

## Original article

# Depression, smartphone addiction and association factors among preclinical medical students

Aticha Wattanaudomchai<sup>a</sup>, Sookjaroen Tangwongchai<sup>a</sup>, Decha Lalitanantpong<sup>a</sup>

<sup>a</sup>Department of Psychiatry, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand

**Background:** There were few studies of smartphone addiction behavior has been found in preclinical medical students.

**Objective:** To determine the prevalence and associated factors of depression of smartphone addiction behavior among preclinical medical students of Chulalongkorn University.

**Methods:** This is a cross-sectional descriptive study. The data were collected from preclinical medical students at Chulalongkorn University in 2020 academic year, prior to COVID-19 pandemic in Thailand. The instruments included the Smartphone Addiction Scale Thai version (SAS-SV-TH), Patient Health Questionnaire-9 Thai version (PHQ-9-T), Pittsburgh Sleep Quality Index Thai version (PSQI-T), and Thai Interpersonal questionnaire. The data were analyzed using SPSS version 25. Univariate analysis was performed to analyze for associated factors and Multiple logistic regression was used to calculate the adjusted odd ratio of depression and smartphone addiction.

**Results:** The study recruited 343 preclinical medical students with a mean age of  $19.6 \pm 1.3$  years old and half of the subjects were males. The prevalence of smartphone addiction was 42.9 %. Depression and poor sleep quality were reported in 25.4% and 11.4% of the subjects, respectively. After adjusted the variables from univariate model, the significant factors of depression were smartphone addiction (2.025; 95% CI 1.163 – 3.524), poor sleep quality (6.767; 95% CI 3.110 – 14.725), having underlying physical illness (2.99; 95% CI 1.583, 5.647), being female (1.76; 95% CI 1.000 – 3.098, GPA < 3.5 (2.995; 95% CI 1.624 – 5.523) and not interested in studying Medicines (2.537; 95% CI 1.262 – 5.103). The significant factors that associated with smartphone addiction were depression (2.115; 95% CI 1.263 – 3.541), regular alcohol drinking (3.783; 95% CI 1.248 – 11.465), interpersonal deficits (1.733; 95% CI 1.099 – 2.732) and 2<sup>nd</sup> year students (2.404; 95% CI 1.357 – 4.258).

**Conclusion:** Smartphone addiction, poor sleep quality, study related problems were associated with depression. Four significant factors that associated with smartphone addiction were depression, class year, regular alcohol drinking, and interpersonal deficits. Smartphone addiction, sleep quality, underlying physical illnesses, gender, GPA and not interested in studying Medicines are associated with depression in preclinical medical students.

**Keywords:** Depression, medical student, smartphone addiction.

Depression was a common psychiatric problem. According to statistics from the World Health Organization in 2017, there were approximately 264 million people suffering from depression worldwide, or 3.6% of the world's population, with the majority of 1 in 3 living in Southeast Asia. It was found that people with depression in the 15 - 24 year-age group had a global prevalence of 36 million or 3.1% of the world population.<sup>(1,2)</sup> In Thailand, a survey

of the prevalence of depression in 2008 found that the prevalence of depression among all Thai people aged 15 years and over was 1.4 million or 2.7%, with women having 1.7 times higher risk of having such symptom than men.<sup>(3)</sup>

Regarding the literature review of both in Thailand and abroad, several studies have been found to be associated with depression among medical students. It was found that medical students worldwide had an average prevalence of depression of 27.2 – 28.0%<sup>(4,5)</sup> and having thought of death was reported around 11.0%<sup>(4)</sup>; this was 9 times higher than the prevalence of depression in the same age group.

Mental health problems could be seen as an important problem especially in medical students who were considered to be in a high-stress group, thus

**\*Correspondence to:** Aticha Wattanaudomchai, Department of Psychiatry, Faculty of Medicine, Chulalongkorn University, Bangkok 10330, Thailand.  
E-mail: cooookies262@gmail.com

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being prone to depression. Several studies have looked at factors associated with depression in medical students. It was found that the factors associated with depression were problems relating to study issues, relationship, family, and sleep.<sup>(6, 7)</sup> Moreover, it was found that gender, class year, and domicile also affected mental health problems. Female medical students were 1.73 times more likely to have mental health problems than its male counterparts. Meanwhile, second-year medical students were 3.56 times more likely to have mental health problems than first-year medical students, and those residing in rural areas were 2.01 times more likely to have mental health problems than medical students residing in cities.<sup>(8)</sup> Another study found that medical students residing in Bangkok Metropolitan Region were more associated with depression than those residing in other provinces.<sup>(7)</sup>

Over the past decades, smartphone use has been more prevalent than ever before especially among youth and adolescents: the age group being prone to mental health deterioration. It was at that time that the study of smartphone addicted issue was initiated. There has been a rise of the research in problems of smartphone use among youth and adolescents. Based on a study by Sohn S. and his colleagues who compiled research from 2011 - 2017, it was found that the average prevalence of smartphone addiction among youth and adolescents was 23.3%; a percentage of which presented 17 - 19 year-old women<sup>(9)</sup> as the dominant group in smartphone addiction in terms of age and gender. Additionally, it was also found that this behavior was significantly associated with mental health problems such as depression, anxiety, stressful conditions, and sleep.<sup>(9, 13 - 16)</sup>

In terms of the relationship between smartphone addiction and depression, several studies have found that smartphones were used to deflect negative moods. For example, people with depression used smartphones to manage depressed mood, leading to more problems with smartphone use<sup>(10)</sup>; while people with chronic stress used online games to relieve stress.<sup>(11)</sup> This was also applied to excessive smartphone use before bedtime which would disturb their sleep, resulting in stress and depression.<sup>(12)</sup> Additionally, a bidirectional correlation between smartphone use and depression was reported. For example, people with depression used smartphones to manage their depressed mood which further affected their sleep and led to a vicious cycle of depression.<sup>(10)</sup>

Mental health problems were considered important issues especially in medical students who were considered as a high-stress group and risking for depression. Smartphone addiction behavior was a widespread problem these days and was associated with depression. According to a recent literature review, there were several studies in Thailand which have looked at stress and depression among medical students; while no study of smartphone addiction behavior has been found in this population before. Therefore, the purpose of this study was to determine the prevalence and related factors of depression and smartphone addiction behavior among preclinical medical students.

## Materials and methods

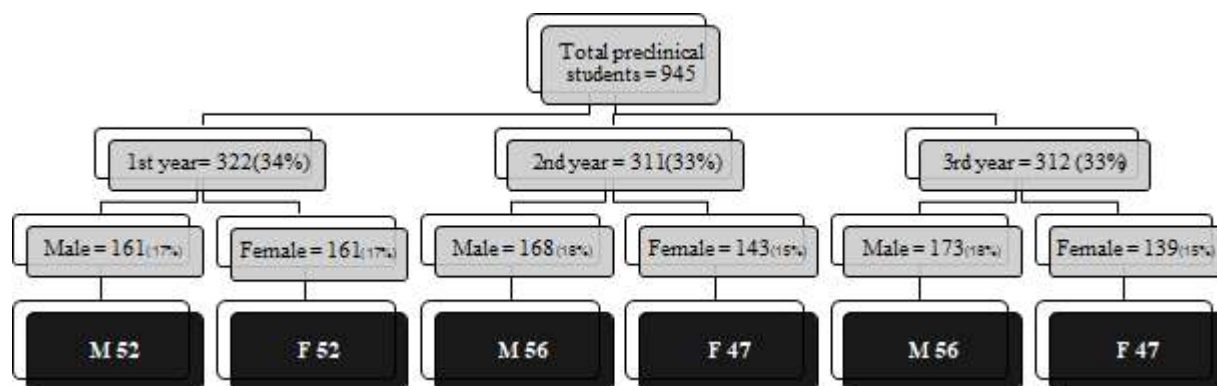
This is a cross-sectional descriptive study. The data were collected from preclinical medical students at Chulalongkorn University in 2020 academic year. Data were collected between November 2020 and April 2021, just prior to COVID-19 pandemic in Thailand.

The sample size was calculated by utilizing Yamane's Formula.<sup>(13)</sup> The whole population were 945 students and at least 282 subjects were needed. However, to minimize incomplete data we added number of subjects 10.0% was added. Thus, 343 students were recruited by stratified random sampling technique based on class year and gender as shown in Figure 1 below.

Inclusion criteria of this study were preclinical medical students at Chulalongkorn University in academic year 2020 who were capable of providing consent for participation and can communicate in Thai language. The students dropped out were not included in this study.

This study has been approved by the Research Ethics Committee of the Faculty of Medicine, Chulalongkorn University (COA 845/2020). Each subject was informed about the research objectives and details before giving the written informed consent to participate in this research.

The research questionnaires were comprised of five parts; including the questionnaire assessed for demographic and clinical data, the Smartphone Addiction Scale: Thai Short Version (SAS-SV-TH)<sup>(14, 15)</sup>, the Patient Health Questionnaire-9 Thai version (PHQ-9) for screening of depression<sup>(16)</sup>, Thai version of the Pittsburgh Sleep Quality Index (PSQI)<sup>(17, 18)</sup> and Thai interpersonal questionnaire.<sup>(19)</sup> All questionnaires were standard tools.



**Figure 1.** Stratified random sampling technique based on class year and gender.

- The SAS-SV is a validated scale that contains 10 items rated on a dimensional scale [ranging from 1 (*strongly disagree*) to 6 (*strongly agree*)]. The total score ranges from 10 to 60, with a score of  $\geq 31$  in men,  $\geq 33$  in women being defined as smartphone addiction. Cronbach's alpha = 0.94 (each item 0.76 - 0.97)
- The PHQ-9 is a 9-item measure of depressive symptoms directly based on DSM-IV-TR criteria for major depressive disorder. The cut-off point score for depression was  $\geq 10$  sensitivity = 0.84, specificity = 0.77, Cronbach's alpha = 0.79
- The PSQI consisted of 19 questions to assess 7 domains of sleep quality. The cut-off point score for bad sleep quality was  $> 5$  sensitivity = 0.77, specificity = 0.93, Cronbach's alpha = 0.83
- The interpersonal questionnaire consisted of 4 domains of interpersonal problems;
  - Domain 1 Grief; Cronbach's alpha coefficient at 0.79
  - Domain 2 Interpersonal disputes; Cronbach's alpha coefficient at 0.96
  - Domain 3 Role transitions; Cronbach's alpha coefficient at 0.96
  - Domain 4 Interpersonal deficits; Cronbach's alpha coefficient at 0.82

### Statistical analysis

Statistical data were analyzed by statistical package for the social sciences (SPSS) for Window Version 25.0. We reported the prevalence and descriptive statistics of depression, smartphone addiction, sleep problem in mean  $\pm$  standard deviation (SD), interpersonal problem, study issues in frequency and percentage. Univariate analysis was performed using the unpaired Student *t* - test and Mann-Whitney U-test for continuous data and Chi-square test and Fisher Exact test for categorical data. Multivariate analysis was performed using logistic regression

models to study associations between depression and smartphone addiction. The models were adjusted for variables that significant on univariate analysis. The results were reported as the adjusted odds ratios (ORs) with 95% confidence intervals (CIs). *P* - value  $< 0.05$  was considered statistically significant.

## Results

### Demographic characteristics

We recruited 343 preclinical medical students of Chulalongkorn University with completely collected data. Subjects consisted of 106 (30.9%) first-year students, 112 (32.7%) second-year students, 125 (36.4%) third-year students. The result showed that mean age of students was 19.7 years with standard deviation of 1.3 years. Half of the subjects were male. More than half of our students (55.7%) had GPA of  $\geq 3.50$ . One-fifth of the students (20.1%) had underlying physical illnesses and allergic rhinitis was the most common reported illnesses (75.0%). Psychiatric disorders were found in 7 subjects (2.0%). There were 5.0% of the students reported regular alcohol drinking and 3 subjects reported smoking cigarettes. The demographic and clinical characteristics were shown in the Table 1.

### Prevalence of depression and smartphone addiction

As shown in Table 1, there were 25.4% of the subjects had the PHQ-9 scored  $\geq 10$  which could be implied of having depression. The prevalence of smartphone addiction was 42.6%. Most of the students ( $n = 304$ , 88.6%) had good sleep quality. The majority of students had well-adapted interpersonal skills except for interpersonal deficits domain which half of them had moderate to severe problems. Almost three quarters of the students reported study related problems.

**Table 1.** Demographic and clinical characteristics of preclinical medical students (n = 343).

	Total (n = 343)	
	N	Percentage
<b>Gender:</b> Male	172	50.1
<b>Age:</b> Mean $\pm$ SD (years)	19.7	$\pm$ 1.3
Median (Min - Max)	20	(18 - 22)
<b>Class year</b>		
Year 1	106	30.9
Year 2	112	32.7
Year 3	125	36.4
<b>Incomes (Baht per month)</b>		
Mean $\pm$ SD	10,073.33	$\pm$ 4,759.73
Median (Min - Max)	10,000	(1,000 – 30,000)
< 10,000	122	47.8
10,000 – 15,000	107	42.0
> 15,000	26	10.2
<b>GPA</b>		
$\leq$ 2.99	49	14.3
3.00 - 3.49	103	30.0
$\geq$ 3.50	191	55.7
<b>Underlying physical illnesses</b>	69	20.1
Allergic rhinitis	54	15.8
Anemia	6	1.8
<b>Underlying psychiatric disorder</b>	7	2.0
Depression	3	0.9
ADHD	2	0.6
Anxiety	2	0.6
<b>Family history of psychiatric disorder</b>	15	4.4
Family history of depression	5	1.5
Smoking	3	0.9
Regular alcohol drinking	17	5.0
Depression	87	25.4
Smartphone addiction	146	42.6
Poor sleep quality	39	11.4
<b>Interpersonal problems</b>		
<b>Domain 1 Grief</b>		
No to minimal	267	77.8
Moderate to severe	76	22.2
<b>Domain 2 Interpersonal disputes</b>		
No to minimal	274	79.9
Moderate to severe	69	20.1
<b>Domain 3 Role transitions</b>		
No to minimal	276	80.5
Moderate to severe	67	19.6
<b>Domain 4 Interpersonal deficits</b>		
No to minimal	187	54.5
Moderate to severe	136	45.5
<b>Study issues</b>		
Fatigue from studying hard	182	53.1
Lack of time	165	48.1
Not understand the lessons	89	25.9
Dissatisfaction with academic scores	77	22.4
Not interested of studying medicines	52	15.2
Overburdened with tasks	25	7.3
Too much pressure from teachers	5	1.5

### Depression, smartphone addiction and associated factors

Table 2 showed variables that associate with depression and smartphone addiction among the participants. The variables which had  $P < 0.05$  were considered statistically significant in univariate analysis and were selected for multiple logistic regression. The result showed that the significant factors for depression were gender ( $P = 0.032$ ), GPA ( $P = 0.009$ ), underlying physical illnesses ( $P < 0.001$ ); allergy ( $P = 0.032$ ), anemia ( $P = 0.005$ ), smartphone addiction ( $P = 0.001$ ), sleep quality ( $P < 0.001$ ), interpersonal problem domain 2 ( $P = 0.020$ ), domain 3 ( $P = 0.012$ ), domain 4 ( $P = 0.002$ ) and 6 study issues. Adjusted OR and 95% CI of factors associated with depression were shown in the Table 3.

There were 7 significant factors for smartphone addiction that were class year ( $P = 0.004$ ), regular alcohol drinking ( $P = 0.017$ ), underlying psychiatric disorder ( $P = 0.022$ ), depression ( $P = 0.001$ ), interpersonal problem domain 2 ( $P = 0.008$ ), domain 4 ( $P = 0.003$ ), and study issues ( $P = 0.031$ ). All 6 significant factors (those 7 factors except underlying psychiatric disorder because none of smartphone addiction groups have any psychiatric disorder) were included in multiple logistic regression analysis. Adjusted OR and 95% CI of factors associated with smartphone addiction were shown in the Table 4.

Domicile, Incomes, Smoking and psychiatric disorder in family were not significant factors of both depression and smartphone addiction.

**Table 2.** Variables that associate with depression and smartphone addiction (n = 343).

	Depression		P - value	Smartphone addiction		P - value
	Yes (n = 87)	No (n = 256)		Yes (n = 146)	No (n = 197)	
	n (%)	n (%)		n (%)	n (%)	
<b>Demographic data</b>						
<b>Gender</b>			0.032*			0.791
Male	35 (20.3)	137 (79.7)		72 (41.9)	100 (58.1)	
Female	52 (30.4)	119 (69.6)		74 (43.3)	97 (56.7)	
<b>Class year</b>			0.413			0.004*
Year 1	22 (20.8)	84 (79.2)		33 (31.1)	73 (68.9)	
Year 2	30 (26.8)	82 (73.2)		60 (53.6)	52 (46.4)	
Year 3	35 (28.0)	90 (72.0)		53 (42.4)	72 (57.6)	
<b>GPA</b>			0.009*			0.709
< 3.50	49 (32.2)	103 (67.8)		63 (41.4)	89 (58.6)	
≥ 3.50	38 (19.9)	153 (80.1)		83 (43.5)	108 (56.5)	
<b>Underlying physical illnesses</b>	29 (42.0)	40 (58.0)	< 0.001*	31 (44.9)	38 (55.1)	0.657
Allergy	20 (23.0)	34 (13.3)	0.032*	26 (17.8)	28 (14.2)	0.366
Anemia	5 (5.7)	1 (0.4)	0.005*	2 (1.4)	4 (2.0)	1.000
Underlying psychiatric disorder	4 (57.1)	3 (42.9)	0.072	0 (0.0)	7 (100.0)	0.022*
Regular alcohol drinking	3 (17.6)	14 (82.4)	0.576	12 (70.6)	5 (29.4)	0.017*
<b>Smartphone addiction</b>	50 (34.2)	96 (65.8)	0.001*			
Mean ± SD	33.8 ± 8.6	28.9 ± 8.0	< 0.001*			
<b>Depression</b>				50 (57.5)	37 (42.5)	0.001*
Mean ± SD				7.47 ± 3.74	5.29 ± 4.30	0.001*
<b>Poor sleep quality</b>	24 (61.5)	15 (38.5)	< 0.001*	22 (56.4)	17 (43.6)	0.063
Mean ± SD	4.0 ± 2.4	2.8 ± 1.4	< 0.001*	3.3 ± 1.9	2.9 ± 1.7	0.059
<b>Interpersonal problems</b>						
<b>Domain 1 Grief</b>			0.496			0.664
No to minimal	70 (80.5)	197 (77.0)		112 (76.7)	155 (78.7)	
Moderate to severe	17 (19.5)	59 (23.0)		34 (23.3)	42 (21.3)	
<b>Domain 2 Interpersonal disputes</b>			0.020*			0.004*
No to minimal	62 (71.3)	212 (82.8)		106 (72.6)	168 (85.3)	
Moderate to severe	25 (28.7)	44 (17.2)		40 (27.4)	29 (14.7)	
<b>Domain 3 Role transitions</b>			0.012*			0.131
No to minimal	62 (71.3)	214 (83.6)		112 (76.7)	164 (83.2)	
Moderate to severe	25 (28.7)	42 (16.4)		34 (23.3)	33 (16.8)	

**Table 2.** (Con) Variables that associate with depression and smartphone addiction (n = 343).

	Depression		P - value	Smartphone addiction		P - value
	Yes (n = 87) n (%)	No (n = 256) n (%)		Yes (n = 146) n (%)	No (n = 197) n (%)	
<b>Domain 4 Interpersonal deficits</b>			0.002*			0.003*
No to minimal	35 (40.2)	152 (59.4)		66 (45.2)	121 (61.4)	
Moderate to severe	52 (59.8)	104 (40.6)		80 (54.8)	76 (38.6)	
<b>Study issues</b>			0.002*			0.031*
No	12 (13.2)	79 (86.8)		30 (33.0)	61 (67.0)	
Yes	75 (29.8)	177 (70.2)		116 (46.0)	136 (54.0)	
Fatigue from studying hard	58 (31.9)	124 (68.1)	0.003*	85 (46.7)	97 (53.3)	0.099
Lack of time	55 (33.3)	110 (66.7)	0.001*	77 (46.7)	88 (53.3)	0.139
Not understand the lessons	34 (38.2)	55 (61.8)	0.001*	44 (49.4)	45 (50.6)	0.128
Dissatisfaction with academic scores	35 (45.5)	42 (54.5)	<0.001*	38 (49.4)	39 (50.6)	0.172
Not interested in studying medicines	24 (46.2)	28 (53.8)	<0.001*	24 (46.2)	28 (53.8)	0.570
Overburdened with tasks	10 (40.0)	15 (60.0)	0.081	11 (44.0)	14 (56.0)	0.880
Too much pressure from teachers	4 (80.0)	1 (20.0)	0.016*	1 (20.0)	4 (80.0)	0.304

P - values for mean data were calculated with the use of Mann-Whitney U - test or Independent *t* - test, for percentages with the use of Chi-square test or Fisher's exact test, \* Significant at the 0.05 level

Table 3 showed the adjusted OR and 95% CI of factors associated with depression among preclinical medical students at Chulalongkorn University. After adjusting for the other variables in the model, students who were having smartphone addiction were more likely to be depressed compared to those who did not addict to smartphone (2.025; 95% CI 1.163 - 3.524). The students who were bad sleepers were 6.767 (95% CI 3.110 - 14.725) times more likely to be depressed than those who had good sleep quality. Students having underlying physical illnesses were 2.99 (95% CI 1.583,

5.647) times more likely to be depressed than those who did not have underlying disease.

Additionally, the students who are female (Adjusted OR 1.76; 95% CI 1.000 - 3.098), GPA < 3.5 (Adjusted OR 2.995; 95% CI 1.624 - 5.523) and not fond of studying Medicines (Adjusted OR 2.537; 95% CI 1.262 - 5.103) are significantly more likely to have depression. However, there are no significant association between interpersonal problems and depression.

**Table 3.** Multivariate Logistic Regression analysis of factors associated with depression.

Factors	Adj OR	95% CI	P - value
<b>Gender</b>			
Male	Ref		
Female	1.760	1.000, 3.098	0.0499 *
<b>GPA</b>			
< 3.50	2.995	1.624, 5.523	<0.001 *
≥ 3.50	Ref		
<b>Underlying physical illnesses</b>			
Yes	2.990	1.583, 5.647	0.001 *
No	Ref		
<b>Smartphone addiction</b>			
Yes	2.025	1.163, 3.524	0.013 *
No	Ref		
<b>Sleep quality</b>			
Good	Ref		
Bad	6.767	3.110, 14.725	<0.001 *
<b>Study issues: Not interested in studying medicines</b>			
Yes	2.537	1.262, 5.103	0.009 *
No	ref		

Adj. OR was adjusted for Gender, GPA, underlying physical illnesses, Underlying psychiatric disorder, Smartphone addiction, Sleep quality, Interpersonal problems domain 2, 3, 4, and all 7 Study issues

\* Significant at the 0.05 level

Table 4 showed the adjusted OR and 95% CI of factors associated with smartphone addiction among preclinical medical students at Chulalongkorn University. After adjusting for the other variables in the model, there were 4 significant factors that associated with smartphone addiction; depression, class year, regular alcohol drinking, and interpersonal problem domain 4 (interpersonal deficits).

Students who were depressed were more likely to addict to the smartphone (Adjusted OR 2.115; 95% CI 1.263 – 3.541). The students who drank alcohol regularly were 3.783 (95% CI 1.248 – 11.465) times more likely to addict to the smartphone than those who did not drink alcohol regularly. The 2<sup>nd</sup> year students were 2.404 (95% CI 1.357 - 4.258) times more likely to addict to smartphone than those 1st year students. There was no statistically significant difference in smartphone addiction between the 3<sup>rd</sup> year and 1<sup>st</sup> year students. Students having interpersonal deficits were 1.733 (95% CI 1.099 – 2.732) times more likely to addict to the smartphone than those who did not have interpersonal deficits. However, there were no significant association between other domain of interpersonal problems and smartphone addiction.

## Discussion

The objective of the study was to determine the prevalence and associated factors of depression and smartphone addiction behavior among preclinical medical students at Chulalongkorn University. In the present study, prevalence of depression is 25.4% (20.8%, 26.8% and 28.0% for 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> year students respectively), which is consistent with previous studies that medical students worldwide had prevalence of depression of 27.2 – 28.0% <sup>(4,5)</sup>; which was 9 times higher than the prevalence of depression in the same age group; indicating that it is a widespread problem.

A higher prevalence of depression could be attributed to many reasons. One of them is study issue; none of the previous studies specifies the reason. Our study identifies the issues that Fatigue from studying hard, Lack of time, Not understand the lessons, Dissatisfaction with academic scores, Not interested in studying medicines have become the main factors. However, after adjusting for the other variables, the only significant study issue is not interested in studying Medicines which was 2.537 times more likely to have depression.

According to GPA, students who had GPA < 3.5 are 2.995 times more likely to have depression than

**Table 4.** Multivariate Logistic Regression analysis of factors associated with smartphone addiction.

Factors	Adj OR	95% CI	P-value
<b>Class year</b>			
Year 1	ref		
Year 2	2.404	1.357, 4.258	0.003 *
Year 3	1.449	0.826, 2.543	0.196
<b>Regular alcohol drinking</b>			
Yes	3.783	1.248, 11.465	0.019 *
No	ref		
<b>Depression</b>			
Yes	2.115	1.263, 3.541	0.004 *
No	ref		
<b>Interpersonal problem: Domain 4 interpersonal deficits</b>			
No to minimal	ref		
Moderate to severe	1.733	1.099, 2.732	0.018 *

Adj. OR was adjusted for Class year, Regular alcohol drinking, Depression, Sleep quality, Interpersonal problem domain 2, 4, and study issues: fatigue from studying hard

\* Significant at the 0.05 level

those with GPA  $\geq 3.5$ . Reasons for this could be that academic achievement has always been the top priority for medical students. Medical students with stress also reported significantly more academic problems than students without stress. Moreover, we hypothesized that “not interested in studying Medicines”, low self-esteem, feeling inferiority and highly competitive environment may cause depression in medical students.

Regarding the literature review, several studies have been found to be associated with depression among medical students. It was found that sleep quality, gender, class year, and domicile affected mental health problems.<sup>(6,7)</sup> Consistently, our result show that sleep quality and gender affected depression. Students who had bad sleep quality are 6.767 times more likely to be depressed than those who had good sleep quality. This could be explained from biological relationship between sleep and depression as a bidirectional relationship. Insomnia may increase the risk of developing depression. On the other hand, depression causes insomnia. Female medical students were 1.76 times more likely to have depression than its male counterparts. Consistent with previous study of Kunadison W, *et al.*<sup>(8)</sup> in Prince of Songkla University which found that female medical students were 1.73 times more likely to have depression than male. According to the result, promoting mental health in female medical students with GPA  $< 3.5$  may be beneficial and may decrease risk of depression.

Moreover, smartphone addiction, underlying physical illnesses also affected depression. Students having underlying physical illnesses were 2.99 times more likely to be depressed than those who did not have underlying disease. Reasons for this could be both biological factors and psychological factors. There is growing evidence that inflammation can exacerbate or even give rise to depressive symptoms. The most common underlying physical disease from our study is allergic rhinitis and the second is anemia. These can affect physical health and vigority. For example, anemia may cause fatigue. Psychologically, students who had underlying disease may feel inferior.

The main objective of our study is to find association between smartphone addiction and depression in medical students. To the best of our knowledge, no study has established this association before.

Our result shows that having smartphone addiction were 2 times more likely to be depressed compared

to those who were not addicted to smartphone. We hypothesized that using smartphone may increase perceived stress and poor educational attention. Excessive smartphone usage before bedtime also disturbs sleep quality, resulting in stress and depression<sup>(12)</sup>, which explains the bidirectional correlation between smartphone use and depression.

There are no significant association between class year, domiciles, incomes, smoking, alcohol drinking, interpersonal problems and depression.

Our study found that 146 of 343 subjects (42.6%) had smartphone addiction, which is much higher than previous studies done in general population; a systematic review, meta-analysis of Sohn S, *et al.* found that prevalence of smartphone addiction among youth and adolescents was 23.3% in 2011 - 2017<sup>(9)</sup>, A study by Haug S, *et al.* found prevalence of 16.9% among age 15 - 21 in 2015.<sup>(10)</sup> However, A study done in medical student found higher rate of smartphone addiction than general population that was 36.5% in 6<sup>th</sup> year medical student at King Abdulaziz university in Saudi arabia in 2017. A higher prevalence of smartphone addiction could be explained by life-style that change from time to time. The development of technology is dramatically increased. Nowadays technology has become more integrated in our lives. Smartphones are part of daily used by this generation especially in the group of medical students who use it for study especially currently trend of online study, paperless e-book, and for social communication.

Our study did not specify the cause of smartphone usage such as internet browsing, gaming, social networking, taking a class or getting educational content. This could explain the higher prevalence from our result.

Our result show that there were 4 significant factors that associated with smartphone addiction; depression, class year, regular alcohol drinking, and interpersonal deficits.

Students with depression were more likely to be addicted to the smartphone with adjusted OR 2.115. To explain why, several studies have found that smartphones were used to deflect negative moods, leading to more problems with smartphone use which further affected their sleep and led to a vicious cycle of depression.<sup>(10)</sup>

The students who drank alcohol regularly were more likely to be addicted to the smartphone and this was consistent with the previous report.<sup>(26, 27)</sup> One possible explanation is that both alcohol use problems



and smartphone problems shared the common temperamental trait for addiction behaviors, e.g., high sensation seeking and harm avoidance trait.<sup>(28)</sup> Furthermore, the socially isolated individuals and those with depressive symptoms may be more vulnerable for excessive use of smartphone or alcohol as mood augmentation.<sup>(26, 27)</sup>

The second-year students were more likely to addict to smartphone than the third year and first-year students. We hypothesized that the second year in medical curriculum had more study load harder than the first year. While most of the third-year students were already well adapted to the curriculum. The higher rate of smartphone uses in second year medical student reflected that they used the smartphone to relief the stress from study.

In line with the findings of previous studies on smartphone addiction and interpersonal problems.<sup>(29, 30)</sup> The presence of interpersonal problems was found to affect smartphone addiction in this study. Our result show students who having interpersonal deficits were more likely to be addicted to the smartphone. We hypothesized that some people with interpersonal deficits may use smartphone to compensate their social interaction skill. They may increase the smartphone usage to distract their negative relationship in the real world. However, there were no significant association between other domain of interpersonal problems and smartphone addiction.

This study was assessed in medical students who were a high-stress level group and were prone to be depressed. The result demonstrates the huge prevalence of smartphone addiction in preclinical medical students that needs more awareness. Managing modifiable associated factors are probably beneficial to decrease the problem in the future. Improving interpersonal skill and on-site class room may be benefit to improve the mental health problem of these population.

## Conclusion

The prevalence of depression was comparable with the previous reports. Smartphone addiction, poor sleep quality, study related problems were associated with depression. The prevalence of smartphone addiction was higher than the others studies. Four significant factors that associated with smartphone addiction were depression, class year, regular alcohol drinking, and interpersonal deficits. Smartphone addiction, sleep quality, underlying physical illnesses, gender, GPA and not interested in studying Medicines

are associated with depression in preclinical medical students.

## Conflict of interest statement

The authors have each completed an ICMJE disclosure form. None of the authors declare any potential or actual relationship, activity, or interest related to the content of this article.

## Data sharing statement

The present review is based on the reference cited. Further details, opinions, and interpretation are available from the corresponding authors on reasonable request.

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