

# RELATIONSHIP BETWEEN SLEEP, DIGITAL USAGE AND EMOTIONAL STATES IN THAI OCCUPATIONAL THERAPY STUDENTS

Winai Chatthong, Supalak Khemthong, Maliwan Rueankam

Division of Occupational Therapy, Mahidol University, Salaya, Nakhon Pathom 73170 Thailand

Correspondence: winai.cha@mahidol.ac.th

## ABSTRACT

### INTRODUCTION:

Occupational imbalance of overloaded online education and sleep deprivation has been complained by Thai occupational therapy students (OTS) during the worldwide pandemic of coronavirus disease 2019 (COVID-19) e.g., feeling asleep in the classroom, inactive engagement in problem-based learning.

### METHODS:

This cross-sectional study aims to survey the OTS (n = 52 out of 128) regarding many standardized tools: smartphone addiction, internet addiction, sleep quality, sleep hygiene, and emotional states. Data analysis includes Pearson's and Spearman's rank-order correlations, Chi-square tests, and calculation of point prevalence rates.

### RESULTS:

A strong correlation of smartphone and internet addiction was found ( $r = 0.703$ ,  $p < 0.001$ ). Moderate correlations were addressed including sleep quality and smartphone addiction ( $r = 0.566$ ), sleep quality and stress ( $r = 0.574$ ), sleep quality depression ( $r = 0.554$ ), and anxiety and smartphone addiction ( $r = 0.512$ ). This study has reported point prevalence rates, such as 23.44% poor sleep quality, 17.96% smartphone addiction, and 7.81% anxiety.

### CONCLUSION:

The unwell sleep OTS are gaining comorbidities of smartphone and internet addiction and negative emotional states than those well sleep OTS. A restoration of occupational balance will be required for those poor sleep quality and anxiety.

### KEYWORDS

Sleep quality, Smartphone addiction, Emotional states, Cognitive overload, Occupational Therapy

## INTRODUCTION

Digital usage is studied for everyone in the 21st century; the numbers of smartphone users were reported at 5.22 billion people worldwide as well as 4.66 billion for internet users. [1] There were 90.66 million and 48.59 million Thais for smartphone and internet users, respectively. [1] International university students (n = 470) could not break a routine pattern of unhealthy lifestyle which was smartphone addiction or using the smartphone/tablet longer period of time than intended. They gained excessive use of the smartphone/tablet in classes, even controlled by their observed peers, resulting in poor academic performance over 2 years. [2] There were many smartphones and internet addiction studies in Thai university students [3-5]. Thai pharmacy students (N = 484) were surveyed and 39.1% out of 391 students were smartphone addiction. They preferred looking down at their smartphone/tablet screens rather than face-to-face communication which becomes negative emotional states of depression ( $p < 0.001$ ) and stress ( $p < 0.002$ ). [3] Thai Thammasat University students (n = 460) were smartphone addiction around 109 males and 156 females. When compared to those students with no smartphone addiction, both genders with addictive smartphone scored higher depression and stress ( $p < 0.001$ ). [4] Moreover, 45.8% out of 800 Thai university students at Chiang Mai who had engaged internet addiction; excessive levels of smartphone or tablet use including internet activities. They would be significantly scored low psychological well-being such as social relationship and meaningful life ( $p < 0.001$ ). [5]

Thai occupational therapy students (OTS) have complained during the worldwide pandemic of coronavirus disease 2019 (COVID-19) e.g., sleep fragmentation, worrying about overloaded assignments in a long period of online learning. To extend a new normal life the smartphone and internet users have developed a multipurpose of occupational participation, which is defined as individual characteristics related meaningful involvement in the environment of social and educational activities including sleep quality and hygiene. [6] As seen those smartphone and internet addiction studied in Thai university student, however, no study was conducted in Thai Occupational Therapy Students (OTS) who would be trained for helping their clients with occupational participation after impairments of physical and mental health. Previously, there was significant correlation

between quality of sleep and stress; internet addiction and stress in the Indian OTS study (n = 110). [7] Consequently, this OTS study suggests a prevention of smartphone and internet addiction is needed for enhancing occupational balance which is defined as individual experience of having right time use and amount of productive, leisure, and sleep activities. [8-9] Similarly, the Korean OTS study (n = 120) showed smartphone and internet addiction related negative relationships with interpersonal relationships, problem-solving skills, self-efficacy, participation in classes, and self-control learning. [10] The Spanish OTS study (n = 192) resulted a self-control on their internet use only 3.2% of samples and a moderate occupational imbalance (averaged 38.7 out of 65) meaning stress related too little spending on productive activities and too much internet activities without social engagement. [11]

As seen those OTS studies were discussed in non-Thai cultural contexts and a number of lifestyle modification has been suggested [12-15], this study was firstly interested in finding a relationship between smartphone and internet addiction, sleep quality, sleep hygiene, and emotional states in the OTS at Mahidol University, Thailand. The utilization and generalization of the findings are a psychoeducation of sleep and emotional states for the Thai OTS including individualized consultation for occupational balance without smartphone and internet addiction.

## METHODS

### PARTICIPANTS AND PROCEDURE

This study was a cross-sectional descriptive study. Participants were Occupational Therapy Students (OTS) studying in the 1st to the 4th year at Mahidol University. From all participants (N = 128) who have enrolled in the an academic year of 2020, a stratified sampling was used prior to filling out the questionnaires. All interested participants on voluntary basis were briefed about the study procedure including informed consent within an anonymous online health survey. The results derived from this study will be confidentially kept; de-identified and coded process will be unbiasedly conducted without any relevant academic performance. Ethical endorsement was obtained under The Centre of Ethical Reinforcement for Human Research of the Mahidol University (MU-CIRB 2020/177.1607)

## SAMPLE SIZE AND SUBJECT SELECTION

The sample size was calculated for 38.40, with the largest sample size required 40 students. [16] In order to minimize the risk of miscalculation, a replacement participant could be accepted in the event of a participant's withdrawal.

Inclusion criteria for subject selection included no history of psychiatric disorders and the daily use of smartphone as well as internet connection. Different age ranges between 18 and 23 years were excluded. All participants had the human rights for unwilling to participate, and request to be a withdrawal criterion halfway through the online survey.

## INSTRUMENTS FOR DATA COLLECTION

The online survey consisted of five sections of the following standardized instruments: Smartphone Addiction Scale: Thai Short Version (SAS-SV-TH), Internet Addiction Test: Thai version (IAT: Thai version), Thai version of the Pittsburgh Sleep Quality Index (T-PSQI), Sleep Hygiene Index: Thai version (SHI: Thai version), and Depression Anxiety Stress Scales: Thai version (DASS-21: Thai version). Demographic information was also collected including age, gender, educational attainment, cumulative grade point average, and residential contexts.

The SAS-SV-TH [17] has been used to assess smartphone addiction behavior; a cut-off score above or equal to 31 and 33 for males and females, respectively. The SAS-SV-TH was composed of 10 items with scores ranging from 10 to 60; choices ranging from 1 (strongly disagree) to 6 (strongly agreed) for each question. The SAS-SV-TH had internal consistency of 0.94 for the total scale and validity with satisfactory at aged 18 to 23. [17]

The IAT: Thai version [18] has been extensively tested for its psychometric properties; with 20 items to be rated ranging from 1 (rarely) to 5 (always). Total scores greater than 30 were considered internet addiction. Cronbach's alpha of 0.89 was previously tested at aged 18-25. [18]

The T-PSQI [19] has been used to assess an overall sleep quality over one-month; consisted of 19 self-rated items. Each item was scored between 0 (no difficulty) to 3 (severe difficulty). The overall score of less than or equal to 5 indicated good sleep quality. The T-PSQI has a sensitivity of 89.6, a specificity of 86.5, and Cronbach's alpha coefficient of 0.73. [19]

The SHI: Thai version [20] had Cronbach's alpha of 0.74 in a total of 14 questions for sleep hygiene behaviors; score ranged "5" indicates most practiced while "1" indicates least practiced. A low level of the practice of sleep hygiene behaviors scored 1.00-2.33, a moderate level scored 2.34-3.66, and a high level scored 3.67-5.00. [21]

The DASS-21: Thai version was consisted of 21 questions of emotional states with the Cronbach's alpha coefficient for depression of 0.82, anxiety of 0.78, and stress of 0.69. [22] The scoring criterion for each item was between 0-3. For depression there were 5 levels of judging a trend as normal (0-4), mild (5-6), moderate (7-10), severe (11-13) and extremely severe (14 or above). For anxiety there were normal (0-3), mild (4-5), moderate (6-7), severe (8-9) and extremely severe (10 or above). For stress there were normal (0-7), mild (8-9), moderate (10-12), severe (13-16) and extremely severe (17 or above). [22]

## STATISTICAL ANALYSIS

All obtained data were analyzed using the IBM Statistical Package for the Social Sciences (IBM SPSS) version 23. [23] Descriptive statistics, point prevalences, Chi-square test, Pearson's and Spearman's rank-order correlation coefficients were calculated. Correlational interpretation related normality of data was used for both Pearson's and Spearman's including 0.30-0.50 (weak), 0.50-0.70 (moderate), 0.70-0.90 (strong), and 0.90-1.00 (very strong). [24]

## RESULTS

### PARTICIPANT CHARACTERISTICS

Fifty-two of OTS were recruited in this study (see Table 1). There was a higher proportion of females (82.70%; n = 43) than males (17.30%; n = 9). Mean  $\pm$  standard deviation of age was 20.04  $\pm$  1.19 years.

### SLEEP QUALITY AND HYGIENE

The T-PSQI averaged 6.10  $\pm$  2.23 with its point prevalence rate of poor sleep quality 23.44% (n = 30). A moderate level practice of sleep hygiene behaviors has shown to be 3.51  $\pm$  0.35 with its point prevalence rate of 32.81% (n = 42). However, there was no significant correlation between sleep quality and sleep hygiene (r = -0.260, p = 0.063).

TABLE 1: DEMOGRAPHIC INFORMATION AND INDEPENDENT VARIABLES OF PARTICIPANTS (N = 52)

DEMOGRAPHIC PROPERTIES	N (%)	MEAN ± SD
Gender		
<i>Male</i>	9 (17.30)	
<i>Female</i>	43 (82.70)	
Age (years)		20.04 ± 1.19
Education		
<i>OTS 1<sup>st</sup> year</i>	13 (25.00)	
<i>OTS 2<sup>nd</sup> year</i>	15 (28.80)	
<i>OTS 3<sup>rd</sup> year</i>	13 (25.00)	
<i>OTS 4<sup>th</sup> year</i>	11 (21.20)	
Cumulative overall grade point average (GPAX)		
<i>GPAX = 2.51 - 3.00</i>	7 (13.50)	
<i>GPAX = 3.01 - 3.50</i>	18 (34.60)	
<i>GPAX = 3.51 - 4.00</i>	27 (51.90)	
Residential contexts		
<i>Dormitory</i>	27 (51.90)	
<i>Home with parents</i>	22 (42.30)	
<i>Home with relatives</i>	3 (5.80)	
SAS-SV-TH		30.87 ± 9.51
IAT: Thai version		32.42 ± 15.26
T-PSQI		6.10 ± 2.23
SHI: Thai version		3.51 ± 0.35
DASS-21: Thai version		
<i>Depression</i>		2.25 ± 1.45
<i>Anxiety</i>		2.15 ± 1.51
<i>Stress</i>		1.64 ± 1.10

SAS-SV-TH, Smartphone Addiction Scale: Thai Short Version; IAT: Thai version: Internet Addiction Test: Thai version; T-PSQI: Thai version of the Pittsburgh Sleep Quality Index; SHI: Thai version: Sleep Hygiene Index: Thai version; DASS-21: Thai version: Depression Anxiety Stress Scales: Thai version.

## SMARTPHONE AND INTERNET ADDICTION

From a population size was 128 OTS, there were existing cases of smartphone and internet addiction ( $n = 23$  and  $27$ ). A point prevalence rate was calculated by  $(23/128) \times 100 = 17.96\%$  and  $(27/128) \times 100 = 21.09\%$  of smartphone and internet addiction, respectively. The SAS-SV-TH scored  $30.87 \pm 9.51$  as well as the IAT Thai version scored  $32.42 \pm 15.26$ . Both smartphone and internet addiction were strongly correlated ( $r = 0.703$ ,  $p < 0.001$ ) as shown in Table 2.

## EMOTIONAL STATES

This study considered a cut-off scoring below 5, 4, and 8 for normal levels of depression, anxiety, and stress, respectively. [22] A self-reported set of three emotional states included depression of  $2.25 \pm 1.45$ , anxiety of  $2.15 \pm 1.51$ , and stress of  $1.64 \pm 1.10$ . Their point prevalence rates showed 4.69% for mild depression ( $n = 6$ ), 7.81% for mild anxiety ( $n = 10$ ), and 3.13% for mild to moderate stress ( $n = 4$ ). Both depression and stress were strongly correlated ( $r = 0.702$ ,  $p < 0.001$ ) as shown in Table 2.

**TABLE 2: PEARSON'S (R) AND SPEARMAN'S (R<sub>s</sub>) CORRELATION BETWEEN SMARTPHONE & INTERNET ADDICTION, SLEEP QUALITY, AND EMOTIONAL STATES**

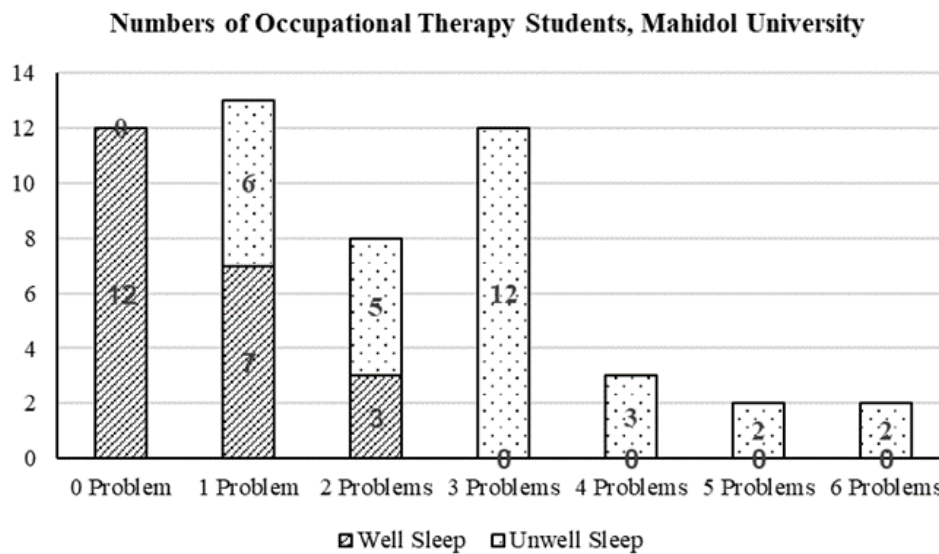
<b>MATCHED PARAMETERS</b>	<b>T-PSQI</b>	<b>SAS-SV-TH</b>	<b>IAT: Thai version</b>	<b>DASS-21: Thai version Depression</b>	<b>DASS-21: Thai version Anxiety</b>	<b>DASS-21: Thai version Stress</b>
<b>T-PSQI</b>	-	0.566	0.416	0.554	0.360	0.574
<b>r</b>	-	0.566	0.416	0.554	0.360	0.574
<b>p</b>	-	0.000	0.002	0.000	0.009	0.000
<b>n</b>	-	52	52	52	52	52
<b>SAS-SV-TH</b>	0.566	-	0.703	0.335	0.512	0.411
<b>r</b>	0.566	-	0.703	0.335	0.512	0.411
<b>p</b>	0.000	-	0.000	0.015	0.000	0.002
<b>n</b>	52	-	52	52	52	52
<b>IAT: Thai version</b>	0.416	0.703	-	0.425	0.400	0.445
<b>r</b>	0.416	0.703	-	0.425	0.400	0.445
<b>p</b>	0.002	0.000	-	0.002	0.003	0.001
<b>n</b>	52	52	-	52	52	52
<b>Depression</b>	0.554	0.335	0.425	-	0.438	0.702
<b>r<sub>s</sub></b>	0.554	0.335	0.425	-	0.438	0.702
<b>p</b>	0.000	0.015	0.002	-	0.001	0.000
<b>n</b>	52	52	52	-	52	52
<b>Anxiety</b>	0.360	0.512	0.400	0.438	-	0.459
<b>r<sub>s</sub></b>	0.360	0.512	0.400	0.438	-	0.459
<b>p</b>	0.009	0.000	0.003	0.001	-	0.001
<b>n</b>	52	52	52	52	-	52
<b>Stress</b>	0.574	0.411	0.445	0.702	0.459	-
<b>r<sub>s</sub></b>	0.574	0.411	0.445	0.702	0.459	-
<b>p</b>	0.000	0.002	0.001	0.000	0.001	-
<b>n</b>	52	52	52	52	52	-

## CORRELATION OF SMARTPHONE & INTERNET ADDICTION, SLEEP QUALITY, AND EMOTIONAL STATES

The results in Table 2 showed a moderate positive correlation between sleep quality and smartphone addiction ( $r = 0.566, p < 0.001$ ). A weak positive correlation was found between sleep quality and internet addiction ( $r = 0.416, p < 0.05$ ). Significant correlations of smartphone addiction and emotional states were found at depression ( $r_s = 0.335, p < 0.05$ ); anxiety ( $r_s = 0.512, p < 0.001$ ) and stress

( $r_s = 0.411, p < 0.001$ ). Moreover, internet addiction and emotional states were also found at depression ( $r_s = 0.425, p < 0.001$ ); anxiety ( $r_s = 0.400, p < 0.001$ ) and stress ( $r_s = 0.445, p < 0.001$ ). Significantly, a chi-square test found differences at 95% confidence interval; the unwell group ( $n = 30$ ) seemed to get more problematic counts or comorbidities than the well sleep group ( $n = 22$ ) as seen in Figure 1.

FIGURE 1: COMPARISON OF PROBLEMATIC COUNTS IN UNWELL AND WEEL SLEEP GROUPS VIA THE PSQI



## DISCUSSION

This correlational study cannot predict cause and effect, but the results assess independent variables equally including smartphone/internet addiction variables, sleep variables, and negative emotional states in Thai OTS with a total of 52 out of 128 participants. The point prevalence rates are also contributed to be a further implementation as early psychoeducation for a quality of sleep associated emotional states in order to improve occupational balance with less smartphone and internet addiction. Interestingly, three major findings are discussed in congruence with the previous studies.

Firstly, the mean  $\pm$  SD scores of self-report smartphone ( $30.87 \pm 9.51$ ) and internet ( $32.42 \pm 15.26$ ) addiction, indicate some OTS are behaving with smartphone and internet addiction. Especially for individual calculation of scores, the OTS have been accounted 44.23% of samples

for smartphone addiction and 51.92% of samples for internet addiction. Thai pharmacy students [3] have gained smartphone addiction (39.10% of samples) less than Thai OTS whereas Thammasart University students [4] have gained smartphone addiction (57.61% of samples) more than Thai OTS. Whereas Thai university students at Chiang Mai [5] have gained internet addiction (45.8% of samples) less than Thai OTS, not being a severe trend as the Spanish OTS ( $n = 189, 96.8\%$  of samples). [11] Additionally, Indian OTS have gained internet addiction more than Thai OTS ( $n = 63, 57.27\%$  of samples) [7] so that normal internet users are found in Thai OTS ( $n = 25, 48.08\%$  of samples) more than Indian OTS ( $n = 47, 42.72\%$  of samples. [7] Thai OTS might use internet for online studying, working on class's materials, and searching for contents related with assignments.

Secondly, Thai OTS (57.69% of samples) have poor sleep quality which is agreed with the previous result of India OTS study (74.55% of samples). [7] Although most Thai OTS

reveals a moderate level of sleep hygiene behaviors ( $n = 42$ ) and a high level is slightly found ( $n=10$ ), but there was no significant difference between the smartphone/internet addiction and the sleep hygiene. In addition, the unwell sleep of OTS ( $n = 30$ ) gain mental health comorbidities of smartphone and internet addiction than the well sleep of OTS ( $n = 22$ ). A moderate correlation was found in between sleep quality and smartphone addiction ( $r = 0.566$ ,  $p < 0.001$ ) whereas a weak correlation was found in between sleep quality and internet addiction ( $r = 0.412$ ,  $p < 0.05$ ). Surprisingly, Thai university students were focused on smartphone or internet addiction in relation with depression and stress, rather than sleep quality. This study highlights that Thai OTS have gained internet addiction with a negative consequence of sleep quality while both smartphone and internet addiction were strongly correlated ( $r = 0.703$ ,  $p < 0.001$ ). In contrast to the India OTS study, internet addiction was not correlated with sleep quality ( $r = 0.180$ ,  $p = 0.061$ ). [7] It might be that the Indian students get benefits from using the internet e.g., education, communication and entertainment to relieve stress which was slightly correlated with sleep quality ( $r = 0.285$ ,  $p = 0.003$ ). [7] Since the data collection was made at the duration of pandemic in Thailand, Thai OTS might use smartphone with internet connection to their families as well as in peer-group assignment at nighttime.

Thirdly, Thai OTS have scored with low point prevalence rates for mild depression ( $n = 6$ ), mild anxiety ( $n = 10$ ), and mild to moderate stress ( $n = 4$ ). In depth of individual scoring Thai OTS have accounted to be anxious alone ( $n = 7$ ), anxious stress ( $n = 1$ ), depressive stress ( $n = 1$ ), depressive anxious stress ( $n = 2$ ), and depression alone ( $n = 3$ ). All three emotional states measured by the DASS-21: Thai version have been significantly correlated ( $r = 0.438$  to  $0.702$ ,  $p \leq 0.001$ ), but those have not been correlated with sleep hygiene ( $r = -0.258$  to  $0.047$ ,  $p > 0.05$ ). Nevertheless, India OTS resulted a weak correlation between internet addiction and stress ( $r = 0.380$ ,  $p < 0.001$ ) similar to Thai OTS ( $r = 0.445$ ,  $p \leq 0.001$ ). Depression and stress were strongly correlated with sleep quality ( $r = 0.554$  and  $0.574$ ,  $p < 0.001$  respectively). Depression and stress were also significantly correlated with smartphone and internet addiction ( $r = 0.335$  to  $0.445$ ,  $p > 0.05$ ). Similar to Thai Pharmacy students and Thammasart University students with smartphone/tablet addiction, numbers of depression and stress were significantly counted more than those without smartphone/tablet addiction ( $p < 0.05$ ). [3-4] However, Thai

OTS might use smartphone to relieve anxiety because their anxiety scores was moderately correlated with smartphone addiction ( $r = 0.512$ ,  $p < 0.001$ ).

Implication for the further research of occupational participation suggests that time-use diary mixed in-depth interview can be used in order to determine whether Thai OTS are able to manage occupational balance or not. The OTS may be trained to prioritize doing self-care activities as the most importance as well as spending time with family and friends. [12] Using the Pomodoro techniques of 5-min breakout in every 25-min working is recommended. [13] As seen the OTS are easily distracted by digital stimuli [14], so that their emotional inhibition may not be created in the classrooms. Creative environment and meaningful activities may improve their concentration adapted to achieve the educational plan of digital usage. [15]

## CONCLUSION

The main purpose of this study is achieved finding moderate correlations: smartphone addiction and anxiety, smartphone addiction and sleep quality, sleep quality and depression, and sleep quality and stress. Both smartphone and internet addiction are strongly correlated, and then both stress and depression are strongly correlated. This study raises awareness and engagement for a reduction of cognitive overload during the day, a prevention of smartphone/internet addiction, and a promotion of sleep quality related emotional states management in Thai OTS.

## DECLARATION OF CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## References

1. Kemp S. Digital 2020: Thailand. Available <<https://datareportal.com/reports/digital-2020-thailand>> (Accessed 18/11/20).

2. Bjerre-Nielsen A, Andersen A, Minor K, Lassen DD. The negative effect of smartphone use on academic performance may be overestimated: evidence from a 2-year panel study. *Psychol Sci* 2020; 31(11):1351-1362.
3. Chuemongkon W, Inthitanon T, Wangsate J. Impact of smartphone and tablet use on health and academic performance of pharmacy students at Srinakharinwirot University. *Srinagarind Med J* 2019; 34(1): 90-98.
4. Charoenwanit S, Charoenwanit E. The differentiation of stress and depressive symptoms between university students with addictive smartphone behavior and university students with non-addictive smartphone behavior. *Songklanakarin J Sci Technol* 2020; 42(3):714-720.
5. Tangmunkongvorakul A, Musumari PM, Thongpibul K, Srithanaviboonchai K, Techasrivichien T, Suguimoto SP, et al. Association of excessive smartphone use with psychological well-being among university students in Chiang Mai, Thailand. *PLoS One*. 2019 Jan [cited 2021 Nov 21]; 14(1): e0210294. Available from: <https://doi.org/10.1371/journal.pone.0210294>
6. Vessby K, Kjellberg A. Participation in occupational therapy research: a literature review. *Br J Occup Ther* 2010; 73(7):319-326. DOI: 10.4276/030802210X12759925544380
7. Shitole BS, Jitta PS, Panchasara TP. Identifying internet addiction, quality of sleep and stress among undergraduate (UG) occupational therapy (OT) students: a cross sectional study. *Indian J Appl Res* 2020; 10(4):84-86. DOI: 10.36106/ijar
8. Wagman P, Håkansson C, Björklund A. Occupational balance as used in occupational therapy: a concept analysis. *Scan J Occup Ther* 2012; 19(4):322-327. DOI: 10.3109/11038128.2011.596219
9. Anaby DR, Backman CL, Jarus T. Measuring occupational balance: a theoretical exploration of two approaches. *Can J Occup Ther* 2010; 77(5):280–288. DOI: 10.2182/cjot.2010.77.5.4.
10. Lee S-M. The impacts on school life of a occupational therapy student use of smartphone. *J Korean Clin Health Sci* 2019 Dec [cited 2021 Nov 21]; 7(2):1289-1297. Available from: <http://doi.org/10.15205/kschs.2019.12.31.1289>
11. Romero-Tébar A, Rodríguez-Hernández M, Segura-Fragoso A, Cantero-Garlito PA. Analysis of occupational balance and its relation to problematic internet use in university occupational therapy students. *Healthcare* 2021; 9(2):197. DOI: 10.3390/healthcare9020197
12. Lukas CA, Berking M. Reducing procrastination using a smartphone-based treatment program: a randomized controlled pilot study. *Internet Interv* 2018; 12:83-90.
13. Almalki K, Alharbi O, Al-Ahmadi Wa, Aljohani M, editors. *Anti-procrastination online tool for graduate students based on the pomodoro technique*. Learning and Collaboration Technologies Human and Technology Ecosystems. Cham: Springer International Publishing; 2020.
14. Hooda M, Saini A. Academic procrastination: a critical issue for consideration. *India J Appl Res* 2016; 6(8):98-99. DOI: 10.36106/ijar
15. Deok Ju K. A systematic review on the intervention program of smartphone addiction. *J Korean Acad Ind Coop Soc* 2020; 21(3):276-88.
16. Ahmed Negida. Sample size calculation guide - part 7: how to calculate the sample size based on a correlation. *Adv J Emerg Med* 2020;4(2): e34. DOI: 10.22114/ajem.v0i0.344
17. Charoenwanit S, Soonthornchaiya R. Development of smartphone addiction scale: Thai short version (SAS-SV-TH). *J Ment Health Thai* 2019; 27(1):25-36.
18. Neelapajjit A, Pinyopornpanish M, Simcharoen S, Kuntawong P, Wongpakaran N, Wongpakaran T. Psychometric properties of a Thai version internet addiction test. *BMC Res Notes* 2018; 11(1):69. DOI: 10.1186/s13104-018-3187-y
19. Sitasuwan T, Bussaratid S, Ruttanaumpawan P, Chofinaiwattarakul W. Reliability and validity of the Thai version of the Pittsburgh Sleep Quality Index. *J Med Assoc Thai* 2014; 97 Suppl 3:S57-67.
20. Kaewpang P, Jitpanya C. Selected factors related to insomnia in adult cancer patients. *J Nurs Sci CU* 2006; 18(2):33-47.



21. Mairs L, Mullan B. Self-monitoring vs. implementation intentions: a comparison of behaviour change techniques to improve sleep hygiene and sleep outcomes in students. *Int J Behav Med* 2015; 22(5):635-644.
22. Oei TP, Sawang S, Goh YW, Mukhtar F. Using the Depression Anxiety Stress Scale 21 (DASS-21) across cultures. *Int J Psychol* 2013; 48(6):1018-1029. DOI: 10.1080/00207594.2012.755535.
23. Kirkpatrick LA. *A simple guide to IBM SPSS Statistics - version 23.0*. 14th ed. Boston, MA: Cengage Learning; 2015.
24. Mukaka MM. Statistics corner: a guide to appropriate use of correlation coefficient in medical research. *Malawi Med J* 2012; 24:69–71.