ORIGINAL ARTICLE

A survey on smartphone dependence and psychological effects among undergraduate students in a Malaysian University

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ABSTRACT

Objective: Problematic smartphone use (PSU) is the development of pathological dependence at the expense of performing activities of daily living, thus having negative health and psychological impact on the users. Previous PSU studies focused on medical students and little is known regarding its effect on students undergoing other courses. The objective of this study is to identify the pattern of smartphone usage and determine the psychological factors affecting PSU among undergraduate students in Malaysia and compare the pattern among students from different fields of study.

Method: A prospective cross-sectional study was conducted using the validated Smartphone Addiction Scale–Malay version (SAS-M) questionnaire. One-way ANOVA was used to determine the correlation between the PSU among the students categorised by their ethnicity, hand dominance and by their field of study. MLR analysis was applied to predict PSU based on socio-demographic data, usage patterns, psychological factors and fields of study.

Results: A total of 1060 students completed the questionnaire. Most students had some degree of problematic usage of the smartphone. Students used smartphones predominantly to access SNAs, namely Instagram. Longer duration on the smartphone per day, younger age at first using a smartphone and underlying depression carried higher risk of developing PSU, whereas the field of study (science vs. humanities based) did not contribute to an increased risk of developing PSU.

Conclusion: Findings from this study can help better inform university administrators about at- risk groups of undergraduate students who may benefit from targeted intervention designed to reduce their addictive behaviour patterns.

INTRODUCTION

In this digital era, smartphone usage among university students, albeit beneficial in many aspects, has led to problematic overdependence on it. The problem has increased exponentially over the past 10 years.[1] It is estimated that close to 2.32 billion people in the worldwide population own smartphones, whilst in Malaysia, the latest statistics in 2014 recorded 10.31 million active smartphone users i.e. close to 89.4% of the Malaysian population use their smartphones to access the internet.[2,3] Problematic smartphone use (PSU) can be defined as an overdependence on smartphones and the inability to regulate its use, despite experiencing ill-effects and unwelcome consequences in daily living.[4,5] The features of PSU are closely related to the criteria for Internet Gambling Disorder as stated in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5). Despite this, the addicted individuals persist with their behaviour; ignoring adverse consequences and display escalation of the behaviour and demonstrate withdrawal symptoms when they attempt to reduce their addictive behaviour.[6,7]

Numerous somatic and psychosocial ill-effects have been associated with PSU. Specifically, it has been associated with musculoskeletal disorders affecting the fingers/hands/wrist due to the excessive use of the devices.[8] In fact, smartphone overuse is known to lead to sleep problems, and somatic effects such as fatigue, tension, headache and dizziness and social problems.[9] Furthermore, a study conducted in South Korea reported that the social problems caused by PSU were similar to the features of other behavioural addictions.[10]

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Several tools have been developed to measure the severity of PSU, in particular questionnaires have been developed to measure Internet addiction by Kimberly Young in 1998, and a revised version in the Chinese language developed by Chen et al., in 2003, which have been adapted to assess for smartphone addiction or PSU.[11,12] More recently, a group of Korean researchers have modified these questionnaires to suit mobile devices overuse and to assess for PSU.[13] This was the Smartphone Addiction Scale (SAS) questionnaire that was later translated into the Malay language and validated by Ching et al., to suit the Malaysian population, called the Smartphone Addiction Scale-Malay version (SAS-M) questionnaire.[14] Other tools that have been utilised to assess for Internet and smartphone addiction or problematic use include functional magnetic resonance imaging (fMRI) studies that look into the brain regions affected by smartphone overuse.[15]

It is important to note that Malaysia is a multi-ethnic country in South East Asia, however, due to cultural adaptations and adjustments, the various ethnic groups share many similarities based on Asian values and can be considered homogeneous in their smartphone usage behaviours. Furthermore, when focusing on undergraduate university students, it is known that they share almost similar education background and IQ levels. Nevertheless, many of the previous reports on Internet and smartphone usage among young adults have focused on medical students only.[16-18]

There is no data available regarding PSU among students from different fields of study other the medical field.[19] Therefore, we conducted a survey among undergraduate students from a Malaysian public university to determine the pattern of smartphone use among undergraduate students from various fields of study, including medicine, in Universiti Putra Malaysia (UPM), and the psychological effects associated with PSU. We also investigated the perception of the students as to how their smartphone usage affected their academic performance. We were particularly interested to correlate the pattern of usage with the degree of PSU; using the SAS-M questionnaire as a tool to gauge the severity of dependence.

MATERIALS AND METHODS

Subjects Recruitment
After acquiring ethical clearance from the local institutional committee (JKEUPM) (UPM/TNCPI/RMC/1.4.18.2), a prospective cross-sectional study was conducted among the undergraduate students in UPM using convenience sampling method. All the respondents were Malaysian nationals in this study and the students from other countries were excluded. The respondents were recruited via advertisements in student notice boards and through communications with undergraduate course lecturers. The sample size calculation was based on a prevalence study conducted among the student population.[20] The sample size formula is:

$$n_r = \frac{Z^2 P(1-P)}{d^2}$$

with the prevalence of smartphone addiction, =0.084 (16), =1.96 and (precision of an estimate) of 0.0168 generated a required sample size of 1048. In anticipation of potential

dropouts in the study, we distributed 1362 copies of the questionnaires. Participation in this survey was voluntary and the students gave informed consent to participate in the study, in keeping with the Declaration of Helsinki principles. No incentive was provided to the respondents and the students were informed that their responses or denial to join this study would not affect their grades.

Tool for data collection
Smartphone Addiction Scale- Malay version questionnaire (SAS-M)
We employed the SAS-M questionnaire to determine the severity of PSU among students. SAS-M is a validated 33-point questionnaire which was rated using a 6-point Likert scale, ranging from 1 to 6 (1=strongly disagree to 6=strongly agree). This well-structured, self-administered questionnaire was designed and validated in the Malay language by Ching et al., in 2015. The ROC curve gave an optimal AUC of 0.801 (95% CI = 0.746 to 0.855) and best cut-off score for identifying at-risk cases was ≥98, giving a sensitivity of 71.43%, specificity of 71.03%, PPV of 64.10% and NPV of 77.44%.[14] Based upon the cut-off score suggested, students with SAS-M scores of ≥98 were considered to have PSU and those with scores <98 were considered to be using their smartphone at a non-hazardous level.[14]

Depression, Anxiety and Stress scale (DASS-21)
In addition to the SAS-M questionnaire, the respondents also completed a validated 21-item self-reported DASS-21 questionnaire, which was used to evaluate the state of emotional response i.e. depression, anxiety, and stress.[21] Each of these was rated on a four-point Likert scale. The scores ranged from 0=did not apply to them at all, to 4=applied to them most of the time. The following cut-off scores were used for each subscale: depression: normal 0–9, mild 10–13, moderate 14–20, severe 21–27 and extremely severe 28+; anxiety: normal 0–7, mild 8–9, moderate 10–14, severe 15–19 and extremely severe 20+; stress: normal 0–14, mild15–18, moderate 19–25, severe 26–33 and extremely severe 34+.

Data Analyses
Statistical Analysis
The data was analysed using SPSS V25.0 (SPSS 25.0, Chicago, IL, USA). General demographic data of the students was described using tables for categorical data, and medians and ranges for continuous variables. Comparison of continuous variables was performed using the Independent-samples t test. Pearson's correlation was done to determine the strength of the relationship between SAS-M scores and pattern of smartphone usage (years of smartphone use, and duration of smartphone use per day). A p-value <0.05 was considered statistically significant. One-way ANOVA was used to determine the correlation between the patterns of smartphone usage among the students categorised by their ethnic groups, hand dominance and by their field of study. In particular, one-way ANOVA was used to find the association between the average time spent per day using the smartphone with the three different fields of study, i.e., medicine, humanities, and applied sciences. Multilinear regression analysis (MLR) was applied to predict PSU based on socio-demographic data, smartphone usage patterns, psychological factors, and field of study.

RESULTS

We received 1060 completed sets with a response rate of approximately 78%. The respondents, ranging from 17–25 years old, from various faculties in UPM, completed and returned the questionnaires, having a female preponderance ratio of 3:1 as shown in Table I. A major portion of the students were from the Faculty of Medicine and Health Sciences (FMHS) (35.8%); followed by 10.8% of students from the Faculty of Veterinary Medicine, 13.0% from the Faculty of Engineering, 9.8% from the Faculty of Agriculture, 9.0% from the Faculty of Modern Languages and Communication, and the rest of the faculties had smaller percentage of participants. The respondents were grouped into 3 main fields of study i.e. medicine (n=380, 35.8%), applied sciences (n=423, 39.9%), and humanities (n=257, 24.2%) as shown in Table I.

Pattern of smartphone usage
The mean age of students when they first started using smartphones was 13.7 years old; male students (14.20±2.67) and female students (13.52±2.63). Additionally, the number of years they had used a smartphone was significantly greater among the female students (6.65±2.90) as compared to male students (5.80±2.79), p-value<0.001. On average, the respondents spent 8 hours per day using their smartphones. Additionally, female students stayed on their smartphones for significantly longer periods (8.47 hours/day, SD=5.19) as compared to the male students (6.94 hours/day, SD=4.53), p-value<0.001. The Malay students used their smartphones for a longer period of hours in a day, i.e., 8.87±5.16 compared to Chinese (6.31±4.32), Indian (7.16±4.71) and other races, i.e. Punjabis, and various ethnic minorities from Sabah and Sarawak (8.52±5.66) (p<0.05). One-way ANOVA did not show any significant differences in the age of first using smartphones, duration of years using a smartphone and the average time spent per day using a smartphone, in terms of hand dominance. Nevertheless, significant differences were noted among medical, humanities, and applied sciences students for age of first using smartphones and duration of years using a smartphone (p<0.05). One-way ANOVA showed that the average time spent per day using a smartphone did not differ significantly among the three fields of study groups as demonstrated in Table II.

Purpose of smartphone usage
The topmost reason for using smartphones across all courses was for social networking and communications (66.8%) followed by 21% for education-related purposes as illustrated in Figure 1a. Overall, the most widely used smartphone application was WhatsApp (72.0%) followed by Instagram (13.7%) and Facebook (7.5%) as shown in Figure 1b. Most students from all courses (>70%) used WhatsApp as the preferred smartphone application, which is mainly utilised for communication as the posts are not publicly available to users outside of the WhatsApp chat group. Hence, Instagram was noted to be the most popular social networking application (SNA) among the students and has exceeded Facebook usage by approximately 6%.

Prevalence of problematic smartphone use and factors affecting it
The prevalence of PSU among the undergraduate students in

UPM was 60.7% comprising of 643 students (males n=165; female n= 478) out of 1060 total respondents. The remaining 417 students were identified to have healthy levels of smartphone usage (males n=104; females n=313). Among the PSU students, 212 were medical students (33%), 159 were humanities students (24.7%) and 272 were applied sciences students (42.3%). Overall, we noted a higher prevalence of PSU among students in the applied sciences field (64.3%), compared to 61.9% in humanities and 55.8% of the medical students, as shown in Figure 2.

Effects of smartphone usage on the perception of academic performance
Almost half (49.62%) of the students reported that the use of smartphones did not have any effect on their studies, whilst 30.28% reported that smartphones had assisted in improving their academic performance. The remaining 20.09% of students reported that smartphones had caused deterioration of their studies. Students who perceived that they had deterioration in their academic performance had significantly higher SAS-M scores (110.39±27.63) as opposed to students who stated that they had experienced improvement in their studies performance (102.89±25.16).

Psychological well-being
The DASS-21 questionnaire was utilised to assess the emotional states of the respondents which can reflect on their mental wellbeing. Most of our subjects did not suffer from any significant depressive symptoms (53%) and none had major depression. Nevertheless, approximately 17% and 20% of the respondents reported that they had mild and moderate depression, respectively. About 5% of them reported that they had experienced severe depressive symptoms at some point. Furthermore, approximately 8%, 31% and 13% of the respondents reported that they had mild, moderate, and severe degree of anxiety, respectively. Notably, 15% of our respondents declared mild stress symptoms and 9% were found to have moderate stress levels.

Predicting Problematic Smartphone use from socio-demographic factors, smartphone usage pattern, and psychological factors
To test the hypothesis that socio-demographic factors, smartphone usage pattern, field of study and psychological factors can account for a significant proportion of variance in SAS-M score, multiple linear regression (MLR) was performed. Four models of regression analyses were used to predict factors that influenced PSU. Total scores for depression was entered in Model 1; The average time spent per day using smartphone was entered in Model 2; Age of using smartphone was entered in Model 3 and total scores for anxiety was entered in Model 4.

From Table III, age of first beginning to use using a smartphone, the average time spent per day using the smartphone, anxiety, and depression were the only variables that can be included in the multivariable analysis. The four-model summary table from the output results were obtained and Model 4 was chosen because 31.4% of the model variation is explained by the independent variables compared to the remaining models 1, 2, and 3 with 24.2%, 30.1% and 30.8%, respectively. Note that the larger the R and R^2 values, the more accurate we can predict SAS-M.

Table I: Socio-demographic characteristics of respondents (n = 1060)

Variable(s)	Gender	n (%)	Mean ± SD	P value
Age (years)	Male	269 (25.4)	21.17±2.17	0.001[a]
	Female	791 (74.6)	21.11±1.63	
Ethnicity				
Malay		676(63.8)		
Chinese		274(25.8)		
Indian		69(6.5)		
Others		41(3.9)		
Hand Dominance				
Right		945(89.2)		
Left		97(9.1)		
Ambidextrous		18(1.7)		
Field of study				
Medicine		380(35.9)		
Humanities		257(24.2)		
Applied Sciences		423(39.9)		
Family Income				
<RM5000		605(57.1)		
RM5000 – RM10,000		309(29.2)		

Significant at p<0.05

Table II: Pattern of smartphone usage among respondents (n=1060) stratified by field of study

	Faculty	Min-Max	Mean ± Sd	F statistic	P value*
Age of first using smartphone (years)	Medicine	6-21	14.06±2.84	6.820	0.001*
	Humanities	6-19	13.29±2.47		
	Applied Sciences	6-21	13.61±2.55		
Years of using a smartphone	Medicine	1-18	6.29±2.94	4.536	0.011*
	Humanities	1-16	6.12±2.93		
	Applied Sciences	2-19	6.75±2.82		
Average time spent per day in smartphone (hours)	Medicine	1 -24	7.63±4.92	2.456	0.086
	Humanities	1-24	8.25±5.41		
	Applied Sciences	1-20	8.39±4.96		

One-way ANOVA
*Significant at p<0.05

Table III: MLR analysis for predicting SAS-M score

| Variable	Unadjusted (Simple regression)		Adjusted (Multiple regression)		
	B (β, 95%CI)	p value	B (β, 95%CI)	p value	VIF
Age	-0.384 (-1.419, 0.650)	0.466	-	-	-
Age of first using smartphone (years)	-0.858 (-1.537, -0.179)	0.013	-0.944	0.004	1.321
	(-1.590, -0.298)				
Years of using a smartphone	-0.389 (-1.036, 0.258)	0.238	-0.485	0.107	1.313
	(-1.075, -0.106)				
Average time spent per day in smartphone (hours)	0.887 (0.590, 1.184)	<0.001	0.887 (0.590, 1.183)	<0.001	1.013
Stress	0.177 (-0.230, 0.464)	0.509	-	-	-
Anxiety	0.265 (-0.054, 0.585)	0.104	0.320 (0.033, 0.607)	0.029	2.225
Depression	0.504 (0.189, 0.820)	0.002	0.554 (0.280, 0.827)	<0.001	2.210
Sciences-based studies	3.287 (-0.451, 7.205)	0.085	2.928 (-0.657, 6.513)	0.109	1.0611
F value			20.073		
P-value			0.001		
Adj R^2			0.098		
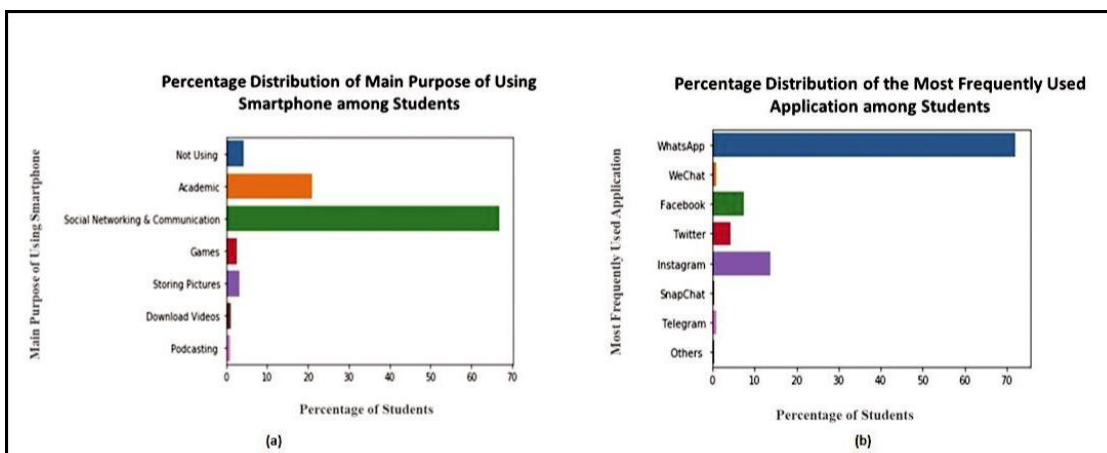
Fig. 1: Pattern of smartphone usage among undergraduate students (a) The Distribution of Main Purpose of Using Smartphones (b) The Most Frequently used
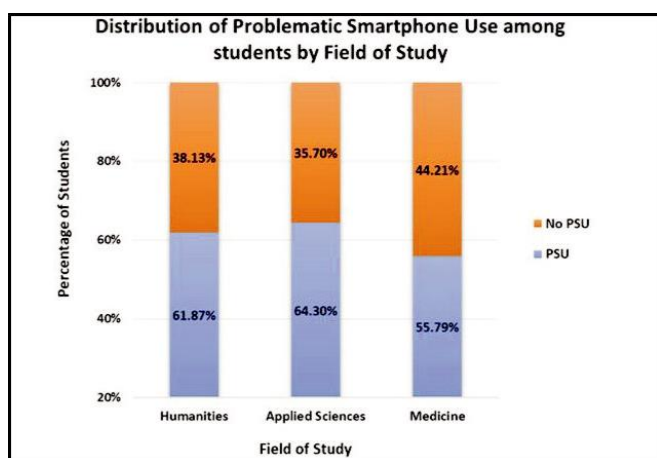
Application on Smartphones

Fig. 2: Distribution of problematic smartphone use among students based

on the field of study

Based on the prediction Model 4 from MLR, the formula to predict SAS-M estimation is SAS-M = 100.943 + [-0.944 ´ age of first using smartphone (AFS)] + [0.887 ´ average time spent per day using a smartphone (ATS)] + [0.320 ´ Anxiety] + [0.554 ´ Depression]. This means that a longer duration spent using the smartphone per day, younger age at first using a smartphone and depression carried higher risk of developing PSU.

DISCUSSION

To the best of our knowledge, this is the first study conducted in Malaysia involving a large population of young adults from a diverse field of study in a public university. Furthermore, the changes in cultural practices among Asian students who have undergone urbanisation is apparent, as we detected a high prevalence of PSU i.e., 60.7% among the undergraduate university students. The rate is generally higher when compared to other countries such as England (10%),[22] Switzerland (16.9%),[23] Germany (23.4%), Spain (20.5%),[24] India (39-44%)[25] and Korea (30.9%).[26] Such higher rate of smartphone addiction/ problematic use in this study may be due to high use of smartphones in

Malaysia. Recent data from the Malaysian Communications and Multimedia Commission showed that smartphone users have increased significantly from 53.4% in 2014 to 78.0% in 2018.[27] Additionally, this prevalence is comparable to a recent study in Malaysia among medical students and staff in a local Malaysian academic institution, that reported 52.2% were having risk of developing SPA based on the SAS-M scores[28], 67% with slight addiction to smartphones in a Middle Eastern population[29], and a study in Saudi Arabia (71.9%) by Venkatesh et al.[30] Furthermore, the variability of this prevalence may be due to the different questionnaires that were used as a tool to survey and score the addictive behaviour, having variable cut-off values, thus giving different results for sensitivity and specificity of the diagnostic ability.

For example, Kwon et al., studied 540 students and identified 24.8% had self-reported smartphone addiction, whereas 17.4% of students responded that they didn't know.[31] Additionally, SAS questionnaire scores with a cut-off score of 33 for girls gave a sensitivity of 0.875 and specificity of 0.886, revealing that 26.6% of girls have smartphone addiction. Conversely, the SAS-M questionnaire that was used to assess our population using the cut-off score of 98 gave a sensitivity of 0.714 and a specificity of 0.710, which indicates lower specificity for detecting PSU. Hence this may have caused an overestimation of the actual figures of PSU in our study population. Considering, the SAS-M is the only validated questionnaire available in the Malay language, we consider this as a limitation in our study. Future validation studies should attempt to re-analyse the wording and scoring of the diagnostic questionnaire to help improve the accuracy of this test.

Our respondents used smartphones for an average of 8 hours per day, which is comparable to studies in other countries like the United States of America that noted an average usage time of 8-10 hours daily.[32] This finding agreed with the observation made by Haug et al., in 2015, which reported that longer duration of smartphone use in a typical day predisposed young adults in Switzerland to have PSU.[33] We noted a higher likelihood of developing PSU when students used their

devices for 9 hours and more per day, as opposed to non-addicted students who used their devices for a mean duration of 7 hours (p<0.001).

Upon evaluating item number 5 in the SAS-M questionnaire, which reads '*Berasa letih dan kurang tidur akibat penggunaan telefon pintar yang berlebihan*' when literally translated means "I feel tired and sleepy due to the overuse of smartphone", we observed that prolonged duration of smartphone usage caused a great increase (48.3%) of our respondents to report having poor sleep quality and experiencing daytime tiredness. This was almost similar to an observation done among Lebanese students, where 35-38% of them experienced similar symptoms that were detrimental to their health.[34] Thus, we recommend that students limit their daily smartphone usage to 7 hours or less to prevent the occurrence of addictive behaviours. Methods that can be utilised include switching off the mobile data and wireless fidelity (WiFi) connection when spending social time with friends and family, during driving and when going to bed.

The majority (69.7%) of our students reported that they used smartphones mainly for social networking purposes followed by for communication purposes. WhatsApp, which was the most commonly utilised mobile application, has gained popularity as an effective communications tool due to its ease to send message, provides group sharing of information and is cost-effective in enabling the users to share images and videos with each other. Nevertheless, the commonest purpose to be online among these students was noted to be for accessing SNA. This may be due to the availability and ease of various SNAs like Facebook, Instagram, and Snapchat, which provide an outlet for the students' socialising needs. The most widely used SNA was Instagram (13.6%) and Facebook (7.5%). This shows the evolution of pattern usage since 2016 whereby another Malaysian study had reported that there was a high Facebook addiction rate of 47% among their students.[35] Instagram users were double the amount of Facebook users in our study population. We postulate that this could be due to the youth who are more inclined to use Instagram because they find it more fun in the aspects of photo-sharing, and sharing their 'daily moments' with their friends and family who follow them; without having to worry about other people 'stealing' their pictures or videos, as they cannot be downloaded and saved directly without the owner's permission. In fact, one of our students responded that 'Facebook is for the older generation' and 'Most of the younger people now use Instagram'.

There was a significant difference in SAS-M scores among students who perceived that they experienced deterioration in their studies compared to those who reported that it improved in their studies, which corroborated with results from previous studies. However, this is a new observation compared to the results reported by Boumosleh & Jaalok in 2017 which had stated that there was no significant correlation between academic performance and PSU.[34] In this instance, students may benefit from using their level of academic performance and its deterioration, as a cue to warn them regarding their addictive behaviours pertaining to smartphone use. Students may try to seek advice from counsellors or academic advisors to overcome this problem. Study by Long et al., among Chinese undergraduate

students identified students majoring in Humanities to have increased risk of developing PSU.[19] In contrast, our study did not identify any predilection for humanities or science-based studies to be a significant predictor of developing PSU. Thus, developing risk of PSU is age and duration of use dependent but not significantly related to the field of study.

The main limitation of this study is the dependency on self-reported data. If we were able to access more primary information, it would provide us with more accurate data on the actual pattern of usage among the students. Furthermore, regarding usage of social networking services, more information is needed with regards to the nature of their interactions, e.g., the type of photos uploaded on Instagram and whether other types of addiction, e.g., substance use disorders mediated this. There is also a potential to delve further into the effects of peer pressure and conformation to social norms among the youth of this millennium in future studies.

CONCLUSION

Proper utilisation of smartphones must be inculcated among the students to prevent any untoward effects and academic deterioration. Findings from this study can help better inform university administrators about at-risk groups of undergraduate students who may benefit from targeted intervention designed to reduce their addictive behaviour patterns.

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DECLARATION OF CONFLICTING INTEREST

The authors declare that there is no conflict of interest.

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