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Understanding the drivers of smartphone addiction among university students: a perspective from Bangladesh

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Abstract

The aim of this study was to empirically analyze the factors that contributed to smartphone addiction proneness among university students in Bangladesh. With the increasing adoption of smartphones and rising rates of excessive smartphone usage, there was a need to investigate the etiology or causal factors of this addiction. A quantitative survey was conducted, which involved 384 students from both public and private universities in Bangladesh. The participants were selected using unequal stratified random sampling, and a structured questionnaire was used to collect data through physical participation. The findings indicated that 28.4% of university students were addicted to smartphones, which had implications for the future of educated young people. The study revealed that demographic and academic variables did not have a significant impact on smartphone addiction among university students. The research suggested that addiction to Facebook, YouTube, and Messenger was strongly linked to emotional individuality, pleasure orientation, and virtual orientation, resulting in a loss of social and self-identity. The study called for further research into the effects of smartphone addiction on various socio-economic groups, which could lead to the development of new theories on smartphone addiction proneness.

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Introduction

With the advancement of new media technologies, smartphones have become a multimedia and fast communication medium, making them widely available and accessible to young people regardless of their geographic location or social status. As a result, smartphones have spread rapidly around the world, with an estimated global population of 3.8 billion smartphone users by 2021 (Statista 2019). In 2015, over half of the population in 47 countries with a dominant media presence were smartphone users, and this is expected to increase from about 26% in 2012 to almost two-thirds by 2018 (Austin et al. 2015). According to Pew Research, 43% of the global population owns a smartphone with internet access and apps, such as iPhone or Android, with younger (age 18–34), more educated, and higher-income individuals having greater access to these devices worldwide, which come in various sizes but have a universal form (Poushter 2016).

Bangladesh has experienced a surge in smartphone affordability, coupled with a rapid expansion in the availability of mobile broadband services, and a decrease in smartphone prices from $168 in 2012 to $130 in 2017, leading to a higher adoption of smartphones in the country in recent years (GSMA 2018). A survey conducted in Bangladesh found that 65% of young people use mobile apps for more than three hours a day, and 62% use internet services. Among them, 75% are undergraduate and graduate students, and 65% belong to the age group of 15–25 years (Nekmahmud et al. 2017). These findings suggest that young and educated groups, including university students, are the primary users of smartphones who construct a virtual community through their virtual orientation. Young people embrace smartphones as a symbolic avenue that facilitates connections with one another (Juhasz and Bradford 2016). However, this preoccupation with smartphones has led to excessive usage and problematic behavior, resulting in addiction (Lee et al. 2017). Smartphone addiction is a form of behavioral addiction, not related to drug or alcohol abuse (Statista 2019). Addiction to smartphones is characterized by excessive obsessions with smartphone use, loss of control, daily disorders due to nervousness and anxiety, and a toxic inclination toward a virtual world (Kim et al. 2014).

Young people have become increasingly obsessed with their smartphones, checking them up to 150 times a day, sending 110 texts per day, and feeling unable to imagine their life without them (Brody 2017). Smartphone addiction has become a prevalent issue in many countries, with addiction rates exceeding 25% in various regions, including South-Asian, Middle-Eastern, East-Asian, and Western countries. Studies have reported addiction rates of 31% among Indian students, 35% among South Korean university students, and 17% among Swiss university students (Kim et al. 2015; Lee and Lee 2017; Haug et al. 2015). These findings indicate the concerning level of smartphone addiction among young people, which is associated with a range of addictive symptoms. Various factors, such as personality traits (e.g., obsessive attitude, excessive virtual involvement, and sense of gratification), psychological factors (e.g., anxiety, depression, loneliness, and relationship disorder), and social factors (e.g., parent–child relation,

family conflict, dysfunctional social relation), have been identified as influential causes of rising dependency on smartphones (Walse et al. 2008; Kim et al. 2014; Lee and Lee 2017; Nayak 2018). Despite numerous studies on the causal analysis of smartphone addiction, scientific research on this issue is still limited in the context of Bangladeshi society. However, the country has experienced a robust increase in smartphone addiction, with 65% of young people using mobile apps for more than three hours per day and 62% using the internet, particularly among undergraduate and graduate students and those aged between 15 and 25 years (Nekmahmud et al. 2017). Therefore, it is crucial to conduct scientific studies on the nature and determining factors of smartphone addiction proneness in Bangladesh.

Although many countries have conducted empirical studies on smartphone addiction and its determinants, Bangladesh lacks significant scientific evidence on the features that cause smartphone addiction in the country. Furthermore, the factors that contribute to the compulsive use of smartphones by educated youths in Bangladesh are not statistically evident. Therefore, the objectives of this study are to identify the determinants associated with the compulsive use of smartphones among university students in Bangladesh and to uncover the etiology or causal factors of smartphone addiction among this group.

Smartphone addiction has become a rising concern for young people worldwide, and Bangladesh is no exception. With the increasing availability and affordability of smartphones, coupled with the rapid expansion of mobile broadband services, more and more Bangladeshi youth are becoming addicted to their smartphones. Despite the prevalence of this issue, there is a lack of substantial scientific evidence on the determining features that instigate smartphone addiction among Bangladeshi university students. Therefore, there is a need to investigate the causal factors of smartphone addiction in Bangladesh, specifically among university students, in order to generate guidelines for the improvement of the youth community. This study aims to fill this gap by providing an empirical analysis of the factors driving smartphone dependency in Bangladeshi university students.

Literature review

Smartphone and smartphone addiction

Smartphones can be considered as a form of "customized media" due to their ability to provide immediate access to tailored information through various features such as messaging, email, web browsing, and multimedia playback (Emanuel et al. 2015). This online access not only changes the way people communicate, but also introduces new opportunities and risks to communication (Gershon and Bell 2013). Smartphones combine the functionalities of traditional mobile phones, personal computers, and the internet, and have transformed users' habits, practices, and modes of accessing media, thereby shaping a new media ecology (Madianou 2014).

The consistent use of technology can lead to addiction, as it involves a strong desire to continue habitual behavior despite its harmful consequences and the

individual's own will to quit (Sulkunen 2015). Addiction can also arise from environmental cues that create an affective response based on past experiences, leading to a feeling of despair when the experience is interrupted or the individual is unable to return to it (Brewer et al. 2014). As a result, smartphone addiction is comparable to other forms of addiction.

In terms of the psychological aspects, smartphone addiction is a compulsive attitude of high-risk behavior that leads to an increase in loneliness, depression, anxiety, and stress with the effects of an increase in neuroticism scores, emotional behaviors, and loss of self-control (Lei et al. 2020). The behavior of smartphone addiction, thereby, involves losing control due to excessive immersion and obsession with smartphone use, leading to daily disorder, nervousness, anxiety, and a preference for virtual interactions over peer group interactions (Kim et al. 2014). This behavior is similar to a crook who indulges too much in pleasure and loses control of their experience, resulting in compulsive disorder, impulsive behavior, and loss of balance in life (Sulkunen 2015; Salicetia 2015; Panova and Carbonell 2018; Park & Lee 2012). Smartphone addiction encompasses various forms of addiction, such as cybersex addiction, virtual relational addiction, virtual game addiction, and web addiction (Salicetia 2015), and can be seen as a way of escaping from reality (Huisman et al. 2000). This addiction is characterized by recursive checking habits, triggered by external ring tones and internal emotional states, which can cause a variety of symptoms, including salience, mood modification, tolerance, withdrawal, relapse, neglecting work, and lack of control (Oulasvirta et al. 2012; Griffiths 1996; Brown 1998).

Prevalence and determinant factors of smartphone addiction

Various studies conducted across the globe have investigated the impact of demographic and academic variables on smartphone addiction, with varying results. With the increasing availability of smartphone applications and diverse user profiles, the prevalence of smartphone addiction has been observed to vary across different age groups, genders, income levels, educational backgrounds, and professions. One study by Vaidya et al. (2016), which employed the Smartphone Addiction Scale, found that 17% of Indian students were classified as smartphone addicts, with a higher prevalence among younger adolescents (aged 15–16) compared to young adults. Gender differences have also been observed in several studies, with male students in countries such as India, Saudi Arabia, and China exhibiting higher rates of smartphone addiction compared to their female counterparts (Kim et al. 2015; Aljomaa et al. 2016; Cao and Su 2006). However, other studies have reported the opposite trend, with females showing higher rates of smartphone addiction (Lee and Lee 2017; Long et al. 2016; Demirci et al. 2015; Mihara et al. 2016) (see Fig. 1).

According to recent studies, the affordability, ease of use, and multifunctionality of smartphones have contributed to their widespread use among young people, making factors such as class, family income, and place of residence insignificant in terms of smartphone addiction (Sung 2016; Gökçearslan et al. 2018). While some studies suggest that undergraduate and humanities students are more prone to

Study	Sampling	Addiction Proneness	Gender difference
Kim et al. 2015	335 Indian students	31.2 % risk	Higher for males
Lee and Lee , 2017,	3000 Korean university students	35.2% risk	Higher for females
Hawi &Samaha, 2016	249 Lebanese private university students	44.6 % risk	Equally susceptible
Aljomma et al., 2016	416 students of King Saud university	48% risk	Higher for males
Long et al., 2016	1062 Chinese undergraduates	21.3% risk	Higher for females
Demirci et al. 2015,	319 Public university students of Turkey	39.8% risk	Higher for females
Cha and Seo , 2018	1824 South-Korean students	30.9% risk	Equally susceptible
Haug et al., 2015,	1,519 students from Switzerland	16.9% risk	Gender unspecified
Cao & Su, 2006	2620 high school students, China	2.4% risk	Males five time higher
Bian & Leung, 2015	414 Chinese university students	13.5%	Unidentified
Mihara et al. , 2016	100, 050 high school students	Unidentified	Higher for females

Fig. 1 Smartphone addiction proneness according to gender & study level. Source: Developed by authors from different sources

smartphone addiction than graduate and science students, statistical significance was not always observed (Nayak 2018; Aljomma et al. 2016; Long et al. 2016). A survey conducted in Lebanon found a significant correlation between smartphone overuse and decreased academic output among university students, but there was no significant relationship between smartphone use and study-related purposes or managing academic classes (Boumosleh and Jaalouk 2018).

Uddin et al. (2016) conducted a survey among 475 students from five private universities in Bangladesh and found that undergraduate students, year of study, and residential status were closely associated with the risk of internet addiction, although statistical significance was not determined. The complexity of smartphone addiction is often measured by the amount of time spent on the device, including the number of calls and messages sent and received, or by counting the frequency of mobile addiction symptoms (Al-Barashdi et al. 2015). Sociological factors such as low parental attachment, family environment, school adjustment, peer relationships, social support, and participation in extracurricular activities such as sports and clubs have been identified as factors that contribute to smartphone addiction (Lee & Lee 2017). Smartphone addiction is typically characterized by excessive use of smartphone content, excessive internet use, and an obsession with the internet (Salicetia 2015; Aljomaa et al. 2016).

Etiological factors of smartphone addiction

The roots of smartphone addiction are entwined with the clinical indicators of this condition. The American Psychological Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-5) identifies tolerance, inability to control urges, impairment of daily life activities, disregard for negative consequences, and withdrawal as key symptoms of smartphone addiction (Statista 2019). Furthermore, the "Smartphone Addiction Proneness Scale" (SAPS) has been developed, which includes disruption of adaptive functions, preoccupation with virtual life,

withdrawal, and tolerance as essential factors (Kim et al. 2014). Another scale, the Smartphone Addiction Inventory (SPAI), investigates compulsive behavior, functional impairment, withdrawal, and tolerance (Lin et al. 2014), which is similar to the SAPS model. These scales reveal various symptoms related to personality traits, psychological features, and social factors.

Personality traits such as time spent on smartphones, disruptions in daily life, a strong attraction to smartphones, and obsessive behavior have been identified as dominant factors contributing to smartphone addiction (Pavia et al. 2016). Additionally, virtual orientation, brand attachment, low self-control, and a high interest in media content such as social networking sites, games, and entertainment are significant factors that contribute to addiction (Jeong et al. 2016; Anshari et al. 2016; Lee & Lee 2017). Psychological symptoms such as frustration, loneliness, relationship dissatisfaction, compulsive checking to recover a feeling of loss, and subjective happiness have also been identified as major reasons for the increase in smartphone addiction (Walse et al. 2008; Ryan et al. 2014; Nayak 2018). Other social symptoms, such as companionship, parental neglect, relational maladjustment, failure of control strategies, withdrawal from relationships, and communication motives, have been found to be determining factors in addiction proneness (James & Drennan 2005; Kwak et al. 2018).

The evidence from various countries indicates that smartphone addiction susceptibility varies based on usage patterns and symptoms, but the extent and direction of addiction are more context-dependent. To summarize, virtual orientation, reward-seeking behavior, and reduced social engagement are found to be the main contributors to smartphone addiction across different countries. However, academic and demographic factors cannot be considered as definitive determinants as their impact may vary. Given the context of Bangladesh, it is important to conduct a scientific study to identify the key causal factors of smartphone addiction that affect educated youth. This study should involve measuring smartphone addiction to establish a significant association between causal factors and the ratio of addicts versus non-addicts. The study should also evaluate demographic and background variables, personality traits, and socio-psychological factors to determine which factors are most responsible for smartphone addiction among university students in Bangladesh.

Theoretical underpinning

The study is based on two fundamental theories, namely Jensen's (2016) 'Meta-media Theory' and Adam Alter's 'Behavioral Addiction Theory'. The smartphone is considered primarily as not only a medium for networking but also an extension of media spaces. In this regard, Jensen's meta-media theory needs to be considered. For Jensen (2016), the smartphone is considered as a technological platform that integrates various forms of media, and the intersection between human communication, social interaction, and computing is achieved through a specific configuration of the software system and virtual expression. As meta-technologies are crucial infrastructure in modern society and are mainly informational or digital, smartphones offer greater degrees of freedom in the socio-material world,

as they provide more flexibility in utilizing a vast range of inputs. This opportunity for flexibility with freedom opens the door to the compulsive use of smartphones extending virtual orientation in online spaces.

According to Jensen (2016), "meta media extend the human capacity for communication across space, time, and social practices" (p. 4), and, as a result, meta-communication shapes human practices and their outcomes in everyday social life. Therefore, Jensen considers the smartphone as a meta-technology that is equipped with dynamic functions of various smartphone apps through which users can easily access communication across the globe. Regarding these functions, the smartphone cannot be separated from the dynamic structure of meta media in daily usage, where various apps, such as Facebook for social exchange, online shopping, and video sharing, and YouTube for disseminating various learning, entertainment, and training programs, are integrated into a constituent medium. This form of integrated structure is associated with Adam Alter's theory of 'Behavioral Addiction' (see Fig. 2).

According to Alter (2017), behavioral addiction consists of six ingredients: (i) unreachable compelling goals; (ii) irresistible and unpredictable positive feedback; (iii) a sense of incremental progress; (iv) slow speed of daily activities and difficulty in completing over time (v) unresolved tensions while resolution is demanded; and (vi) strong virtual connection and obsession with those connections' addiction. Following those ingredients, smartphone addiction equals the addiction to online shopping, pornography, gambling, video games, or social media; and the addictive behavior is so irresistible that a large portion of users recursively involve themselves in texting, playing games, surfing the web, watching online videos and trying to shift away from face to face to virtual space (Alter 2017). The increased accessibility and extensive opportunities of smartphone apps, consequently, promote virtual engagement and orientation towards entertainment, which may contribute to the development of smartphone addiction.
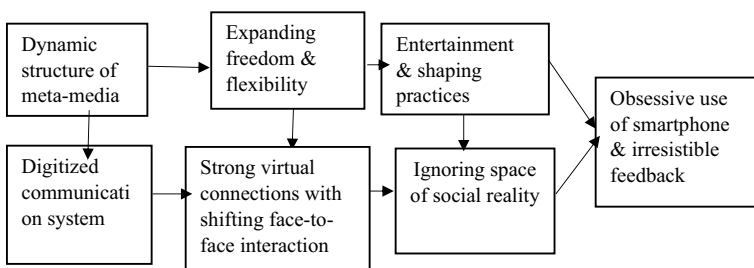
Fig. 2 Theoretical framework of determinants of smartphone. Source: Jensen (2016) and Alter (2017)

Methods

Design and sampling

This research is based on a quantitative approach using the social survey method to collect data. It is an exploratory study that covers both non-government and public universities in Dhaka city, which is home to most of the top-ranked universities in Bangladesh (BANBEIS, 2018; BBS, 2021). A sample size of 384 respondents was determined using a standardized formula for small samples (Krejcie and Morgan 1970), which was extracted from a population of around 0.82 million students in public universities and 0.36 million students in private universities (BBS, 2021). To ensure representation from different universities, faculties, departments, genders, and academic programs, the study used stratified random sampling (Etikan and Bala 2017). The sample included students from two public and six private universities in Dhaka city, but the names of these universities were not disclosed to maintain their privacy. Data was collected from undergraduate and graduate students from faculties of Science, Arts and Social Science, and Business Administration, and with different residential statuses. The aim was to provide a comprehensive understanding of the issue under investigation.

Participants

The study obtained consent from the participants and provided them with information on the study's objectives and questionnaire structure. The self-administered survey comprised 229 students from two major public universities and 155 students from various private universities. The participants included 257 male students and 127 female students, with 128 students from Science, 145 from Arts and Social Science, and 111 from Business Studies. In terms of academic level, 89% of the participants were undergraduate students, while only 11% (n=43) were Masters students. With respect to residential status, more than one-third of the participants (n=114) lived in university halls, another one-third (n=120) in private messes, and the remaining 34% (n=129) were selected from their own families. The participants were selected using stratified random sampling based on gender, university category, academic level, study level, and residential status.

Data collection tools and settings

In this study, a hardcopy formal questionnaire was used to conduct a face-to-face survey from 15 November 2018 to 15 February 2019. Prior to collecting data in written form, the consent of the participants was obtained through face-to-face interaction to ensure their understanding of the questions. The questionnaire comprised two sections, with the first section consisting of 11-item demographic variables, 5-item questions regarding smartphone usage patterns and causal factors, 10-item questions about app preferences, 6-item questions about motives and engagement in app usage, and 15-item questions about addiction symptoms (including personality,

psychological, and social variables). Of these, 15 variables regarding different symptoms were adapted from a model developed by Kim et al. (2014), while the other variables were self-developed. The respondents were instructed to perceive the meanings of a few complicated variables, though most of them were clear to understand. For instance, the demographic variables such as 'family types' and 'parental education' had multiple categories. A total of 47 questions were provided to the participants to measure the etiological factors of smartphone addiction and detect the determinants of this addiction. The questionnaire was in the native language (Bengali), and once the respondents provided their full written responses, the format was translated into English and saved in a Windows file on the computer. The names of all respondents were recorded anonymously to ensure their privacy.

Identifying addicts and non-addicts

To distinguish between smartphone addicts and non-addicts, we utilized 15 variables based on four factors (Adaptive dysfunctions, Virtual-orientation, Withdrawal, and Tolerance) from the Smartphone Addiction Proneness Scale (SAPS) model (Kim et al. 2014). These variables include school grade failure, lack of planning opportunity, negative reactions from those closest against smartphone use, people's recurring comments about overuse, feeling that the smartphone is an enjoyable tool, feeling great loss without it, visualizing life with the smartphone, rising anxiety without the smartphone, increasing feelings of panic without it, loss of self-control, self-endeavor to reduce its use, ignoring what should be done, and continuation of habitual engagement in using it more. Participants were asked questions about' these variables using a 7-point Likert scale, ranging from 1 = 'strongly disagree' to 7 = 'strongly agree'. The total SAPS score, which ranges from 15 to 105, was calculated from these variables. Using Lee and Lee's (2017) technique of a cut-off point, we identified over 65 percent of the scores as indicating addiction, while the remaining scores indicated non-addicts or normal users.

Determinants and etiological factors

To assess the factors contributing to smartphone addiction, we created multiple variables related to personal, family, and academic background. These variables included age, gender, academic identity, family size, parent's income, education, and occupation. We also inquired about the primary reasons for addictive behavior, such as weak social bonds, mental depression, virtual networking, and obsession with entertainment, and the top purposes for using favorite apps, such as entertainment, studying, virtual networking, and family communication. The participants were provided with different options to choose from while answering these questions.

To determine the main causes of smartphone addiction, we developed a set of questions that focused on variables such as time spent on the phone, time spent on other necessary activities, time spent on different apps, typical smartphone usage patterns, and prioritization of app usage. All of the questions were designed to elicit close-ended responses so that we could translate the answers into a fixed coding

scheme. We then used demographic variables, motivational factors, causal factors, and usage pattern variables as independent variables, while addiction ratio was used as the dependent variable. We analyzed the relationship between the dependent and independent variables using the chi-square ($\chi2$) test, which helped us identify patterns in smartphone use and the factors that contribute to addiction.

Statistical reliability

To ensure the reliability of the data, a Cronbach's α value of at least 0.60 is generally acceptable, while a value of 0.70 is considered good (Nunnally & Bernstein 1978). To confirm the statistical significance of the variables, the Kaiser-Meyer-Oklin test (0.85) and Bartlett's 'Test of Sphericity' ($p < 0.000$) were used. The obtained Cronbach's α value was 0.82, indicating a high level of reliability. A significance level of $p < 0.05$ was set as the threshold for statistical significance, with $p \leq 0.05$; **$p \leq 0.01$; *** $p \leq 0.001$ denoting the level of significance in the tables, with the star (*) symbol indicating a significant relationship, and no symbol indicating no significant relationship.

Data analysis

The SPSS-21 statistical software was instrumental in generating both descriptive and inferential statistics, providing an overview of the data and confirming significant determining factors related to smartphone addiction. Descriptive statistics were represented as percentages based on the coding system used for all responses. To investigate the association between the dependent variable (addiction ratio) and independent variables (e.g., demographic variables, time factors, objective factors, causal factors, and symptoms), this research employed Chi-square ($\chi2$) test through cross-tabulation of data. To facilitate comparison, the ratio of total addicts was computed by adding the rate of potential addicts. All independent variables associated with addicts or non-addicts were tested using Chi-square ($\chi2$) test and compared with different secondary evidence. To ensure clear data analysis, variables, scores distribution, and formatting interconnection between variables were systematically arranged in several tables.

Results

Background variables associated with addicts and non-addicts

The purpose of this study was to investigate the factors contributing to smartphone addiction among university students in Bangladesh. The study began by examining the relationship between socio-demographic variables and smartphone addiction ratios. The results are presented in Table 1, which shows the standard deviation and chi-square values to highlight the strength of the association. The sample included 384 university students in Bangladesh, and we found that background variables were

Table 1 Student's demographic variables associated with addiction proneness

Variables	Categories	Total users %	Normal users %	Addicts %	SD	χ2	P-value
University level	Public university	60	40.1	19.5	0.49	5.36	(0.07)
	Private university	40	31.5	8.9			
Faculty code	Science	33.3	25.3	8.0	0.79	3.03	(0.55)
	Arts & social science	37.7	26.8	10.9			
	Business studies	28.8	19.5	9.3			
Semester	First semester	16.6	13	3.6	0.53	4.20	(0.38)
	Up to honors	72.1	51.8	20.3			
	Masters	11.2	6.8	4.4			
Gender	Male	66.9	46.6	20.3	0.47	1.55	(0.46)
	Female	33.1	25	8.1			
Age	18–20 years	32.6	23.7	8.9	0.50	0.96	(0.92)
	21–25 years	65.8	46.6	19.2			
	26–30 years	1.6	1.3	0.3			
Residential type	Student hall	29.7	21.1	8.6	1.3	7.82	(0.45)
	Student mess	31.3	21.9	9.4			
	Relative home	4.5	2.9	1.6			
	Own family	34.7	25.8	8.9			
Family type	Family of orientation	57.8	42.4	15.4	0.64	2.50	(0.65)
	Family of procreation	34.1	22.9	11.2			
	Single parent family	8.1	6.3	1.8			
Family size	Parents & siblings 1–3	76.6	55.2	21.4	0.79	4.17	(0.38)
	Parents & siblings 4–5	20.8	14.6	6.2			
	Parents & siblings 5+	2.6	1.8	0.8			
Parent education	Higher educated	24.4	18.2	6.2	0.80	4.37	(0.36)
	Middle educated	51.6	37.2	14.4			
	Lower educated	23.9	16.1	7.8			
Family income (Tk, per month)	<20,000	24.5	16.7	7.8	1.5	5.46	(0.71)
	20–40,000	26.6	20.1	6.5			
	40–70,000	23.9	18	5.9			
	70,000+	34	16.9	8.1			

SD = standard deviation, χ2 = chi squire value

associated with addiction proneness based on specific standard scores. However, despite differences in percentage among categories of academic and personal background variables, no significant differences were found between addicts and non-addicts in terms of university-level (SD 0.49) (χ2 = 5.36, p = 0.07), faculties (SD

0.79) ($\chi2=3.03$, $p=0.55$), semesters (SD 0.53) ($\chi2=4.20$, $p=0.38$), residential types (SD 1.3) ($\chi2=7.82$, $P=0.45$), gender (SD 0.47) ($\chi2=1.55$, $p=0.46$), and age groups (SD 0.50) ($\chi2=0.96$, $p=0.92$).

Table 1 presents findings on family background variables and their association with smartphone addiction ratio among university students in Bangladesh. Results indicate that family-type (SD 0.64) ($\chi2=2.50$, $p=0.65$), family size (SD 0.79) ($\chi2=4.17$, $p=0.38$), parents' education (SD 0.80) ($\chi2=4.37$, $p=0.36$), and family income (SD 1.5) ($\chi2=5.46$, $p=0.71$) did not exhibit a significant difference between the two groups.

Measuring level of preference

The study analyzed the level of preference for various smartphone apps among respondents, focusing on the top choice and giving priority to specific apps. Results showed that Facebook (homepage) was the most preferred app among the respondents, with 42% placing it as their top choice, followed by YouTube (32%) and Messenger (inbox) (15%). Other apps such as Games, Google, Instagram, WhatsApp or Imo, FM radio, Uber/Pathao as transport app, and Phone-call were less preferred. When asked about their second preference, Facebook (30%) and YouTube (30%) were the most popular choices, followed by Messenger (28%). The study also looked at the amount of time spent on these apps, with the largest time-Fig (20%) spent on using YouTube for more than 3 h a day, followed by Facebook (18%) and Messenger (17%). Other apps were used for the same amount of time by less than 5% of the respondents, as shown in Table 2.

This result is supported by the statistical report. A statistical report on the use of smartphone apps in Bangladesh implies that among a total of 52.58 million internet users in Bangladesh, Facebook reached 85.0 percent of the local internet users, YouTube reached 65.6 percent, and Facebook Messenger reached 40.8

Table 2 Smartphone use in terms of preference and time expenses

Smartphone apps	Positioning the top priority of apps				Approximate time spent on each app daily			
	Top (%)	2nd (%)	3rd (%)	SD	3+hours (%)	1–3 h (%)	<1 h (%)	SD
Facebook	42.1	30	13.9	1.34	17.9	32.6	49.5	1.26
YouTube	31.7	29.6	28.2	1.10	19.5	34.6	46	1.25
Messenger	14.9	28.2	32.2	1.4	17.4	26.3	56.4	1.4
Games	5.2	6.8	9.6	1.9	5.2	10.4	83.9	2.1
Google	4.6	6.3	11.4	1.5	4.8	9.1	85.8	1.8
Instagram	3.7	2.1	6.9	2.1	2.7	4.8	92.5	2.2
Imo/Whatsapp	3.5	1.9	3.8	1.8	2.3	9.6	88.1	2.1
FM radio	.5	0.5	2.2	1.8	1.1	3.8	95	2.4
Uber/*Pathao*	1.3	0.6	1.3	1.9	1.2	1.9	96.7	2.3
Only phone call	2.3	2.3	4.5	2.1	1.6	9.7	88.7	1.6

Source: field survey

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percent of Bangladesh's total internet users in 2022 representing first, second, and third positions among the apps respectively (DataReportal 2022). On the other hand, Instagram only covered 8.5 percent of the local internet users, Twitter covered 8.7 percent, and LinkedIn reached 1.4 percent of internet users (DataReportal 2022)—indicating that those apps are so limitedly used which cannot be compared with the most popular Apps such as Facebook, YouTube, and Messenger. Even, during data collection, we found that respondents enjoyed TikTok videos which were uploaded on Facebook and YouTube; thereby smartphone addiction is equivalent to the addiction to most pervasive and popular apps such as Facebook, YouTube, and Messenger.

Additionally, the study focused on the pattern of smartphone usage among the participants. Results showed that the majority of users (63%) spent only 1–3 h a day studying, which was significantly associated with smartphone addiction (SD 0.86) ($\chi2=12.62$, $p<0.01$). However, the time spent on family contact did not differ significantly between the addicts and non-addicts (SD 0.86) ($\chi2=8.23$, $p=0.22$). Moreover, the study found that long-term smartphone use (SD 1.0) ($\chi2=22.64$, $p<0.001$) and low internet costs (SD 1.1) ($\chi2=20.36$, $p<0.002$) were significantly associated with addiction proneness. Furthermore, addiction proneness was closely associated with time spent on specific apps, such as Facebook (SD 1.3) ($\chi2=29.17$, $p<0.001$) and Messenger (SD 1.4) ($\chi2=19.67$, $p<0.01$), but not with time spent on YouTube (SD 1.4) ($\chi2=8.82$, $p=0.36$) (Table 3).

Causal and motivational factors associated with addiction

The study analyzed the main motivational factors associated with addiction proneness for the three most popular apps. The results indicate that "virtual orientation" and "entertainment" were the most dominant motivational factors, while "family interaction" and "study" were less significant. As a result, Messenger (SD 1.5) ($\chi2=23.49$, $p<0.009$) and YouTube (SD 0.94) ($\chi2=16.24$, $p<0.04$) showed a strong association with addiction proneness. However, Facebook's objectives (SD 1.6) ($\chi2=9.36$, $p<0.67$) did not differ significantly between addicts and non-addicts. It was found that no primary cause was related to smartphone addiction as a machine (SD 1.0) ($\chi2=6.6$, $p=0.58$), but rather to specific apps (Table 4).

Discussion and conclusions

The current study aimed to identify the primary predictors responsible for smartphone addiction proneness. To achieve this objective, the study utilized the smartphone measurement scale of the SAPS model, which is directly related to personality traits, psychological symptoms, and social symptoms. Additionally, the study examined different use patterns of smartphone apps to determine the degree of association between these patterns and addiction proneness. To measure this association, the Chi-square test was used to identify the degree of association between selected variables and smartphone addiction (addicts 28% and

Table 3 Smartphone use pattern associated with smartphone addiction proneness

Using pattern	Variables	Total users %	Normal users %	Addicts %	SD	χ2	P-value
Smartphone use and time spent on study	1–3 h	62.5	41.1	21.4	0.86	12.62**	(0.01)
	3–5 h	27.9	22.1	5.8			
	5+hours	9.6	8.3	1.3			
Smartphone use and internet cost (approximately)	Less than 20 TK	65.1	50	15.1	1.1	20.36**	(0.002)
	20–40 TK	20.6	12	8.6			
	40–60 TK	7.3	4.7	2.6			
	60+TK	7.0	4.9	2.1			
Smartphone using practice each day	Less than 1 h	6.5	5.7	0.8	1.0	22.64***	(0.001)
	1–3 h	29.3	25.3	4.3			
	3+hours	63.0	40.6	22.4			
Time spent per day on using Facebook	Less than 1 h	49.4	40.4	9.0	1.26	29.17***	(0.000)
	1–3 h	32.5	21.8	10.7			
	3 h+	17.9	9.2	8.7			
Time spent per day on using YouTube	Less than 1 h	46	36.1	9.9	1.25	8.82	(0.357)
	1–3 h	34.4	22.3	12.1			
	3 h+	19.4	13.1	6.3			
Time spent per day on using Messenger using pattern	Less than 1 h	56.5	43.8	12.7	1.4	19.67**	(0.012)
	1–3 h	26.2	18.4	7.8			
	3 h+	17.3	8.9	8.4			

**: Significance at the 0.01 level (1% probability of occurring by chance)

***: Significance at the 0.001 level (0.1% probability of occurring by chance)

Table 4 Causal and motivational factors associated with smartphone addiction proneness

Smartphone/apps as variables	Causal/motivational factors as categories	Total users %	Normal users %	Addicts %	SD	χ2	P-value
Prime causal factors of obsession to smartphone							
Smartphone	Family distance	4.6	3.6	1	1.02	6.60	(0.581)
	Weak social cohesion	2.6	1.3	1.3			
	Mental depression	5.7	3.4	2.3			
	Virtual networking	29.1	22.4	6.7			
	Entertainment	57.8	40.9	16.9			
Prime motivational factors of obsession to smartphone apps							
Facebook	Entertainment	51	35.2	15.7	1.62	9.36	(0.67)
	Virtual friendship	22.3	15.8	6.5			
	Family interaction	16.5	12.9	3.6			
	Study	8.7	6.6	2.1			
YouTube	Entertainment	79.5	55.9	21.2	.94	16.24**	(0.04)
	Study	17.6	14.2	3.4			
Messenger	Entertainment	15.1	9.5	5.7	1.5	23.49**	(0.009)
	Virtual friendship	34.6	23	11.7			
	Family interaction	42.2	33	9.2			

non-addicts 72%). Background variables, preference levels for apps, time spent in different locations, and primary objectives of using apps along with causal factors, and motivational factors were measured to identify determining factors and smartphone use patterns associated with smartphone addiction proneness.

The respondents' socio-demographic variables suggest that university students share similar cultural backgrounds. They generally belong to the youth community and have middle-class or lower-middle-class lifestyles. This similarity can be attributed to their exposure to a popular culture that heavily relies on technology. However, the extent of their orientation toward smartphone use can be measured by symptoms such as 'adaptive dysfunctions,' 'virtual orientation,' 'withdrawal,' and 'tolerance,' which are indicative of addiction behavior (Kim et al. 2014). To understand the factors that contribute to smartphone addiction, we investigated different usage patterns of smartphones and assessed their degree of association with addiction proneness, particularly with respect to popular smartphone apps.

The study found that there were no significant differences in addiction proneness between addicts and non-addicts based on their academic background (such as university-level, faculties, and semesters) or personal background variables

(such as age, gender, and residential types) or family background variables (family with income and education), which is consistent with the findings of previous studies (Cha and Seo 2018; Gökçearslan et al. 2018). The main reason behind the reality is that—people, without significant variation, created a new world through the web's electricity of participation which seems to be a paradise in which 'You and I are alive at this moment' (Carr 2016). This kind of instantaneity resolves the gap between personal, academic, and family background making opportunity for all to be addicted to the smartphone. More importantly, with the digitized communication system and multiple operating systems, the smartphone creates networked individualism Castells (2004), implying that the machinery structure itself instigates compulsive attitudes toward excessive use of smartphones.

However, there was a statistical difference in addiction rates between students attending public universities (20%) and private universities (9%) due to organizational roles and mechanisms. There was also little variation in addiction levels among students of different faculties in both private and public universities, with 11% of "arts and social science" faculty students, 9% of "business studies" students, and 8% of "science" faculty students being addicts. While it is assumed that private university students may face more educational pressure and science faculty students may have a heavier study load, these factors did not produce a significant difference, although there was a visually noticeable difference.

Another factor associated with smartphone addiction was the respondents' preferences and time spent on their devices. Pavia et al. (2016) found that compulsivity and time spent were the main factors contributing to smartphone addiction. Our study revealed that Facebook, Messenger, and YouTube were the most commonly used and preferred apps among the respondents, with a larger proportion of their time spent on these three apps. In fact, most of the respondents did not use other apps at all. Moreover, a higher preference level was associated with spending more than 3 h a day on these apps, which is consistent with a report that found that most young people check their smartphones 150 times a day (Brody 2017). Since smartphone extends communication opportunity through software system with a higher degree of flexibility, metacommunication in virtual space shapes human practices and daily activities; in which smartphone users compulsively spend a huge time (Jensen 2016). Therefore, we can conclude that the prevalent use of smartphones is linked to the use of Facebook, YouTube, and Messenger. Furthermore, the amount of time spent on Facebook was significantly different between addicts and non-addicts, while the amount of time spent on YouTube and Messenger did not predict the degree of smartphone addiction. The practice of smartphone apps recognizes the reality with the logic that Facebook involves communicative social exchange, online shopping, video sharing, selfie programming, recursive posting of Facebook status, instant commenting, replying, and continuous reaction sharing from virtual friends and virtual anonymous strangers. All of those virtual activities on Facebook take a huge time increasingly shifting nature from face-to-face social interaction to virtual interaction (Alter 2017). Alongside, the psychological motive for self-presentation in order to receive lots of virtual appreciation and admiration instigates users to spend more time on Facebook.

However, the study found that the prime objectives of using Messenger and You-Tube were strongly associated with smartphone addiction. The results revealed that a greater tendency towards virtual orientation with Messenger ($\chi2 = 23.49$, $p < 0.009$) and a stronger attachment to YouTube for consuming entertainment ($\chi2 = 16.24$, $p < 0.04$) were major determinants of increasing the level of smartphone addiction. Conversely, the objectives of using Facebook did not significantly differ between the two groups. This may be because Facebook is not solely used for virtual relations with virtual friends but also for maintaining family relations, public presentations, entertainment, and knowledge-related work. However, Messenger and YouTube, which were predominantly used by students for personal enjoyment and the enhancement of virtual relationships, were highly associated with smartphone addiction. These findings are consistent with previous research that has linked virtual orientation and a greater interest in media content (entertainment) with an increased tendency toward smartphone addiction (Jeong et al. 2016; Anshari et al. 2016). The structure of smartphone apps such as YouTube and Messenger hypnotize the users for texting on Inbox or Messenger, playing games, surfing the web, and watching online videos that promote virtual engagement and orientation toward entertainment (Alter 2017). The growing texting communication on Messenger is mainly caused by having more opportunities for maintaining privacy which is seemingly out of surveillance. A more important point is that—smartphone apps are not apps for providing messages but those that can construct the minds and so, smartphone apps stress immediacy, simultaneity, contingency, subjectivity, disposability, and, above all, speed with no incentive to stop. This opportunity of net service may increase multiple romantic dating with elusive entertainment and the elastic nature of virtual engagement.

Other studies have suggested that factors such as parental neglect, frustration-depression, relational maladjustment, and loss of self-control may contribute to smartphone addiction (Walsh et al. 2008; James and Drennan 2005; Ryan et al. 2014). However, our study did not find family distance, weak social cohesion, or mental depression to be significant determinants of smartphone addiction ($\chi2 = 6.6$, $p = 0.58$). In terms of smartphone use patterns, using smartphones for studying or maintaining family contact did not show significant association with smartphone addiction. However, the availability of free Wi-Fi service in student halls and the lower cost of internet service through Wi-Fi in the student mess were found to be significant contributors to smartphone addiction. This is because a higher preference for virtual engagement and entertainment was associated with greater smartphone addiction. Specifically, the excessive use of Wi-Fi internet service weakens the self-controlling mechanism because every time they can read a page of text or click on a link or watch a video, every time they can put something in a shopping cart or perform a search, every time they can send an email or chat in an instant-messaging window, thereby, they spend more time and do more things online resulting in smartphone addiction proneness (Carr 2008).

However, this study is subject to a few limitations. First, the use of stratified random sampling may have increased the risk of confidential data breaches, lack of standardized information, and measurement inaccuracies (Mahmud et al. 2021). Second, respondents found it challenging to remember and provide

accurate answers to questions related to time spent, psychological issues, and sensitive topics during data collection. Third, the use of closed-ended questions restricted responses, limiting the depth of the findings. Finally, the chi-square test only indicates directional relationships between variables and does not assess the strength of the variables. Despite these limitations, the study sheds light on the reality of smartphone addiction and its related factors, with a focus on the variables linked to the most frequently used and time-consuming apps that contribute to different directions of smartphone addiction.

A comprehensive longitudinal study is required to investigate the long-term and diverse impacts of smartphone addiction. Survey research with structured questionnaires may not have effectively captured addiction criteria, and future research may benefit from using in-depth interviews and phenomenology to gather subjective data. Despite some perceived limitations, this study has made notable contributions. It revealed that smartphone addiction is linked to excessive use of three major apps: Facebook, YouTube, and Messenger. Addiction is influenced by emotional individuality, pleasure-seeking behavior, and virtual orientation. Excessive smartphone use can serve three purposes: distorting one's identity, obsessing over entertainment at the expense of social interaction, and habituating to virtual communication to the point of hyper-socialization. The study suggests that the increasing emotional individuality of this cultural group is a significant factor in promoting smartphone addiction, which could ultimately impact the cultural development of university students in Bangladesh. Therefore, it is essential to develop relevant policies to address this issue.

The policy implications for reducing smartphone addiction rely on identifying the key causal indicators. Among these determinants, excessive virtual engagement and entertainment consumption via smartphone apps should be controlled on a priority basis. It is essential to adopt comprehensive training and awareness programs by educational organizations ensuring the involvement of teachers, parents, and students. It is essential to establish a "Digital Management Centre" in all universities and schools that could enhance cognitive power and reduce emotional dependence on Facebook, YouTube, Messenger, and other attractive smartphone apps. Besides, every educational organization must have a formal counseling committee in order to provide sufficient and efficient guidance thereby smartphone addicts would come back to their normal behaviors. Furthermore, an up-to-date educational curriculum should be developed to educate students on how to break free from addictive behaviors.

Declarations

Conflict of interest Authors declare no potential conflict of interest.

Ethical approval Ethical approval was taken from the University of Malaya Research Ethics Committee (UMREC) (Reference no. UM. TNC2/UMREC 537).

Consent to publication Written permission and consent were taken from all respondents. Consent was taken from University of Malaya to publish this paper.

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