

PREVALENCE OF SMARTPHONE ADDICTION AND THE IMPACT  
ON SLEEP QUALITY AMONG UNDERGRADUATE STUDENTS AT  
SCHOOL OF HEALTH SCIENCES, USM.

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by

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## LIST OF ABBREVIATIONS

PSQI	Pittsburgh Sleep Quality Index
REM	Rapid Eye Movement
SAS	Smartphone Addiction Scale
USM	Universiti Sains Malaysia

**KETERLAASAN KETAGIHAN TELEFON PINTAR DAN KESAN TERHADAP  
KUALITI TIDUR DALAM KALANGAN PELAJAR SARJANA MUDA DI  
SEKOLAH SAINS KESIHATAN USM.**

**ABSTRAK**

Telefon pintar menjadi teknologi penting yang diperlukan, namun ramai orang semakin ketagih dengannya. Telah dilaporkan bahawa penggunaan telefon pintar lewat malam, dan ketagihan mengurangkan kualiti tidur. Banyak kajian telah dilakukan mengenai kualiti tidur, tetapi sangat sedikit yang mengaitkannya dengan ketagihan telefon pintar. Tinjauan keratan rentas telah dijalankan untuk mengkaji Prevalensi Ketagihan Telefon Pintar dan Kesan Terhadap Kualiti Tidur di Kalangan Pelajar Sarjana Muda di Pusat Pengajian Sains Kesihatan, USM menggunakan satu set soal selidik dalam talian yang ditadbir sendiri yang menggunakan Skala Ketagihan Telefon Pintar (SAS) dan Pittsburgh. Indeks Kualiti Tidur. Seramai 289 pelajar sarjana muda di USM yang memenuhi kriteria kemasukan dan pengecualian telah dimasukkan dalam kajian ini. Data dianalisis secara statistik menggunakan perisian SPSS versi 26.0. Deskriptif dan Pearson's Chi-Square digunakan untuk analisis data. Keputusan menunjukkan bahawa 151 (52.2%) responden telah ketagih. Sementara itu, bagi kualiti tidur, keputusan menunjukkan majoriti responden 261 (90.3%) adalah kurang tidur. Terdapat perkaitan yang signifikan antara skor ketagihan telefon pintar dan skor kualiti tidur ( $p=0.002$ ), iaitu 144 (49.8%) daripada mereka yang ketagih menggunakan telefon pintar juga mengalami kualiti tidur yang lemah. Kesimpulannya, ketagihan telefon pintar adalah kelaziman dalam kajian ini. Kempen kesedaran sosial tentang ketagihan telefon pintar dan kesannya terhadap kualiti tidur diperlukan.



**PREVALENCE OF SMARTPHONE ADDICTION AND THE IMPACT ON  
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**ABSTRACT**

Smartphone is becoming a vital piece required technology, yet many people are getting addicted to it. It has been reported that late-night smartphone use, and addiction decrease the quality of sleep. Numerous studies have been done on sleep quality, but very few have linked it to smartphone addiction. A cross-sectional survey was carried out to study Prevalence of Smartphone Addiction and the Impact on Sleep Quality Among Undergraduate Students at School of Health Sciences, USM using a set of self-administered online questionnaire that adopted the Smartphone Addiction Scale (SAS) and Pittsburgh Sleep Quality Index. A total 289 undergraduate students in USM who fulfilled the inclusion and exclusion criteria were included in this study. Data were statistically analysed using the SPSS software version 26.0. Descriptive and Pearson's Chi-Square were used for data analysis. The results show that 151 (52.2%) of the respondent were addicted to. Meanwhile, for the sleep quality, result revealed majority of the respondents 261 (90.3%) were poor sleepers. There was a significant association between smartphone addiction score and sleep quality score ( $p=0.002$ ), that 144 (49.8%) of those addicted to smartphone usage were also experienced poor sleep quality. In conclusion, smartphone addicted is prevalence in this study. Social awareness campaigns about smartphone addiction and its impact on sleep quality are needed.

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

The background of the study that the researcher would undertake is provided in the first chapter. Furthermore, the researcher would explain on why the necessary of carrying out this study among undergraduate students at School of Health Sciences, Universiti Sains Malaysia in this chapter. In addition, researcher have also listed some objectives and benefits of conducting this study.

### 1.1 Background of the study

Mobile phones or smartphones were considered as a luxurious gadget a few years back, but nowadays it has become an absolute necessity for people around the world. Statistics showed that above 5 billion people were using mobile phones in 2019 (Chowdhury & Chakraborty, 2017). The Cisco's 13<sup>th</sup> annual Visual Networking Index (VNI) predicted that, 829 million people will be using smartphones by 2022 (Chowdhury & Chakraborty, 2017). The addiction to a new medias and technologies might lead to the adverse effects on the mental health (Mehrnaz *et al.*, 2018).

The smartphone addiction also known as “nomophobia” which is fear of being without a mobile phone, is often fuelled by an internet overuse problem (Nikolić, 2021). Smartphone addiction consists of four main components which are obsessive phone use, behaviours such as repetitive checking for message, longer use, feeling agitation without phone, and functional impairment with other life activities (Mehrnaz *et al.*, 2018). A study by Liu *et al.*, (2022) among medical students stated that 52.8% of the students were addicted towards smartphone (Liu *et al.*, 2022).

Previous study reported that overusing of smartphone or addiction was associated with poor sleep quality among students (Rathakrishnan *et al.*, 2021). The study showed that majority of the students spend their time more on the social media compared to other academic purposes (Rathakrishnan *et al.*, 2021). High percentages of university students are addicted to their smartphones, according to certain research. According to Buctot *et al.*, (2020) 62.6% of college students are addicted to their smartphones (Buctot *et al.*, 2020). Another study that examined indicators of smartphone addiction among university students in Belarus and Poland concluded that approximately 10.4% of Belarusian students and 22.9% of Polish students displayed such symptoms (Kwak *et al.*, 2018). A late-night smartphone usage was reported to affect the quality of sleep as well as other adverse effects such as depression, anxiety, and over-workload (Chowdhury & Chakraborty, 2017).

The new type of procrastination which is a bedtime procrastination was suggested as a possible caused for the insufficient sleep (Zhang & Wu, 2020). A bedtime procrastination showed low motivation to sleep that caused by unwillingness behaviour to stop the online pleasure-seeking activities via smartphone (Zhang & Wu, 2020). The study also reported that a bedtime procrastination led to a longer sleep latency, shorter sleep duration, and poorer sleep quality (Zhang & Wu, 2020). According to Chang *et al.*, (2015) the short-wavelength-enriched light that is released from electronic devices may be the reason of the detrimental effect on sleep that it has. A prolonged lack of sleep is likely to result from inducing such a misalignment of the circadian phase (Chang *et al.*, 2015).

In conclusion, smartphone addiction had raised concerns especially in today's digital era. Healthy awareness regarding the adverse effects of smartphone addiction is crucial

to give a better understanding to the society. The awareness can be used as a prevention to significantly reduce the smartphone addiction in the society.

## **1.2 Problem statement**

A previous statistics showed that 44.8% of smartphone consumers agreed with the importance of smartphone in their daily life (Malaysian Communications And Multimedia Commission, 2015). In other hand, the psychological problem is considered as one of the main effects of the smartphone addiction among students. Previous study showed a significant positive correlation between the smartphone addiction and sleep quality among students ( $r = 0.137$ ,  $P = 0.05$ ) (Sanusi *et al.*, 2022). Previous study also reported a prevalence of smartphone addiction among medical students was 36.5% with 55.8% of them used their smartphone more than five hours per day (Alhazmi *et al.*, 2018). The smartphone addiction also affected a face-to-face communication (Kuyulu & Beltekin, 2020).

Previously, a study by Fook *et al.*, (2021) showed that 45.5% of students using their smartphone between 3 to 6 hours and 27.3% of them using the smartphone between 7 to 10 per day. The study also showed that three quarter of users (71.4%) was constantly checking their smartphone without any notification (Fook *et al.*, 2021). Moreover, 60.9% of young adults (20 to 39 years old) and 13.2% of pre-teens also showed a constant smartphone checking habits even though the phone showed no notifications (Fook *et al.*, 2021).

Furthermore, a study by Sohn *et al.* (2021) indicated there a link between the sleep quality and smartphone addiction. The study showed that 68.7% of the respondents with smartphone addiction had a poor quality of sleep compared those who were not exhibiting smartphone addiction (57.1%) (Sohn *et al.*, 2021). According to a study by Albursan *et*

*al.*, (2022) among university students, 37.4% of them had smartphone addictions and 7.7% had significant levels of procrastination (Albursan *et al.*, 2022). The researchers also discovered that smartphone addiction was common among students in Yemen (8.8%), Saudi Arabia (27.2%), Sudan (17.3%), and Jordan (59.8%) (Albursan *et al.*, 2022). Individuals that addicted towards smartphone show psychological symptoms such as tolerance, compulsive behaviour, withdrawal, and anxiety (Albursan *et al.*, 2022).

Taken together, the adverse effects of the smartphone addiction among students as well as society is now a crucial problem. However, a study of the quality of sleep and smartphone addiction among undergraduate students is poorly understood. Thus, this proposed study is very important to determine the prevalence of smartphone addiction and its effects on the sleep quality among undergraduate students in Universiti Sains Malaysia (USM). The data could be used to spread the awareness among students in USM specifically as well as Malaysia, regarding the importance of good sleep quality to pursue a healthy lifestyle.

### **1.3 Research Question**

1. What is the prevalence of smartphone addiction among undergraduate students at School of Health Sciences, USM?
2. What is the quality of sleep among undergraduate students at School of Health Sciences, USM?
3. Is there any association between smartphone addiction and sleep quality among undergraduate students at School of Health Sciences, USM?

## **1.4 Research Objective**

Research objective is the outcomes that the researcher aims to achieve by conducting research or study. Many research study contains more than one research objectives. The purpose is to drive research project, including data collection, analysis, and conclusions.

### **1.4.1 General Objective**

The aim of this study is to determine the prevalence of smartphone addiction and the quality of sleep among undergraduate students at School of Health Sciences, USM.

### **1.4.2 Specific Objective**

The following specific objectives of this study are:

1. To determine the prevalence of smartphone addiction among undergraduate students at School of Health Sciences, USM.
2. To determine the sleep quality among undergraduate students at School of Health Sciences, USM.
3. To identify association between smartphone addiction and sleep quality among undergraduate students at School of Health Sciences, USM.

## **1.5 Hypothesis**

Hypothesis  $H_0$ : There is no significant association between smartphone addiction and sleep quality among undergraduate students at School of Health Sciences, USM.

Hypothesis  $H_A$ : There is a significant association between smartphone addiction and sleep quality among undergraduate students at School of Health Sciences, USM.

## 1.6 Conceptual and Operational Definitions

Definitions for the Operational terms used in this research proposal are as follows:

Table 1.1 Definitions for the operational terms used in this research proposal.

Terms	Conceptual	Operational
<b>Addiction</b>	A compulsive, chronic, physiological, or psychological need for a habit-forming substance, activity having harmful physical, psychological, behaviour, or social effects and usually causing well-defined symptoms such as tremors, nausea, anxiety, upon withdrawal (Wicaksana, 2016)	Refers to smartphone addiction among undergraduate students at School of Health Sciences, Universiti Sains Malaysia by using Smartphone Addiction Scale (SAS) questionnaire.
<b>Sleep quality</b>	Defined as an individual's self-satisfaction with all aspects of the sleep experience consist of four attributes which is sleep efficiency, sleep latency, sleep duration, and wake after sleep onset (Nelson <i>et al.</i> , 2022)	In this study, sleep quality is referring to the quality of sleep among undergraduate students by using Pittsburgh Sleep Quality Index (PSQI).

<b>Undergraduate</b>	A student at a college or university who has not received a first and especially a bachelor's degree (Meriam-Webster, 2022)	A person who takes degree course in Health Campus, USM such as degree in audiology, biomedicine, dietetics, environmental and occupational health, exercise and sport science, forensic science, medical radiation, nursing, nutrition, and speech pathology.
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### **1.7 Significance of the Study**

Everyone needs a mobile phone in this sophisticated age, especially university students. Without smartphone, it will be challenging for students to finish their tasks such as coursework, online group discussions, communication, online lecture, and communication, and so on. Therefore, it can be claimed that many students are required to use their smartphones a lot. While some people can limit how much they use their smartphones, others struggle to do so due to the smartphone addiction. Smartphone addiction is harmful because the radiation produced from the mobile phones can be passed on directly into brain. This condition will give a huge impact on overall health. Furthermore, the usage of smartphones during the bedtime will lead to the sleep problems. Thus, this research is very important to study the smartphone addiction on the quality of life among undergraduate students at School of Health Sciences, USM.



Therefore, the finding of this research will provide a baseline information about smartphone addiction on the quality of sleep among undergraduate students at School of Health Sciences, USM. The finding also can be used to emphasize the needs of interventions to help the students to have better quality of sleep that are not affected by uncontrolled smartphone usage or addiction towards smartphone. This study is very important and helpful to plan strategies to prevent other health issues that may occur due to poor sleep such as depression, obesity, heart problem, stroke, and so on. Adequate sleep can help students to stay focused, improve concentration, and improve academic performance.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.0 Introduction

This chapter is going to review the literature related to smartphone addiction on the quality of sleep among undergraduate students in Health Campus Universiti Sains Malaysia (USM). In this literature review, previous research regarding this topic with different opinions will be discussed and elaborated to broad our knowledge regarding this topic. The outcome of previous research will be discussed to improve the effectiveness of smartphone usage and sleep quality among undergraduate students in Health Campus of USM.

#### 2.1 Review of Literature

##### 2.1.1 Prevalence of Smartphone Addiction among Students

The same condition, in which people become so involved in their smartphone use until they overlook other aspects of life. This has been referred to as "smartphone addiction" and "mobile phone addiction." University students have been identified as one of the most significant target groups and the largest consumer group of smartphones, even though smartphone use has increased across economic and age sectors. Students now place a high value on smartphone use because they use it for a variety of activities, such as exploring programmes that offer new features in addition to using the internet (Al-Barashdi *et al.*, 2015).

Smartphones enable individuals to interact with others and partake in a variety of forms of entertainment, including games and internet browsing, among other things. It appears that a lot of students tend to rely on their phones a lot, which will inevitably result in even more use. However, a study found that younger users had the highest rates of

problematic mobile phone use (Al-Barashdi *et al.*, 2015). James and Drennan's study on smartphone usage among college students revealed a high use rate of 1.5 to 5 hours per day, and their findings revealed a range (Al-Barashdi *et al.*, 2015). Their research revealed a variety of traits, including impulsivity, building anxiety prior to smartphone use, the ineffectiveness of control mechanisms, and withdrawal symptoms, that are linked to smartphone addiction (Al-Barashdi *et al.*, 2015).

In addition, a different study conducted among students at Mauritius University found that between 6% and 11% of them exhibited smartphone addiction signs such as tolerance, withdrawal, or a shift in focus at school (Al-Barashdi *et al.*, 2015). Albursan *et al.*, (2022) found that 37.4% of university students were addicted to smartphone use, despite there being no appreciable differences between smartphone addiction and quality of life according to gender and educational stage.

There are several approaches to manage and reducing the detrimental effects of smartphone addiction in society, particularly among adolescents. To ensure the proper usage of cell phones, employers and colleges should implement policies and stringent compliance procedures. With the help of these measures, users will be able to use their phones when necessary and when doing so is crucial. According to Griffiths (2005), treatment for smartphone addiction should put more of an emphasis on altering the addict's feelings and thoughts. For instance, the cognitive behavioural approach, which includes five stages including pre-contemplation, contemplation, preparation, maintenance, and termination, focuses more on modifying the behaviour of addicts over time (Al-Barashdi *et al.*, 2015). The use of motivational interviewing is another form of therapy that places an emphasis on individual responsibility and choice (Al-Barashdi *et al.*, 2015).

### **2.1.2 Sleep Quality among Students**

The quality of students' sleep has a significant impact on their academic performance. For successful academic achievement, sleep is regarded to have a key and function in memory consolidation. But a lack of sleep has been connected to diminished cognition and attentiveness. Studies on sleep deprivation have demonstrated that sleep loss not only worsens cognitive function but also increases weariness and drowsiness. In fact, a person who has been awake for 17 hours has cognitive abilities on par with those who have a blood alcohol level of 0.05% (Okano *et al.*, 2019).

A cross-sectional study conducted by Li *et al.* (2020) on college students in China found that 31.0% of participants fell into the category of having poor sleep quality, as measured by a PSQI score of more than 5. Males perform much better than females in terms of sleep quality and length, whereas females performed significantly better in terms of overall PSQI and sleep disturbance (Li *et al.*, 2020). Freshmen, alcohol use, and gambling behaviour are all known to be strong determinants of poor sleep quality (Li *et al.*, 2020). Additionally, among college students, lifestyle factors had the greatest impact on the quality of their sleep, followed by social, mental, and physical aspects. According to different research, sedentary lifestyles, media consumption, alcohol use, irregular sleep-wake cycles, caffeine use, and smoking have a deleterious impact on sleep (Wang & Bíró, 2021).

Poor sleep hygiene among students and the resulting poor sleep quality can have both psychological and physical effects. Students who spend their nights sleeping for one to two hours fewer have a tendency to build up "sleep debt," which causes them to feel sleepy all day (Afandi, 2015). However, lack of sleep can cause substantial cognitive and psychomotor impairment, including a decline in memory, focus, and thinking skills.

Researchers found that students who are sleep deprived tend to avoid more challenging assignments and are unaware of how their academic struggles may be related to their lack of quality sleep. Depression may also result from this illness (Afandi, 2015). The lack of REM sleep may be linked to students' low academic performance when they have poor sleep quality (Afandi, 2015).

### **2.1.3 The Association Between Smartphone Addiction and Sleep Quality.**

Studies from the past have shown that the use of smartphones is occasionally rising along with advanced technology and digitization. Smartphones do more than only let users make and receive phone calls and text messages. These days, all smartphones have internet connectivity and may be used to access online gaming, applications, social networking, online shopping, and more. All of these, especially for teenagers, can lead to smartphone addiction. According to Kuyulu & Beltekin (2020), there is a favourable relationship between smartphone addiction and quality of sleep. Some research claims there is no connection between smartphone use and sleep. Poor sleep hygiene affects 68.4% of students, who only obtain six hours of sleep each day (Kuyulu & Beltekin, 2020). According to the results, 73.4% of the students use their smartphones for more than five hours a day, with "Whatsapp," "Youtube," "Instagram," "Facebook," "Twitter," and "Snapchat" being the most frequently used apps (Kuyulu & Beltekin, 2020).

Additionally, excessive smartphone use at night has been linked to difficulty falling asleep, shorter sleep length, and fatigue during the day. This is due to research showing a delay in circadian rhythm while using smartphones just before night. Researchers hypothesised that using smartphones can affect the quality of sleep through a variety of mechanisms, including electromagnetic fields from the devices that affect

cerebral blood flow, melatonin rhythms, and other related brain functions (Zhang & Wu, 2020).

In addition, bedtime procrastination refers to the inability to fall asleep and is a unique form of procrastination linked with sleep (Zhang & Wu, 2020). It differs from other forms of procrastination that entail delaying unpleasant chores, because sleep isn't typically thought of as unpleasant. Previous research linked problematic smartphone use to normal procrastination, and a longitudinal study found that university students who used internet less would be less likely to procrastinate (Zhang & Wu, 2020).

## 2.2 Theoretical and Conceptual Framework of the Study

### 2.2.1 Theoretical Framework

According to Ali Raza *et al.*, (2020) conceptual model framework from study “Impact of Smartphone Addiction on Students’ Academic Achievement in Higher Education Institute of Pakistan”, the model demonstrates the impact of smartphone usage, self-regulation, general self-efficacy on smartphone addiction and cyber loafing. Apart from that, the relationship between smartphone addiction and students’ academic achievement is analysed. This model described on how the smartphone usage and self-regulation leads to smartphone addiction. At the same time general self-efficacy and self-regulation also can lead to cyber loafing which can cause addiction of smartphone. Overall, they describe how smartphone addiction can effects on students’ academic achievement (Ali Raza *et al.*, 2020).

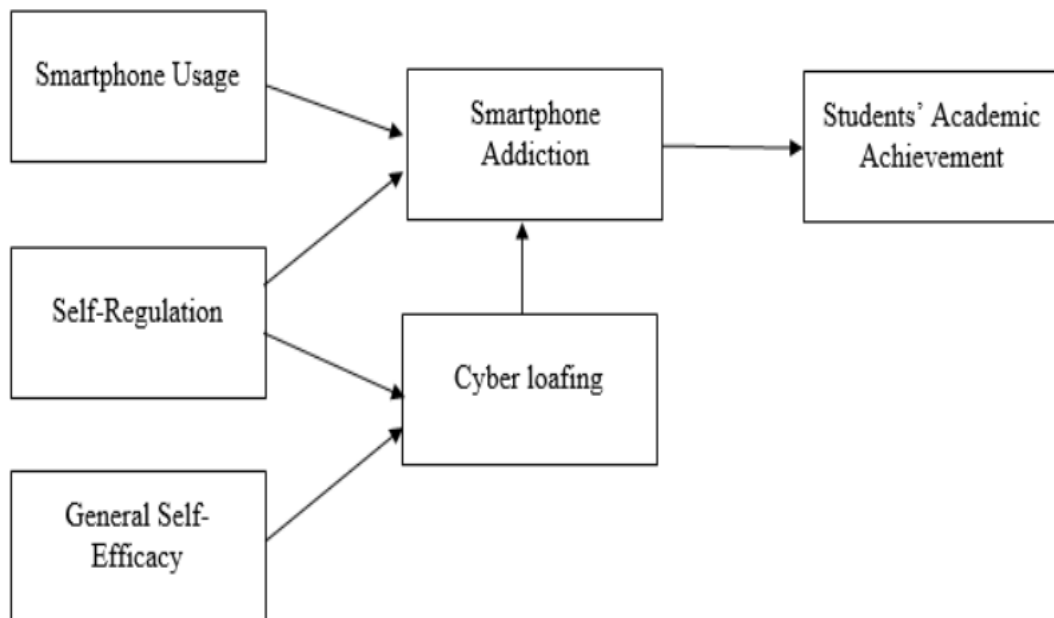


Figure 2.1: The impact of smartphone addiction on students’ academic achievement in higher education institute of Pakistan (Adapted from Ali Raza *et al.*, 2020).

In this proposed study, the researcher will focus on the association between smartphone addictions and sleep quality. The researcher will apply this theory to determine the addiction towards smartphone usage on sleep quality among undergraduate students in School of Health Sciences, USM. Smartphone addiction are the independent variables that may affect the sleep quality among undergraduate students in School of Health Sciences, USM. In this study, the smartphone usage in terms of duration owning a smartphone, duration daily smartphone usage and number of calls per day. These components will determine the addiction level towards smartphone usage. From this, researcher would look over on how it affects the sleep quality among students. This study can contribute to the planning of sleep hygiene and how to control smartphone addiction so that they can improve their quality of life.

### 2.2.2 Conceptual Framework

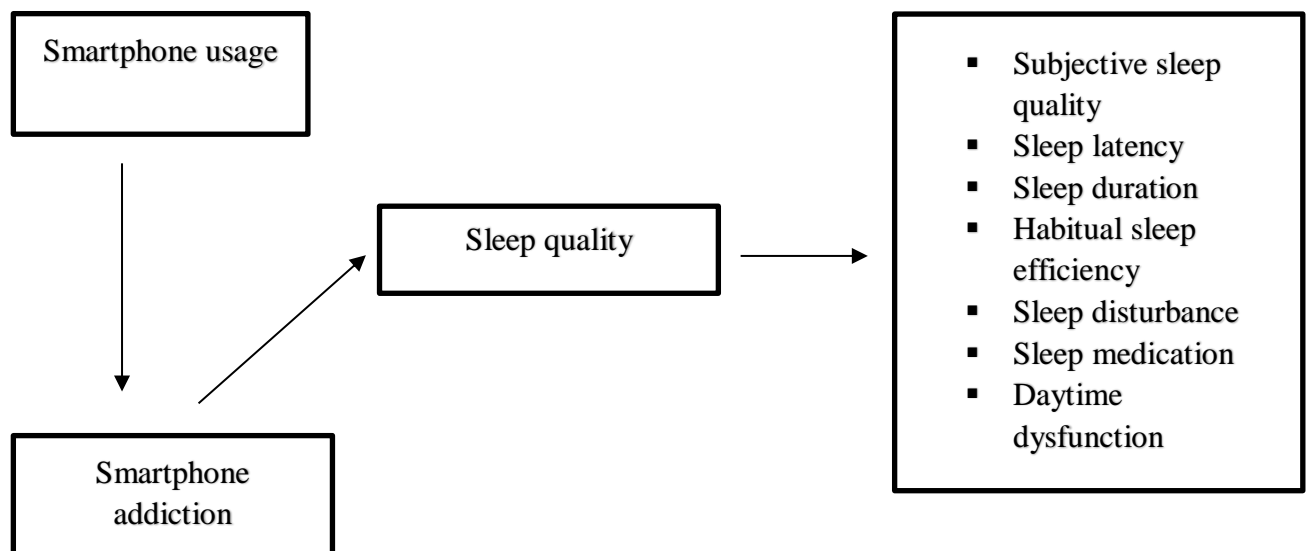


Figure 2.2: Conceptual framework smartphone addiction on sleep quality.



## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter explains how the study carried out including the methodology and methods. Within this chapter, a flow chart of the research was presented. The actual process of carrying out the analysis, such as research design, population and study setting, sample criteria for inclusion and exclusion and sample collection, was defined along with the methodologies and approaches use. Ethical considerations and the method that has been used in the study were also detailed.

#### **3.2 Research Design**

A cross-sectional research design used in this research. This study's methodology utilised to measure the prevalence of disease and conduct population-based surveys (Setia, 2016). Cross-sectional studies enable researchers to gather information quickly and easily via surveys using Google Form.

#### **3.3 Research Location**

This study was conducted at the Health Campus, Universiti Sains Malaysia Kubang Kerian, Kelantan.

#### **3.4 Research Duration**

This study was conducted from January 2023 until August 2023. Meanwhile, the data collection was conducted after obtaining ethical approval from The Human Research Ethics Committee (HREC) of USM which were expected in January 2022 until April 2023.

### **3.5 Research Population**

The study population in this study were undergraduate students from School of Health Science in USM. The study sample were students from first year until fourth year from audiology, biomedicine, dietetics, environmental and occupational health, exercise and sport science, forensic science, medical radiation, nursing, nutrition, and speech pathology programmes.

### **3.6 Subject Criteria**

#### **3.6.1 Inclusion Criteria**

Participants must meet the following criteria to be included in this study:

- Undergraduate students of all programmes in School of Health Sciences, USM.
- Male and female students from first year until fourth year.

#### **3.6.2 Exclusion Criteria**

Subjects are excluded from this study if they are:

- Students who were diagnosed with sleep problem.
- Students who were on sleeping medication.

### **3.7 Sampling Plan**

Sampling is the terms of sample in which a group of people, objects, or items that are taken from a larger population for measurement in research study (Dian Ramadani, 2006).

#### **3.7.1 Sample Size Estimation**

The sample size was calculated for each study objectives. The researcher then chooses the relative greater number of sample size at the end to full-filled the research objectives.

For the first objective (to identify the prevalence of smartphone addiction among undergraduate students at School of Health Sciences, USM), the sample size was determined using single proportion formula. The prevalence of smartphone addiction = 0.084 (Nasser *et al.*, 2020).

$$n = \left[ \frac{z}{\Delta} \right]^2 (1 - p)$$

Where,

n= Sample size

p= Anticipated population proportion = 0.084 (Nasser *et al.*, 2020)

z= Value of standard normal distribution = 1.96

$\Delta$  = Precision= 0.05

Calculation:

$$n = \left( \frac{1.96}{0.05} \right)^2 (0.084) (1-0.084)$$

$$n = 118$$

The minimal sample size is 118, and after considering a 10% drop out, the sample size calculated was:

$$n = 118 + 10\%$$

$$n = 118 + 11.8$$

$$n = 129.8$$

$$n = 130 \text{ participants}$$

Therefore, the sample size needed for the first objective in this study was 130 undergraduate students who fulfilled the inclusion and exclusion criteria.

For the second objective (to assess sleep quality among undergraduate students at School of Health Sciences, USM), the sample size was determine using a single

proportion formula. The prevalence of poor sleepers among undergraduate students at Malaysian public university using PSQI is (p = 0.706) (Nurismadiana, 2018)

$$= \left[ \frac{z}{\Delta} \right]^2 (1 - p)$$

n= Sample size

p= Anticipated population proportion = 0.706 (Nurismadiana, 2018)

z= Value of standard normal distribution = 1.96

Δ = Precision= 0.05

Calculation:

$$n = \left( \frac{1.96}{0.05} \right)^2 (0.706) (1 - 0.706)$$

$$n = 318$$

The minimal sample size was 318, and after considering a 10% drop out, the sample size calculated was:

$$n = 318 + 10\%$$

$$n = 318 + 31.9$$

$$n = 350 \text{ participants}$$

Therefore, the minimal sample size needed for this second objective was 350 undergraduate students who meet the inclusion and exclusion criteria.

The third objective (to identify association between smartphone addiction and sleep quality among undergraduate students at School of Health Sciences, USM), the sample size is determined using double proportion formula. The prevalence of smartphone addiction on sleep quality is 0.776 (Sreeraj *et al.*, 2019).

$$= \left( \frac{1(1 - p1) + p2(1 - p2)}{(1 - p2)^2} \right) (z_{\alpha} + z_{\beta})^2$$

Where,

n = required sample size

$z_{\alpha}$  = value of the standard normal distribution curve cutting off probability Alpha ( $\alpha$ ) in one tail for one-sided alternative or  $\alpha/2$  in each tail for a two-sided alternative ( $z_{0.05}=1.96$ )

$z_{\beta}$  = Power of study, 80% ( $z_{\beta} = 0.84$ )

p = estimated proportion of an attribute that is present in the population

p1 = smartphone addiction on poor sleep quality is 0.776 (Sreeraj *et al.*, 2019)

p2 = smartphone addiction on poor sleep quality is 0.6

$z_{\alpha} = 1.96$ ,  $z_{\beta} = 0.84$ ,  $\Delta = 0.05$ ,  $p_1 = 0.776$ ,  $p_2 = 0.6$

$$= \left( \frac{0.776(1 - 0.776) + 0.6(1 - 0.6)}{(0.776 - 0.6)^2} \right) \times (1.96 + 0.84)^2$$

$$n = 104.7$$

The minimal sample size was 104.7 and after considering a 10% drop out, the sample size calculated was:

$$n = 104.7 + 10\%$$

$$n = 104.7 + 10.47$$

$$n = 115 \text{ participants}$$

Therefore, the minimal sample size needed for this third objective was 115 of undergraduate students.

Hence, the greatest sample size selected in this study was 350 undergraduate students who fulfilled the inclusion criteria.

### **3.7.2 Sampling Method**

To obtain the list of participants for this study, a simple random sampling method was utilised. Simple random sampling is referred to a subset of a population that is chosen at random in a basic random sampling. Each person in the population has an exact equal

probability of getting chosen using this sampling technique. Of all the probability sampling techniques, this one is the easiest to understand because it only needs one random selection and little prior population knowledge (Thomas, 2020).

Each participant in this study was given a number, which then be chosen at random by the researcher. For example, simple random sample would be the names of 350 students being chosen out of a hat from all undergraduate students in School of Health Science. Each of the students would be assigned a number. After that, 350 of those number were chosen using online randomizer.

### **3.8 Research Instrument**

In this study, data was collected from respondents by using a structured, online-administration distribution questionnaire.

#### **3.8.1 Instrument questionnaire**

The Pittsburgh Sleep Quality Index (PSQI) was used to obtain relevant data on the sleep quality among nursing students. The PSQI questionnaire was adopted from Buysse *et al.* (1989). The subjects' for smartphone addiction level was assessed using the Smartphone Addiction Scale (SAS) adopted from Kwon *et al.*, (2013).

#### **Section A: Socio-Demographic Data**

This section contained of 5 close-ended questions represents sociodemographic characteristic data of age, gender, course, ethnicity, academic year.

#### **Section B: Value of Smartphone Usage**

This section contained of 3 close-ended questions represent value of smartphone usage such as duration owning a smartphone, duration daily smartphone usage, and number of calls per day.

#### **Section C: Smartphone Addiction Scale (SAS)**

Smartphone Addiction Scale was used to assess smartphone addiction. This section consisted of 33 items with six-point Likert Scale. The items were directed to assess the smartphone addiction in six factors which is daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationship, overuse, and tolerance.

#### **Section D: Pittsburgh Sleep Quality Index (PSQI)**

Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality. In this section, the question was adopted from the PSQI which a self-rated questionnaire that assess sleep quality and disturbances over an 1-month time interval. The measure consisted of 10 individual items, creating 7 components that produce one global score.

#### **3.8.2 Translation of Instrument**

The original questionnaire was established in English. As the study population were students who were well educated and expected to understand well English, the questionnaire was kept in the original English version.

#### **3.8.3 Validity and Reliability**

When creating a research instrument, validity and reliability are two crucial factors to consider guaranteeing the accuracy and measurement of the data collected for the study. The extent to which a research tool measures what it claims to measure is referred to as its validity (Bagozzi, 2013). The degree of objectivity in the results was what matters. The questionnaire with Cronbach's alpha of 0.7 was considered as reliable and stable.

The Smartphone Addiction Scale's (SAS) Cronbach's Alpha coefficients were 0.8 for the overall scale, 0.80 for the Cyber-Space Oriented relationship/Withdrawal subscale, 0.70 for Daily Life disruption subscale, 0.74 for Positive Anticipation Subscale, and 0.62 for Overuse Subscale. These suggest the validity of the SAS questionnaire (Ching *et al.*,

2020). The Pittsburgh Sleep Quality Index (PSQI), meantime, has been used in numerous research. The PSQI had a fair to good Cronbach's Alpha Coefficient value ranging from 0.64 to 0.83, according to a systematic evaluation of 37 studies (Zhang et al., 2020).

A pilot study was carried out to identify any issues related to the questions and to estimate the time spent responding to the tools. The recommended sample of the pilot study is 35 students. The researcher was select students from that population to be the subject in pilot testing because all students were in the campus. This would make it easier for the researcher to conduct pilot testing face to face.

### **3.9 Variables**

This study has identified two different variables which were dependent variable and dependent variable. The variables were as followed:

#### **3.9.1 Variable measurement**

Table 3.1: Independent and dependent variables

Dependent variables	Sleep quality of undergraduate students
Independent variables	Smartphone addiction of undergraduate students

#### **3.9.2 Variable scoring**

The level of students' sleep quality was presented in frequency and percentage form. The higher the percentage value, the higher level of sleep quality among undergraduate students in USM. Background information such as age, gender, ethnicity, academic year, and course programme were included in this questionnaire to assess the subject's sociodemographic status.

Furthermore, the smartphone addiction subjects were assessed by using Smartphone Addiction Scale (SAS). SAS is a 33-item self-report measure of behaviours associated with



problematic use. The 33 items were arranged into six subscales which was Daily-Life Disturbance, Positive Anticipation, Withdrawal, Cyberspace-Oriented Relationship, Overuse, and Tolerance. The six subscales' scores were summed up to yield a total SAS score with a 33–198 range, where a higher score indicates more serious smartphone addiction and lower score indicate not addicted (Kwon et al., 2013).

The sleep quality of the subject was assessed using the Pittsburgh Sleep Quality Index (PSQI) questionnaire. This section consisted of seven domains to ascertain the respondents' quality and pattern of sleep, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, and sleep disturbances, use of sleep medication, and daytime dysfunction over the last month that consisted of 10 questions related to sleep. PSQI differentiates “poor” from “good” sleep quality by measuring seven components for the past month: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. The PSQI questions were rated from 0 = no difficulty to 3 = severe difficulty, generating scores that correspond to the domains of the scale. The scores range from 0 to 21 and the authors suggest that a score >5 be considered as a significant sleep disturbance and expected time to complete PSQI scale around 5 to 10 minutes (Buysse *et al.*, 2011)