2014). It can impact an individual's psychosocial functioning, and comprises core criteria including salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse (Griffiths, 1996, 2005, 1998; Kuss et al., 2014a,b,c). Prevalence rates of IA have been wide ranging (i.e., 1%–43.9%) mainly due to differences in populations studied, the assessment tools used, the use of differing cutoff scores even when using the same instruments, and the different conceptualizations of IA and problematic internet use (PIU) (Ko et al., 2012; Kuss et al., 2014a; Shao et al., 2018). A recent large-scale European study, including Italian, German, French, Spanish, Polish, Turkish, Hungarian, Greek and English samples highlighted the prevalence of PIU ranged between 14% and 55% (Laconi et al., 2018).

Kuss et al. (2014a,b,c) reviewed the interconnected factors influencing IA including sociodemographic variables, internet use variables, psychosocial factors, and comorbid symptoms. Among these, gender plays a significant role in terms of risk for IA (Lam et al., 2009; Morrison and Gore, 2010; Salehi et al., 2014). Although most studies

*Abbreviations:* PIU, problematic internet use; IA, internet addiction; IAT, internet addiction test

\* Corresponding author at: Director, Undergraduate Research Organization, Gerua Rd, Savar, Dhaka 1342, Bangladesh.

E-mail address: [mamunphi46@gmail.com](mailto:mamunphi46@gmail.com) (M.A. Mamun).

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indicate that males are more likely to experience IA symptoms, some research indicates that females are also prone to developing problems as a consequence of excessive internet use (Afrin et al., 2017; Mo et al., 2018). Other factors associated with IA and PIU have included being preparatory, high school and university students (Afrin et al., 2017; Bener and Bhugra, 2013; Islam and Hossin, 2016; Lam et al., 2009; Ni et al., 2009; Uddin et al., 2016), living in a city (Ni et al., 2009), low physical activity (Afrin et al., 2017; Bener et al., 2018; Lam et al., 2009), low sleep duration (Afrin et al., 2017; Bener et al., 2018; Morrison and Gore, 2010), being a smoker (Lam et al., 2009; Salehi et al., 2014), the age of first exposure to the internet, lower self-efficacy of internet in abstaining from internet use (Lin et al., 2011; Ni et al., 2009), more time spent using the internet on a daily basis (Islam and Hossin, 2016; Salehi et al., 2014), and using the internet for social networking, watching online videos, and viewing websites with sexual content (Kuss et al., 2014a; Lin et al., 2011; Mamun et al., 2019b; Morrison and Gore, 2010; Simcharoen et al., 2018).

Relationships between PIU and IA and psychopathology have been studied in previous studies (Kuss et al., 2017; Mamun et al., 2019a; Spada, 2014). Previous studies have shown that psychiatric symptoms are often comorbid with IA, including symptoms of depression (Bener and Bhugra, 2013; Ho et al., 2014; Lin et al., 2011; Morrison and Gore, 2010; Ni et al., 2009; Uddin et al., 2016), anxiety (Ho et al., 2014; Ni et al., 2009; Younes et al., 2016), sleeping disorders (Lam et al., 2009), attention deficit hyperactivity disorder (Ho et al., 2014), social phobia (Ko et al., 2012), loneliness (Ho et al., 2014), and hostility (Ho et al., 2014). Depression, anxiety and stress appear as important factors contributing to PIU. Khantzian (1997) noted substance abuse, similar to IA or PIU, can emerge as a result of the individual attempting to cope with their stress, anxiety, and depression as a form of self-medication, a similar view expressed by researchers in the PIU field (Kuss et al., 2017).

PIU has been considered to be a global public health problem and social issue (Bener and Bhugra, 2013; Mamun and Griffiths, 2019c; Spada, 2014). Similar to the situation in developed countries, problematic Internet penetration is growing rapidly in developing and undeveloped countries (Islam and Hossin, 2016). In Bangladesh (where the present study was carried out), the current government aims to develop an information technology-based country by 2021 by developing a ‘Digital Bangladesh’ program to improve internet access by making it freely available (Uddin et al., 2016; Mamun et al., 2019a). Easier and free internet access in Bangladesh may increase the propensity of individuals in this country to develop addiction-related symptoms as a consequence of internet use (Mamun and Griffiths, 2019a). However, current knowledge of PIU in Bangladesh is limited. Although a few studies have been conducted in this country (Afrin et al., 2017; Islam and Hossin, 2016; Karim and Nigar, 2014; Shahnaz and Karim, 2016, 2014; Uddin et al., 2016), they have used small sample sizes and have not typically examined comorbid factors (Mamun and Griffiths, 2019b). The relationship between mental health issues and PIU has been ignored by most Bangladeshi research examining PIU (e.g., Afrin et al., 2017; Islam and Hossin, 2016; Karim and Nigar, 2014), and only two studies addressed the issues of mental health (e.g., Mamun et al., 2019a; Uddin et al., 2016). This lack of knowledge may negatively affect education and public health policymaking (Lai and Kwan, 2017). In order to fill this gap in Bangladeshi knowledge concerning PIU, the present study assessed the self-reported prevalence of PIU, and its associated risk factors, including sociodemographic, internet and health-related behaviors and comorbid psychiatric symptoms, including depression, anxiety, and stress.

## 2. Methodology

### 2.1. Participants and procedure

A cross-sectional study was conducted among the students of

Jahangirnagar University (Dhaka, Bangladesh), between June and July 2018. Data from 410 participants were collected via a face-to-face survey on campus during class lectures of which 405 were completed and kept for final analysis following the removal of incomplete questionnaires. The research was conducted based on a convenience sampling design. All respondents were informed about the purpose of the study and their verbal and formal consent was obtained prior to participation. Participants were informed that all their information would be kept anonymous and confidential, and they were provided with information about the nature and purpose of the study, the procedure, and the right to withdraw their data.

### 2.2. Statistical analysis

SPSS 22.0 and Microsoft Excel 2016 were used for the statistical analysis. First, the data were entered into Excel, then prepared for SPSS format. Descriptive statistics were used to describe the data, frequencies and percentages for categorical variables, and mean values with standard deviations for continuous variables. Additionally, chi-square tests, Pearson correlation coefficients, and scale reliability were also calculated. All variables in the bivariate analysis were then entered into the binary logistic regression model with PIU as the dependent variable. The results of logistic regression are reported as unadjusted and adjusted odds ratios with 95% confidence intervals.

### 2.3. Instruments

#### 2.3.1. Sociodemographic and behavioral measures

The sociodemographic variables assessed included age, sex, city or village residence, relationship status, and socio-economic status (higher, middle and lower class). Health factors assessed in the present study included physical activity, sleep duration, and smoking. To assess physical activity, respondents were asked if they participated in moderate physical activities such as walking, playing games, cycling, swimming or any other activity that caused some increase in breathing or heart rate for at least 30 min at a time each day. Participants reported whether they were cigarette smokers with a dichotomous response (i.e., yes/no). As for sleep duration, respondents were asked to report the average duration of sleep per day. Based on the US National Sleep Foundation’s recommendations, sleep duration was categorized as normal (7–9 h), short (< 7 h) and long (> 9 h) (Hirshkowitz et al., 2015). Data concerning internet-related variables were also collected including frequency of Internet use, purposes of internet use (i.e., communication purpose or chatting, research purposes), and social media use.

#### 2.3.2. Problematic internet use

To assess problematic internet use, the Internet Addiction Test (IAT; Young, 1998) was used. The IAT is the most commonly used measure in previous studies on IA (e.g., Laconi et al., 2014; Morrison and Gore, 2010; Ndasauka et al., 2019; Simcharoen et al., 2018; Uddin et al., 2016). It includes 20 Likert-type questions assessed on a six-point scale (0 = *never*, up to 5 = *always*). The total score of the IAT ranges from 20 to 100. In the present study, the participants were separated into two groups according to their IAT scores, the PIU group (moderate/high PIU group with a cut-off score of 50) and the non-PIU group (score < 50) (Bener and Bhugra, 2013; Younes et al., 2016). Adequate and acceptable reliability and validity have been demonstrated for the scale previously (e.g., Anand et al., 2018; Bener et al., 2018; Simcharoen et al., 2018). Very good internal consistency was obtained in the present study (Cronbach’s  $\alpha = 0.89$ ).

#### 2.3.3. Depression anxiety stress scale (DASS)

The DASS is a 21-item self-report inventory that provides scores on three subscales, i.e., depression (7-items), anxiety (7 items), and stress (7 items) (Lovibond and Lovibond, 1995). Each item was rated on

**Table 1**  
Distribution of socio-demographics of the respondents ( $N = 405$ ).

Variables	n (%)	Internet Addiction Score		
		Non-PIU (%)	PIU (%)	p-value (chi-square test)
<b>Gender</b>				
Male	203 (50.1)	133 (48.7)	70 (53.0)	0.416
Female	202 (49.9)	140 (51.3)	62 (47.0)	
<b>Permanent residence</b>				
Village area	234 (57.8)	156 (58.2)	78 (59.5)	0.800
City area	165 (40.7)	112 (41.8)	53 (40.5)	
<b>Family status</b>				
Higher class	12 (3.0)	9 (3.3)	3 (2.3)	0.796*
Middle class	359 (88.6)	240 (88.9)	119 (90.8)	
Lower class	30 (7.4)	21 (7.8)	9 (6.9)	
<b>Relationship status</b>				
Single	341 (84.2)	232 (85.6)	109 (83.2)	0.529
Partnered	61 (15.1)	39 (14.4)	22 (16.8)	

\*Fisher Exact Test.

a five-point Likert scale ranging from *never* (0) to *always* (3). This scale severity rating index was used to define levels of stress (normal 0–14, mild 15–18, moderate 19–25, severe 26–33, and extremely severe +34), anxiety (normal 0–7, mild 8–9, moderate 10–14, severe 15–19,

**Table 2**  
Distribution of Internet-related behaviors.

Variables	n (%)	Internet Addiction Score		
		NPIU (%)	PIU (%)	p-value (chi-square test)
<b>Frequency of using the internet</b>				
Once a week	9 (2.2)	8 (3.0)	1 (0.8)	< 0.001*
Few times a week	22 (5.4)	18 (6.8)	4 (3.1)	
Every day	197 (48.6)	148 (56.1)	49 (38.3)	
Few times a day	164 (40.5)	90 (34.1)	74 (57.8)	
<b>Time spent a day using the internet</b>				
Less than 2 hours	124 (30.6)	101 (38.0)	23 (17.6)	< 0.001
2-3 hours	126 (31.1)	89 (33.5)	37 (28.2)	
4-5 hours	63 (15.6)	34 (12.8)	29 (22.1)	
More than 5 hours	84 (20.7)	42 (15.8)	42 (32.1)	
<b>Online Activities#</b>				
<i>Educational or informational purposes</i>				
Yes	333 (82.2)	229 (86.4)	104 (80.6)	0.136
No	61 (15.1)	36 (13.6)	25 (19.4)	
<i>Communication purposes or chatting</i>				
Yes	367 (90.6)	242 (90.6)	125 (97.7)	0.011*
No	28 (6.9)	25 (9.4)	3 (2.3)	
<i>Online gaming</i>				
Yes	172 (42.5)	112 (46.3)	60 (50.0)	0.505
No	190 (46.9)	130 (53.7)	60 (50.0)	
<i>You-tubing or watching videos</i>				
Yes	355 (87.7)	236 (90.4)	119 (93.0)	0.403
No	34 (8.4)	25 (9.6)	9 (7.0)	
<i>Watching sexually explicit material or pornography</i>				
Yes	111 (27.4)	70 (28.9)	41 (34.2)	0.309
No	251 (62.0)	172 (71.1)	79 (65.8)	
<i>Using social media like Facebook, Twitter</i>				
Yes	343 (84.7)	225 (87.9)	118 (94.4)	0.046
No	38 (9.4)	31 (12.1)	7 (5.6)	
<i>File downloading</i>				
Yes	317 (78.3)	208 (81.3)	109 (83.6)	0.069
No	62 (15.3)	48 (18.8)	14 (11.4)	
<i>Online shopping</i>				
Yes	184 (45.9)	127 (50.4)	59 (48.8)	0.767
No	187 (46.2)	125 (49.6)	62 (51.2)	
<b>Internet Addiction Test (IAT) Score</b>				
Normal internet use (< 50 scores)	273 (67.4)	–	–	
Problematic internet use (> 50 scores)	132 (32.6)	–	–	

\*Fisher's Exact Test.

#Multiple response.

and extremely severe +20), and depression (normal 0–9, mild 10–13, moderate 14–20, severe 21–27, and extremely severe +28). Moderate, severe, and very severe were combined to denote a problematic score for depression, anxiety, and stress respectively. Acceptable internal consistency was obtained previously for the depression, anxiety and stress subscales as well the overall scale (Mamun et al., 2019a; Ostovar et al., 2016). For the present study, the Cronbach's alphas for the depression, anxiety and stress subscales were 0.81, 0.71, and 0.67, respectively, and the overall Cronbach's  $\alpha$  was 0.88.

### 3. Results

The characteristics of the total sample ( $N = 405$ ) are presented in Table 1. The participants' mean age was 20.2 years ( $SD = 1.61$  years). Half of the respondents were male (50.1%) and half were female (49.9%). A higher proportion of the participants came from village areas (57.8%), and middle-class families (88.6%). Most of the participants reported being single (84.2%). Slightly more males experienced PIU than females (53% vs. 47%), but this was not statistically significant ( $p = 0.416$ ) (see Table 1).

The outcomes of the IAT are shown in Table 2. Of the 405 respondents, 132 were classed as having PIU with a score of over 50 on the IAT (32.6%). The majority of the participants used the internet daily, and the average time they were continuously connected to the

**Table 3**  
Distribution of health-related variables.

Variables	n (%)	Internet Addiction Score		
		NPIU (%)	PIU (%)	p-value (chi-square test)
<b>Sleep</b>				
More than normal	92 (22.7)	55 (20.4)	37 (28.2)	0.194
Less than normal	76 (18.8)	51 (19.0)	25 (19.1)	
Normal	232 (57.3)	163 (60.6)	69 (52.7)	
<b>Smoking status</b>				
Yes	60 (14.8)	38 (14.1)	22 (17.1)	0.436
No	339 (83.7)	232 (85.9)	107 (82.9)	
<b>Physical activity status</b>				
Yes	181 (44.7)	129 (49.4)	52 (40.6)	0.102
No	208 (51.4)	132 (50.6)	76 (59.4)	
<b>Psychiatric co-morbidities</b>				
<b>Depression</b>				
Problematic depression score	196 (48.4)	103 (37.7)	93 (70.5)	< 0.001
Normal score	209 (51.6)	170 (62.3)	39 (29.5)	
<b>Anxiety</b>				
Problematic anxiety score	241 (59.5)	144 (52.7)	97 (73.5)	< 0.001
Normal score	164 (40.5)	129 (47.3)	35 (26.5)	
<b>Stress</b>				
Problematic stress score	96 (23.7)	43 (15.8)	53 (40.2)	< 0.001
Normal score	309 (76.3)	230 (84.2)	79 (59.8)	

internet was 2–3 hours. Among the PIU group, 96% were daily Internet users ( $p < 0.001$ ) and 32% used it more than five hours per day ( $p < 0.001$ ). The most common reasons for accessing the internet were communication and chatting purposes (90.6%), watching videos (87.7%), using social media (84.7%), educational or informational purposes (82.2%), and 45.9% used it for online shopping. Among those respondents with PIU, 97.7% accessed the internet for communication or chatting purposes (compared to 90.6% non-PIU;  $p < 0.05$ ), followed by 94.4% using social media (compared to 97.9% non-PIU;  $p < 0.05$ ). (see Table 2)

Health-related information and comorbid psychiatric symptoms are presented in Table 3. A slight majority of the respondents reported normal sleeping patterns (57.3%). A small proportion of participants reported being a cigarette smoker (14.8%). Engaging in physical activities (e.g., exercising, walking, cycling, etc.) that increase heart rate was reported by 45% of the sample. Problematic comorbid psychiatric symptoms were reported for depression (48.4%,  $n = 196$ ), anxiety (59.5%,  $n = 241$ ), and stress (23.7%,  $n = 96$ ). Of individuals with PIU, 70.5% experienced problematic depression (compared to 37.7% non-PIU;  $p < 0.001$ ), 73.5% anxiety (compared to 52.7% non-PIU;  $p < 0.001$ ) and 40.2% stress (compared to 15.8% non-PIU;  $p < 0.001$ ) (see Table 3). Moreover, the problematic internet users showed significantly higher mean scores of psychiatric symptoms compared to the non-problematic internet users for depression (18.92 [ $\pm 9.29$ ] vs. 12.26 [ $\pm 8.48$ ];  $t = 7.17$ ,  $df = 401$ ,  $p < .001$ ), anxiety (14.14 [ $\pm 8.06$ ] vs. 10.35 [ $\pm 6.88$ ];  $t = 4.9$ ,  $df = 402$ ,  $p < .001$ ) and stress (17.39 [ $\pm 7.46$ ] vs. 12.56 [ $\pm 6.86$ ];  $t = 6.43$ ,  $df = 401$ ,  $p < .001$ ).

The regression analysis examined associations between PIU and all variables of interest (i.e., socio-demographics, internet-related behaviors, health-related variables), and are presented in Table 4. The regression analysis demonstrated that depression (AOR: 2.447; 95% CI: 1.273–4.703,  $p = 0.007$ ) and stress (AOR: 2.893; 95% CI: 1.461–5.730,  $p = 0.002$ ) were predictors of PIU (see Table 4).

#### 4. Discussion

Although problematic internet use (PIU) has become a global social issue (Spada, 2014), it has been much less studied in Bangladesh. In

order to fill the knowledge gap, the present study assessed the self-reported prevalence of PIU, and its associations with socio-demographic variables, internet-related behaviors, health-related behaviors, and psychiatric comorbidities (i.e., depression, anxiety, and stress). As with previous studies outside of Bangladesh, the present study found an association between PIU and mental impairment and distress (e.g., Block, 2008; Weinstein and Lejoyeux, 2010). Most of the PIU-related research in Asia has been conducted in developed countries, such as Thailand (Simcharoen et al., 2018), Taiwan (Lin et al., 2011), China (Lam et al., 2009), and Korea (Fu et al., 2010). A study conducted in six Asian countries using IAT with a cutoff score of 70 on the IAT reported the following prevalence rates: South Korea (14%), China (19%), Hong Kong (35%), Malaysia (37.5%), Japan (48%), and Philippines (51%) (Mak et al., 2014). The global prevalence of PIU ranges from 1% to 43.9% across different populations using various validated psychometric instruments for assessment (Ko et al., 2012; Kuss et al., 2014a; Shao et al., 2018). However, the prevalence of PIU in China has been reported to be higher than that in other countries within the Asian region (Cheng and Li, 2014). In Europe, one multi-country study reported the prevalence rate of PIU ranged between 14.3% and 54.9%, prof they estimated 9 nations prevalence, which ranged from 14.3% to 54.9% using the nine-item Problematic Internet Use Questionnaire (PIUQ). Scoring higher than 21 out of 45 is considered as indicating PIU, which may explain the differences in terms of reported prevalence to some extent (Laconi et al., 2018). Moreover, recent studies from India (an adjacent country of Bangladesh) have reported prevalence rates of 17% PIU in Delhi, India (Balhara et al., 2018), 0.8% as having severe IA in Southern India (Anand et al., 2018), and 0% IA in Northern India (8.2% having moderate IA; Grover et al., 2019) and in Southern India (9.2% at-risk IA; Shrivastava et al., 2018).

In the present study, the prevalence of PIU was found to be 32.6%. Most of the previous Bangladeshi studies (Islam and Hossin, 2016; Karim and Nigar, 2014; Uddin et al., 2016) were conducted in the capital Dhaka (i.e., the same geographical region), among university students, and using the same instrument (the IAT). In Islam and Hossin's study (2016), PIU was assessed among 573 university students using the cut-off score of over 50 on the IAT to indicate PIU (24%), which was identical to the cutoff score the present study. They reported a 24% as having PIU and is similar to the present study (i.e., 32.6%). Uddin et al. (2016) reported the prevalence of severe PIU among 475 students to be 47.7% for males and 44.5% for females using the original cutoff score of IAT (i.e. scoring over 80 out of 100). In Karim and Nigar's study (2014) of 177 university students, 34.3% were categorized as moderate internet users (IAT score of 36–62) and only 1.74% were excessive users (IAT score  $> 62$ ). But, a study conducted by Mamun et al. (2019a) showed, surprisingly no cases of IA (3.9% as excessive users [ $\geq 60$  in IAT]) among the graduate job seekers residing in Rajshahi of the country. Using a different instrument (i.e., the Internet Addiction Survey), the one remaining Bangladeshi study by Afrin et al. (2017) reported a 2.51% prevalence rate of severe PIU among 279 high school students in Chittagong, a province located far from the Bangladeshi capital (Afrin et al., 2017). The scale differs from the IAT as the response format is binary (rather than using a continuous scale), leading to problems in comparing outcomes across studies (Afrin et al., 2017). Consequently, it has been demonstrated that using scales other than the IAT for assessing PIU, the prevalence rate can be different in the same contexts and study populations (Afrin et al., 2017; Laconi et al., 2018; Mamun et al., 2019a).

Many previous studies have indicated males are more likely than females to experience PIU (e.g., Lam et al., 2009; Morrison and Gore, 2010; Salehi et al., 2014). However, a few studies have reported that females also experience PIU (Afrin et al., 2017; Mo et al., 2018; Yen Ko et al., 2007). In the present study, the prevalence of PIU was slightly higher among males than females (53% vs. 47%). Inferential analyses did not indicate male gender as a risk factor for PIU in the present study ( $p = 0.214$ ). This may have been due to the residence of both male and

**Table 4**  
Regression analysis of factor associated with problematic internet use.

Variables	Unadjusted Model			Adjusted Model <sup>a</sup>		
	OR	(95% CI)	p-value (X <sup>2</sup> test)	OR	(95% CI)	p-value (X <sup>2</sup> test)
<b>Sociodemographic variables</b>						
<b>Gender</b>						
Male	1.188	(0.784-1.802)		1.517	(0.786-2.930)	
Female	1		0.416	1		0.214
<b>Permanent residence</b>						
Urban area	0.946	(0.619-1.448)		.931	(0.516-1.680)	
Rural area	1		0.800	1		0.812
<b>Family status</b>						
Higher class	0.798	(0.170-3.564)	0.798	.469	(0.055-4.012)	0.425
Middle class	1.157	(0.514-2.604)		1.452	(0.478-4.415)	
Lower class	1			1		
<b>Relationship status</b>						
Single	0.833	(0.471-1.473)	0.529	0.879	(0.400-1.934)	0.749
Partnered	1			1		
<b>Internet-related behaviors</b>						
<b>Frequency of using the internet</b>						
Once a week	1		< 0.001			
Few times a week	1.778	(0.171-18.534)				
Everyday	2.649	(0.323-21.712)				
Few times a day	6.578	(0.804-53.795)				
<b>Hours spent daily using the internet</b>						
Less than 2 hours	1		< 0.001			
2-3 hours	1.826	(1.009-3.304)				
4-5 hours	3.746	(1.914-7.328)				
More than 5 hours	4.391	(2.355-8.187)				
<b>Online Activities</b>						
<b>Educational or information purposes</b>						
Yes	0.654	(0.373-1.145)	0.137	.706	(0.323-1.544)	0.384
No	1			1		
<b>Communication purpose or chatting</b>						
Yes	4.304	(1.275-14.534)	0.019	2.412	(0.642-9.054)	0.192
No	1			1		
<b>Online gaming</b>						
Yes	1.161	(0.749-1.799)	0.505	.825	(0.457-1.488)	0.522
No	1			1		
<b>Watching videos</b>						
Yes	1.401	(0.634-3.096)	0.405	.776	(0.262-2.297)	0.647
No	1			1		
<b>Watching sexual explicated materials or pornography</b>						
Yes	1.275	(0.798-2.037)	0.309	1.239	(0.621-2.470)	0.543
No	1			1		
<b>Using social media like Facebook, Twitter</b>						
Yes	2.323	(0.993-5.433)	0.050	1.847	(0.592-5.758)	0.290
No	1			1		
<b>File downloading</b>						
Yes	1.797	(0.948-3.404)	0.072	2.542	(0.994-6.502)	0.052
No	1			1		
<b>Online shopping</b>						
Yes	0.937	(0.607-1.445)	0.767	1.051	(0.588-1.881)	0.866
No	1			1		
<b>Health-related variables</b>						
<b>Sleep status</b>						
More than normal	1.589	(0.961-2.628)	0.196	1.340	(0.680-2.641)	0.561
Less than normal	1.158	(0.665-2.018)		.855	(0.399-1.830)	
Normal	1			1		
<b>Smoking status</b>						
Yes	1.255	(0.708-2.226)	0.437	1.347	(0.608-2.983)	0.463
No	1			1		
<b>Physical activity status</b>						
Yes	0.700	(0.456-1.074)	0.103	.688	(0.380-1.246)	0.217
No	1			1		
<b>Psychiatric co-morbidities</b>						
<b>Depression</b>						
Problematic depression score	3.936	(2.517-6.153)	< 0.001	2.447	(1.273-4.703)	0.007
Normal score	1			1		
<b>Anxiety</b>						
Problematic anxiety score	2.483	(1.577-3.908)	< 0.001	1.463	(0.764-2.801)	0.251
Normal score	1			1		
<b>Stress</b>						
Problematic stress score	3.588	(2.228-5.780)	< 0.001	2.893	(1.461-5.730)	0.002

(continued on next page)

Table 4 (continued)

Variables	Unadjusted Model			Adjusted Model <sup>a</sup>		
	OR	(95% CI)	p-value ( $\chi^2$ test)	OR	(95% CI)	p-value ( $\chi^2$ test)
Normal score	1			1		

<sup>a</sup>Adjusted Model for all variables shown in Table 4, except frequency of using internet and hours spent daily using internet.

female respondents in the same geographical area in the university campus, and having equal access to the Internet, and is mainly cost-free.

PIU has been found to be positively correlated with many online behaviors and activities (e.g., social networking, shopping, education, watching online videos, and viewing sexual content (e.g., Kuss et al., 2014a; Lin et al., 2011; Morrison and Gore, 2010; Simcharoen et al., 2018). A number of internet use-related variables were also found to increase the risk of experiencing PIU in the present study. Using the internet every day increased the risk of PIU six-fold, whereas spending more than five hours on the Internet in one sitting increased it four-fold. These results are similar to those of previous studies (e.g., Ni et al., 2009; Salehi et al., 2014; Vigna-Taglianti et al., 2017). The internet can be used to develop and maintain interpersonal relationships with friends and family, possibly increasing the risk for problematic use over and above using the internet for other purposes (Cerniglia et al., 2017; Weinstein and Lejoyeux, 2010). However, in the present study, the findings from the adjusted model indicated that PIU had no association with specific internet-related activities. Lifestyle factors associated with PIU have previously been identified including sleep disturbances (i.e., sleeping longer than nine hours a night [Afrin et al., 2017; Islam and Hossin, 2016; Lam et al., 2009], sleeping less than seven hours [Lam et al., 2009]), smoking (Islam and Hossin, 2016; Lam et al., 2009; Van Rooij et al., 2014), and lesser engagement in regular physical activities (Bener et al., 2018; Islam and Hossin, 2016). These variables should be researched further in a Bangladeshi context.

PIU contributes to reclusive behavior of university students (Ni et al., 2009). Furthermore, research indicates that individuals who experience PIU often experience a range of comorbid psychological and psychiatric symptoms such as depression (Bener and Bhugra, 2013; Ho et al., 2014; Lin et al., 2011; Morrison and Gore, 2010; Ni et al., 2009; Uddin et al., 2016), anxiety (Ho et al., 2014; Ni et al., 2009; Younes et al., 2016), and stress (Lam et al., 2009; Ostovar et al., 2016; Younes et al., 2016). The association between PIU and depression was first suggested by Young and Rogers (1998), suggesting higher levels of depression predict more vulnerability to experiencing PIU. The present study replicated the findings, given that PIU was associated with higher scores on both the depression and stress scales, which may be explained with reference to Khantzian's 'self-medication hypothesis of substance abuse' (Khantzian, 1997; Kuss et al., 2017). Khantzian (1997) suggested, that similar to other addictions, PIU may occur as a result of the individual attempting to 'self-treat' their stress, anxiety, and depression. However, the present study did not find a positive association between anxiety and PIU.

#### 4.1. Limitations

Limitations of the present study include its cross-sectional nature and convenience sampling method, which provide no indication of causality. In order to remedy this, longitudinal investigations of PIU are needed to assess causal relationships between the assessed variables in the present study. Furthermore, the present study was conducted at the only university in Bangladesh and therefore generalizability to other university student samples in (or outside) the country are likely to be limited, which can be remedied in future studies by using a random selection of university students from different universities. There is also

a need for similar studies to be conducted with larger samples from different universities so that the results can be generalized. It should also be noted that the data were self-report and are subject to well-known biases (e.g., memory recall, social desirability, etc.) (Mamun and Griffiths, 2019b).

#### 4.2. Implications

It is concerning that a large proportion of the student participants in the present study suffered from mental health symptoms (i.e., depression, anxiety, and stress) some of which were associated with PIU. Therefore, the present study suggests that it is of utmost importance to consider university students' mental health and wellbeing. In order to ensure mental wellbeing of university students, additional mental health support needs to be made available, together with the implementation of on-site prevention and counseling centers and initiatives.

#### 5. Conclusions

The present study investigated the prevalence of PIU and its associations with a variety of risk factors based on data from a sample of Bangladeshi university students. The present exploratory study found that 32.6% of the university students surveyed were operationally defined as experiencing PIU. Significant risk factors for experiencing PIU predictably included more frequent use of the Internet, as well as depression and stress. Additionally, no sociodemographic factors appeared to significantly increase the risk of experiencing PIU. The present findings provided new knowledge regarding PIU in the context of university students in Bangladesh. Moreover, the present study found relationships between PIU and psychiatric symptoms. In addition to the assessed variables, it is suggested that future studies longitudinally investigate additional comorbid symptoms, including ADHD, online gambling, social anxiety, social phobia, loneliness, hostility, and substance use disorders in further studies.

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#### Declaration of Competing Interest

None.

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