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ESTIMATING PREVALENCE AND PATTERNS OF PROBLEMATIC SMARTPHONE USE AMONG NURSING AND PUBLIC HEALTH STUDENTS: A CROSS-SECTIONAL INVESTIGATION

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Abstract

BACKGROUND: The popularity of smartphones and their excessive usage led to the introduction of the term problematic smartphone use (PSU). Whereby PSU can lead to various negative mental and physical consequences.

AIM: This study aims to investigate prevalence and patterns of PSU among nursing and public health students at the University of Sunderland in London (UoSiL).

METHODS: A cross-sectional study was carried out between June and September 2022 utilising a pre-validated questionnaire.

RESULTS: A total of 262 students participated in this study consisting of 195 females and 67 males. The overall prevalence of PSU was 46.6%, whereby a positive correlation between young age and PSU ($r = 0.152$, $r2 = 0.23$, $\alpha = 0.014$) could be found. Furthermore, a significant association between daily hours spent on smartphones and PSU ($p < 0.002$) with a positive correlation for higher numbers of daily smartphone usage ($r = 0.253$, $r2 = 0.064$, $p < 0.001$) was seen. Also, significant results were calculated focusing on social media with a higher possibility for PSU in students using mostly TikTok or Facebook compared to those who mainly used Twitter or Instagram. Students who did not use social media at all had the smallest risk for PSU.

CONCLUSION: A high prevalence of PSU among university students was seen. Young age and a high number spent on phones were discovered as predictive factors. It is important to raise awareness among students and conduct future longitudinal studies to get a better understanding of causal relationships.

Keywords: cross-sectional study, problematic smartphone usage, smartphone addiction, university students, England

Introduction

In 1997, cell phone manufacturer Sony Ericsson had the idea for the first smartphone. In contrast to common cell phones with unchangeable features like calendar, games or music, a smartphone should be a multipurpose device with: "the ability to run software programs, later called 'apps,' that enabled them to perform tasks that had not been envisaged when the phone was manufactured" (1). Since then, the popularity of smartphones steadily grows worldwide (2). To make a statistical statement about percental smartphone users in a specific county the penetration rate is often used. With around 80%, the United States, the UK, and France had the highest penetration rates among their population worldwide in 2021 (3). The Deloitte Consumer Survey 2018 reported that 95% of smartphone users in the UK were between 16 and 75 years old. Excessive smartphone use was particularly reported in the age group between 16 to 24 years (4). The success of smartphones came with their simplicity and availability. The fact that such technical devices interfere with many aspects of life, such as verbal and nonverbal communication, work and study, makes it difficult to define when an overuse can be seen as excessive, problematic or even unhealthy (5, 6).

Studies investigated that people get anxious when separated from their phones and can evidence withdrawal-like symptoms (7, 8). Furthermore, various studies focusing on mental health and PSU observed significant correlations between anxiety, depression, sleep problems and PSU (9-11). Also, physical consequences such as an increased risk of myopia due to increased screen time, and higher reports of thumb and wrist pain among children with PSU were published (12, 13). Although knowledge about negative effects of PSU is increasing, scientists disagree on whether an excessive usage can be considered as behavioural addiction (9, 14). To date, there is no scientifically verified definition of smartphone addiction. Because the term "addiction" is arguably overused and the concept of smartphone addiction is controversially discussed, the term PSU is commonly applied in other literature and will be utilised in context of this paper (9, 15-17).

This research study tries to contribute a part in solving the riddle behind PSU by analysing behavioural structures of students. This population group was deliberately chosen because students represent a particularly vulnerable group for PSU (4). To conclude, this study aims to identify prevalence and patterns of PSU among nursing and public health students from the UoSiL.

Methods

Study design and sample

This study used a cross-sectional design including males and females from every nationality who studied nursing or public health at the UoSiL over the age of 18 years. Utilising the mathematical formula for finite population, 211 surveys were needed for a confidence interval (CI) of 95%. After including a 10% default rate, this research study aimed to generate 232 responses using a purposive sampling technique.

Questionnaire

Overall, this study used a self-administrated questionnaire which consisted of three parts:

(1) A demographic part including gender, age, marital status, living and employment situation.

(2) General information of smartphone consumption, which included the variables apps used on average day, app notification, most often used social media, reasons for using apps and daily hours spend on phone.

(3) The last part consisted of the short version of the Smartphone Addiction Scale (SAS-SV). SAS-SV is a validated and widely used tool to assess PSU and is already translated into several languages such as Italian (18), Portuguese (19) and German (20). It is adopted from its original longer version and contains 10 items, which are rated on a self-administrated Likert scale ranging between 1 (strongly disagree) to 6 (strongly agree). Kwon et al. (2013) the SAS-SV into six different content domains including positive anticipation, withdrawal symptoms, cyberspace-

oriented relationship, tolerance, overuse, and daily-life disturbance. One of the main advantages of this questionnaire were clear cut-off points with 31 points for males and 33 for females. Equivalent to PSU at a score of 31 for males and 33 for females (21).

Data Analysis

In this study, a significance level (α) of 0.05 was interpreted as statistically significant and a CI of 95% was used. Descriptive and interferential analysis was undertaken using IMB SPSS 24 software. For descriptive statistics, categorical variables (see Table 1) were expressed as frequency and percent. As seen in Table 1, different statistical tests such as Chi-Square test , ANOVA and Correlation were utiliseddepending on the measurement scale. Whereby calculations were done, assuming that the variables "SAS" and "Has student PSU" to be the dependent variables.

Variable Name	Type of Variable	Possible Answers	Unit	Statistical Test
Gender	Nominal/Categorical	Male, Female, Other	-	Chi-Square
Age	Ratio/Continuous	0 - 100	Years	One-way ANOVA[a]
Marital Status	Nominal/Categorical	Single, Married, Divorced, Separated	-	Chi-Square
Course enrolled	Nominal/Categorical	Nursing, Public Health	-	Chi-Square
Living with Family	Nominal/Categorical	Yes, No	-	Chi-Square
Living alone	Nominal/Categorical	Yes, No	-	Chi-Square
Currently employed	Nominal/Categorical	Yes, No	-	Chi-Square
Do you have any children?	Nominal/Categorical	Yes, No	-	Chi-Square
How long have you been using smartphones?	Ordinal/Categorical	Up to 7, more than 7	Years	Chi-Square
Apps used on an average day	Ordinal/Categorical	1 -3, 4-5, >5	-	Chi-Square
Do you use app notifications?	Nominal/Categorical	Yes, No	-	Chi-Square
Which social media do you use more frequently?	Nominal/Categorical	Facebook, Twitter, TikTok, Instagram, None of them	-	One-way ANOVA[a]
How long is your approximate smartphone screen time?	Ordinal/Categorical	< 1, 1-2, 2-3, 3-4, > 4	Hours	Correlation
SAS	Interval/Continuous	10 - 60	-	-
Has student PSU	Ordinal/ Categorical	0, 1	-	-

Table 1: *Measurement scale of variables and statistical tests used*
a. analysis of variance (ANOVA)

Ethical Approval

This study was ethically approved on the 27th of May 2022 by the University of Sunderland´s ethics reviewers (Reference Number 012587). Prior every participation, students received detailed information about the study itself, as well as potential personal advantages or disadvantages. Furthermore, every student was informed about their right to refuse to participate in this study. An informed consent form had to be signed before participation.

Results

265 students finished the created questionnaire including 10 pilot study surveys. This leads to a response rate of 56.1%. For the final calculation 3 responses had to be eliminated because of

incomplete data resulting in a total of 262 participants, whereby 195 (74%) were female and 67 (25%) male (Table 2). About half of the participants lived together with their family and 35% stated that they were living alone. Two-thirds of students worked and only 35% were unemployed. The participant´s age varied between 20 to 59 years with a mean of 30 whereby most students were between 20 to 34 years old.

		Frequency	Percent
Gender	Female	195	74,4
	Male	67	25,6
	Total	262	100,0
Marital Status	Single	151	57,6
	Separated	6	2,3
	Married	101	38,5
	Divorced	4	1,5
	Total	262	100,0
Living with Family	No	121	46,2
	Yes	141	53,8
	Total	262	100,0
Living alone	No	168	64,1
	Yes	94	35,9
	Total	262	100,0
Currently employed	No	90	34,4
	Yes	172	65,6
	Total	262	100,0

Table 2: *Demographics*

Prevalence and Sociodemographic Pattern

In this study 122 out of 262 university students suffered from PSU, resulting in a prevalence of 46.6%. As seen in Table 3, Male students had a significant (p = 0.012) higher probability of PSU and were two times more likely (Cl: 1.60 – 3.59) to suffer from it compared to women.

Crosstab

		Has student PSU? 0	1	Total
Female	Count	113	82	195
	within Gender	57,9%	42,1%	100,0%
	within PSU	80,7%	67,2%	74,4%
Male	Count	27	40	67
	within Gender	40,3%	59,7%	100,0%
	within PSU	19,3%	32,8%	25,6%
Total	Count	140	122	262
	within Gender	53,4%	46,6%	100,0%
	within PSU	100,0%	100,0%	100,0%

Chi-Square Test Gender

	Value	df	Asymptotic Sig. (2-sided)	ExactSig. (2-sided)
Pearson Chi-Square	6,243[a]	1	,012	
Continuity Correction[b]	5,554	1	,018	
Likelihood Ratio	6,250	1	,012	
Fisher's Exact Test				,016
Linear-by-Linear Association	6,220	1	,013	
N of Valid Cases	262			

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 31.20.
b. Computed only for a 2x2 table

Table 3: *Chi-Square test Gender and PSU*

Furthermore, a positive correlation between SAS and age (r = 0.152, r2 = 0.23, p = 0.014) was seen (Table 4). The median SAS score was higher among younger students with the tendency to decrease in older ones (Figure 1).

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	782,902	1	782,902	6,180	,014[b]
	Residual	32937,128	260	126,681		
	Total	33720,031	261			

Table 4: *Comparison of means between Age and SAS*
a. Dependent Variable: SAS
b. Predictors: (Constant), Grouped Age in 5a intervals

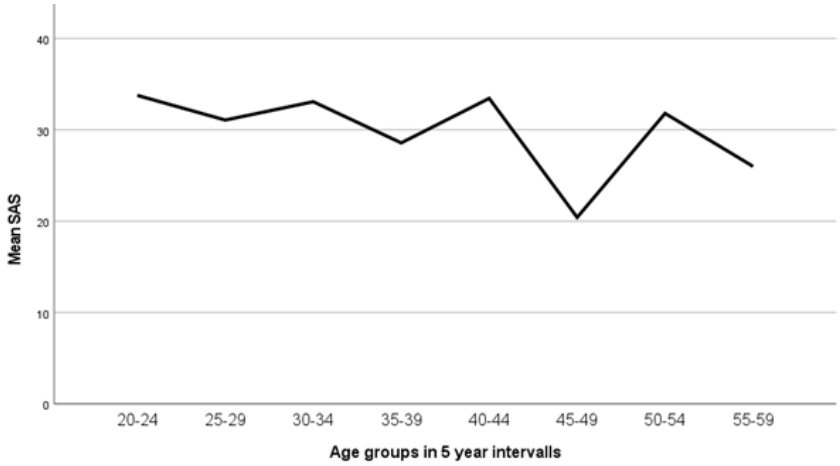

Figure 1: *SAS in relation to age (grouped in 5-year intervals)*

Smartphone Usage Pattern

An increasing trend of PSU and number of apps used daily could be seen whereby no statistically significant result was found (p = 0.414). However, 40% of participants who used 1 to 3 apps per day suffered from PSU, 48% of students who used 4 to 5 apps, and 50% of the group who used more than 5 apps per day. Moreover, no association between PSU and duration of phone usage (p = 0.834) or app notification (p = 0.576) was found. As seen in Table 5, 40% of students with PSU were using their phones for over 4 hours. Leading to a significant association between PSU and approximate screen time (p = 0.002). In the group of students who were using their phones over four hours, about 66% suffered from PSU. Compared to that, only 37% of students who used their phone between 1 to 2, 2 to 3 or 3 to 4 hours had PSU. As seen in Table 6, a linear regression model was used to identify approximate screen time as a predictive factor with a highly significant correlation between it and PSU (r = 0.253, r2 = 0.064, p < 0.001).

Crosstab Approximate Screen Time

		Has student PSU?		
		0	1	Total
< 1 hour	Count	21	19	40
	Approximate Screentime	52,5%	47,5%	100,0%
	PSU	15,0%	15,6%	15,3%
1 - 2 hours	Count	35	21	56
	Approximate Screentime	62,5%	37,5%	100,0%

Chi-Square Tests Approximate Screen Time

	Value	df	Asymptotic Significance
Pearson Chi-Square	16,553[a]	4	,002
Likelihood Ratio	16,730	4	,002
Linear-by-Linear Association	6,163	1	,013
N of Valid Cases	262		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 18.63.
b. 2-sided

	PSU	25,0%	17,2%	21,4%
2 - 3 hours	Count	32	17	49
	Approximate Screentime	65,3%	34,7%	100,0%
	PSU	22,9%	13,9%	18,7%
3 - 4 hours	Count	27	17	44
	Approximate Screentime	61,4%	38,6%	100,0%
	PSU	19,3%	13,9%	16,8%
> 4 hours	Count	25	48	73
	Approximate Screentime	34,2%	65,8%	100,0%
	PSU	17,9%	39,3%	27,9%
Total	Count	140	122	262
	Approximate Screentime	53,4%	46,6%	100,0%
	PSU	100,0%	100,0%	100,0%

***Table 5**: Chi-Square test Screentime and PSU*

Correlations

		SAS_Score	Approximate Screentime_Trans
Pearson Correlation	SAS_Score	1,000	,253
	Approximate Screentime_Trans	,253	1,000
Sig. (1-tailed)	SAS_Score	.	<,001
	Approximate Screentime_Trans	,000	.
N	SAS_Score	262	262
	Approximate Screentime_Trans	262	262

***Table 6:** Correlation between Screentime and PSU*

When it comes to the most used social media a significant association (p = 0.012) with PSU was examined. About 63% of TikTok users, 56% of Facebook users and 40% of Instagram users faced PSU (Table 7). The median overall SAS was much higher in students using mostly TikTok (mean SAS 37) or Facebook (mean SAS 35) compared to those who mainly used Instagram (mean SAS 27) or no social media (mean SAS 22). Moreover, an ANOVA model led to the result that there is a significant correlation (r=158, r2 = 0.25, p = 0.011) between the most frequently used social media and PSU (Table 8).

Crosstab most frequent social media

		Has student PSU?		
		0	1	Total
Facebook	Count	40	50	90
	frequent social media	44,4%	55,6%	100,0%
	PSU	28,6%	41,0%	34,4%
Twitter	Count	5	9	14

Chi-Square Tests most frequent used social media

	Value	df	Asymptotic Significance [b]
Pearson Chi-Square	12,933[a]	4	,012
Likelihood Ratio	13,189	4	,010

	frequent social media	35,7%	64,3%	100,0%
	PSU	3,6%	7,4%	5,3%
Tiktok	Count	6	10	16
	frequent social media	37,5%	62,5%	100,0%
	PSU	4,3%	8,2%	6,1%
Instagram	Count	67	45	112
	frequent social media	59,8%	40,2%	100,0%
	PSU	47,9%	36,9%	42,7%
None of them	Count	22	8	30
	frequent social media	73,3%	26,7%	100,0%
	PSU	15,7%	6,6%	11,5%
Total	Count	140	122	262
	frequent social media	53,4%	46,6%	100,0%
	PSU	100,0%	100,0%	100,0%

Linear-by-Linear Association	9,447	1	,002
N of Valid Cases	262		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.52.
b. 2-sided

Table 7: *Chi-Square test most frequent used social media and PSU*

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	839,801	1	839,801	6,641	,011[b]
	Residual	32880,230	260	126,462		
	Total	33720,031	261			

Table 8: *Comparison of means between most frequent used social media and SAS*
a. Dependent Variable: SAS
b. Predictors: (Constant), Most frequent social media

Discussion

Prevalence and Sociodemographic Pattern

One main aim of this research study was to determine the prevalence of PSU among university students. Our findings could confirm that the prevalence in university students can be considered as high with 46.6% of students at the UoSiL suffering from it. These results are verified by Zhong et al. who carried out a meta-analysis focusing on prevalence rates in Asian medical students, summarising that 42% (95% CI [36.24%, 47.72%]) of their study population had PSU (22). Also, Alageel et al. and Dharmadhikari et al. showed similar results with a prevalence rate of 51% and 46% in their cross-sectional studies (23, 24). The only study found that focused on PSU prevalence among British adolescences was published by Lopez-Fernandez et al. in 2013. The researchers summarised that 10% of 1,529 secondary school pupils suffered from PSU. Even though this cross-sectional study focused on a slightly different population group (11- to 18-year-old), results are alarming. If we can assume that in 2013 only 10% and in 2022 already 43% are affected by the problem of PSU, public health measures must be introduced quickly to draw attention to this issue. One reason for the high

prevalence rates in university students could be the fact that a lot of learning and study material is available online nowadays. Another potential reason is that smartphone usage raised significantly during the COVID-19 pandemic and is now embedded as a fixed habit in our society. An Italian cohort study analysing pre-pandemic and COVID-19 data concluded that phone use frequency was significantly higher during the pandemic than before. About 66% of their participants spent over 4 hours a day on their phones during COVID compared with only 16% before (25).

Furthermore, our findings determined that male students had a twofold increased risk for PSU compared to females. However, previous publications on gender patterns are inconsistent. Some studies did not show any association between PSU and gender (26-28), some showed a positive association (29) when it comes to female gender and some other published a positive association for male gender (30, 31). The reason for this high variance can be multifactorial and should be always contextualised. Therefore, it can be summarised, that our study results reflect a negligible association relationship between gender and PSU which does not have any impact on further recommendations.
Considering the factor age, we could identify young age as a predictive marker when it comes to PSU. These results stay in line with already published literature, showing a higher risk for PSU among younger people (32, 33). Furthermore, researchers published significant associations between PSU and a young age of first smartphone usage (34, 35).

Smartphone Usage Pattern

Our study indicates that there is a strong association between smartphone usage patterns and the variable PSU. We could indetify increased hours spent on the phone as predictive factor ($r = 0.253$, $r2 = 0.064$, $p < 0.001$) for PSU. Therefore, this variable has a potential to monitor excessive smartphone behaviour in clinical settings. In this study, about 38% of students who used their phone for 1 to 2 hours, 35% of students who used their phone for 2 to 3 hours, 39% of students who used their phone for 3 to 4 hours, and 66% of students who used their smartphone for over 4 hours suffered from PSU. Which in turn reflects a steady increase of PSU probability in relation to hours spent on smartphone. These results have already been confirmed by other studies and stay in line with already published literature (36, 37). Some researchers even suggest that a predefined number of hours spend on smartphone indicates whether a person has PSU or not (38-40). Therefore, it is important to consider this variable when it comes to creating a valid clinical measurement.

However, not every high smartphone usage can be equated with PSU, as phones are already indispensable for certain occupations (41). That is why more attention must be paid to the reason for usage. Al-Mohaimeed et al. and Laurence et al. investigated, that students using their smartphones for social media, communication or entertainment reasons significantly suffered more from PSU than students using their phones for other reasons like work, religion, or education (42, 43). According to our study, it even makes a difference which social media website is mainly used. Students are particularly at risk for PSU when they are increasingly using TikTok or Facebook ($p = 0.012$).

Limitations

One limitation of this study comes with the taken study design. The cross-sectional design only analyses observed target variables at exactly one specific time point. Therefore, results cannot give causal assumptions about exposure and outcome. Furthermore, this study only included students from one university studying a specific subject. Therefore, results are not representative or generalizable for other universities. Another limitation came with the data collection process because this study used a self-reported questionnaire which makes it prone to recall bias.

Conclusion

Results of this study suggest that the prevalence of PSU among university students can be considered as high with 46.6%. Additionally, PSU positively correlated with a young age and a high number of

daily hours spend on smartphones. Whereby, it is not only important how many hours someone spends on their smartphone, but also the reason for its usage. Furthermore, it must be highlighted that it is time for stakeholders and public health advocates to take action and design preventative programs to raise awareness for PSU. Future longitudinal studies are needed to analyse causal relationships between potential predictive factors and PSU.

Conflicts of Interest

There are no conflicts of interest.

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