UNIVERSITI PUTRA MALAYSIA

RELATIONSHIP BETWEEN SMARTPHONE USAGE BEFORE BEDTIME WITH INSOMNIA AND DEPRESSION AMONG UPM'S STUDENTS

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BY

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Thesis submitted in fulfilment of the requirement for the degree of Bachelor Science (Environmental and Occupational Health) from the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

ABTRACT

RELATIONSHIP BETWEEN SMARTPHONE USAGE BEFORE BEDTIME WITH INSOMNIA AND DEPRESSION AMONG UPM'S STUDENTS

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Introduction: The advance function of smartphone has increased the dependency of population on smartphone for daily demand and routine. The use of smartphone before bedtime is one of the risk factor for sleep problems among adolescents and adults. Sleep problems in turn might lead to mood dysregulation such as depression. **Objective:** This study aimed to determine the relationship between smartphone usage before sleep with insomnia and depression. **Methodology:** In total, 340 of undergraduate students were selected in this study by using convenient sampling method (23 students from each faculty). The selected respondents were completed a set of self-administered questionnaire. The questionnaire comprised of four main sections; socio-demographic information, smartphone using duration (in a whole day and particularly before bedtime, Insomnia Severity Index and Beck Depression Index. **Results and discussion:** A significant association between smartphone usage before sleep with insomnia was reported (χ^2 = 18.042, $p < 0.05$). No significant association between smartphone usage before sleep with depression. There is significant difference between different duration of smartphone usage before sleep with severity of insomnia (χ^2 = 6.546, $p < 0.05$). The effect of smartphone usage before bedtime on insomnia severity score remain significant after inclusion of the mediator (depression index score) in the regression model (β = 0.930, t = 3.003, $p < 0.01$, R^2 = 0.221). **Conclusion:** Most of the undergraduate students were having not only sleeping difficulties to the extent of potentially clinical insomnia but also depression which is correlated with the duration of smartphone usage before bedtime.

Keywords: smartphone, insomnia, depression, undergraduate

ABSTRAK

HUBUNGKAIT ANTARA PENGGUNAAN TELEFON PINTAR SEBELUM TIDUR DENGAN INSOMNIA DAN KEMURUNGAN DALAM KALANGAN PELAJAR UPM

NOR AFIKAH SAMAN

Pengenalan: Fungsi telefon pintar yang semakin maju telah meningkatkan pergantungan manusia pada telefon pintar untuk aktiviti dan keperluan harian. Penggunaan telefon pintar khususnya sebelum tidur adalah antara faktor risiko untuk masalah tidur (insomnia) di kalangan remaja dan orang dewasa. Masalah tidur seterusnya mungkin membawa kepada ketidakstabilan emosi seperti kemurungan. **Objektif:** Kajian ini bertujuan untuk mengenalpasti hubungkait antara penggunaan telefon pintar dengan insomnia dan kemurungan. **Metodologi:** Keseluruhannya, 340 pelajar prasiswazah telah dipilih dalam kajian ini dengan menggunakan kaedah persampelan mudah (23 pelajar dari setiap fakulti). Setiap responden yang berpotensi telah disaring untuk memastikan mereka memenuhi kriteria dan kemudian dipilih untuk menjawab boring soal selidik. Borang soal selidik mengandungi empat seksyen; maklumat sosio-demografi, tempoh penggunaan telefon pintar (sepanjang hari dan sebelum tidur), *Insomnia Severity Index* dan Beck Depression Index. **Keputusan dan perbincangan:** Terdapat hubungan yang signifikan antara penggunaan telefon pintar sebelum tidur dengan insomnia($\chi 2 = 18.042$, $p < 0.05$). Tiada hubungan yang signifikan antara pendedahan penggunaan telefon pintar sebelum tidur dengan kemurungan. Selain itu, terdapat perbezaan yang signifikan di antara tempoh yang berbeza penggunaan telefon pintar sebelum tidur dengan keterukan insomnia ($\chi 2 = 6.546$, $p < 0.05$). Kesan penggunaan telefon pintar sebelum tidur pada skor insomnia kekal signifikan selepas kemasukan mediator (skor indeks kemurungan) dalam model regresi ($\beta = 0.930$, $t = 3.003$, $p < 0.01$, $R2 = 0.221$). **Kesimpulan:** Kebanyakan pelajar pra-siswazah mengalami kesukaran untuk tidur sehingga layak dikategorikan sebagai mempunyai insomnia secara klinikal dan kemurungan yang dihubungkaitkan dengan penggunaan telefon pintar sebelum tidur.

Kata kunci: Telefon pintar, insomnia, kemurungan, prasiswazah

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ISI	Insomnia severity index
BDI	Beek Depression Index

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Smartphones are well-known mobile electronic devices capable of processing more information compared to the conventional mobile phones. Nowadays, the design and function of a mobile phone to smartphone are keep improving proportionally with the development of world and technologies.

However, the introduction of smartphone in the early of 20th century has now become one of the most prominent and essential tools that shall be owned by majority of population especially youth and adult. The mobile industry demand continues to rise up rapidly especially in developed and developing countries, with 3.6 billion of mobile subscribers recorded at the end of 2014 (Group Speciale Mobile Association, 2015). In addition, the committee of association predicted an additional of one billion subscribers by 2020, considering the global penetration rate to approximately 60%. Based on the data issued by International Data Corporation (2013), there were more than 1.5 billion smartphone users around the world in 2012, and estimated over one billion smartphones will be sold in just 2016. In Malaysia, smartphone penetration increased from 47% in 2012 to 63% in 2013 (Malaysian Communication and Multimedia Commission, 2014).

Improvement in smartphone models design serve to have more functions such as cameras, videos recording, media players, and the current one is the GPS navigation units. Smartphone typically have the functions of web browsers with high-resolution touch screens that can access and properly display standard webpages that can fit smartphone screen size. Hence, there is no doubt that the current smartphone design has more advanced computing function and connectivity than conventional feature phones that has provided people with enormous convenience for their daily activities.

There are a lot of studies discussed and reported the numerous benefits of smartphone for social interaction and medical facilities or services. For instance, there are 35 out of 83 healthcare software application installed in smartphone (42%) were found the most useful by healthcare professionals and health sciences students in United States (Abu Saleh et al., 2012). In another example, people are conveniently getting connected to social media as a new platform for people to interact and also light the way to get better and various ideas with the improvement of smartphone features.

However, the plethoric use of smartphone has concerned as a social issue and emerged modern mental health problems in which the user tends to increase the dependency on the smartphone and indirectly reduce their dependency on the real life services such as in banking purpose, booking of ticket and ordering meals (Emad and Haddad, 2015). In addition to the issues of smartphone dependency, the excessive use of smartphone specifically at night has been found to cause sleep difficulties among adolescents and young adult, where most of them are students either high-school or college students. Proper sleep length and quality are basic physiological requirements for emotional and

physical well-being of each individual. This essential health requirement may be diminished among the youth especially in this increasing technologically oriented society (Buboltz, et al, 2009). A research found out that majority of college students are suffered from sleep deprivation, poor sleep habits and sleep quality (Lund et al., 2009). Sleep difficulties or poor sleep quality might in turn lead to emotional dysregulation as reported by a group of researchers that short sleep length and poor sleep quality may adversely affect the cognitive function, general health, and emotional well-being especially among students (Brown, Buboltz, and Soper, 2002).

1.2 PROBLEM STATEMENT

The fact that smartphone is built up with many advanced functions have emerged the psychological issue of smartphone addiction (Kwon et al., 2013). Since the smartphone addiction are closely related to the behaviour of the individuals, it is complicated to define because the addiction are not only associated with physical features, but also might be related to social and psychological factors (Lee, Ahn, Choi & Choi, 2014).

Excessive used of smartphone has been reported to be associated with sleep deprivation and health problems (Lonn et al., 2004; Koivusilta et al., 2007; Lajunen et al., 2007). The use of smartphone after lights off was related to increased tiredness (Van den Bulck, 2007) and was positively associated with sleep disturbance (Munezawa et al., 2011).

Sleep disturbance can lead to many unpleasant impact. Sleep problem not only cause psychomotor impairment and poor performance, but also lead to emotional

dysregulation such as confusion and depression, while the risk of mood and anxiety disorders can cause by long term chronic insomnia (Motomura and Mishima, 2014). Besides that, in a 1-year follow-up study among young people, the researchers found that high frequency of mobile phone used before bedtime may be one of the risk factor that lead to sleep disturbance and symptoms of emotional instability among the subjects (Thomee, Harenstam, and Hagberg, 2011).

1.3 STUDY JUSTIFICATION

There are limited number of local studies reported the smartphone using pattern in term of behaviour among youth specifically college students, except among medical students (Ching et al., 2015). Despite the pervasiveness of smartphone penetration in Malaysia, survey on how the Malaysian youth behave towards the used of smartphone are limited.

There are only several studies found on sleep problems among undergraduate students in Malaysia. Undergraduate students are mostly comprise of among late adolescents to the early adulthood in which they are very active and exciting in doing activities till the extend some of them might ignoring their sleep hygiene in term of duration and quality. Since the data on sleep problems among undergraduate student are limited, this study is needed so that the data on sleep disturbance among the students generally can be established.

In Malaysia, there are currently a gap in terms of relationship between blue light exposures from smartphone usage before bedtime with sleeping difficulties particularly among universities' students who are currently the vast majority of smartphone users. This study can verify findings in other country, compare, and see if solution can be found. Therefore, the result from this research are useful as a baseline on the smartphone using behaviour among youth in Malaysia and the effect of blue light exposure before sleep on sleep hygiene that in turn might affect performance and mood regulation among the students.

1.4 OBJECTIVES

1.4.1 GENERAL OBJECTIVE

To determine the relationship between smartphone usage before sleep with insomnia and depression among Universiti Putra Malaysia (UPM)'s students.

1.4.2 SPECIFIC OBJECTIVES

i. To determine the socio-demographic background of the respondents.

ii. To determine the duration of smartphone usage particularly before bedtime.

iii. To determine the sleeping pattern among the respondents.

iv. To determine the prevalence of insomnia among the respondents.

v. To determine the prevalence of depression among respondents.

vi. To determine the association between smartphone usage before sleep with insomnia.

vii. To compare the different duration of smartphone usage before sleep with severity of insomnia.

viii. To determine the association between severity of insomnia with depression.

ix. To determine the correlation between study variables.

x. To determine the relationship between smartphone usage before bedtime with insomnia and depression among respondents.

1.5 HYPOTHESIS

H1: There is significant association between smartphone usage before sleep with insomnia.

H2: There is significant difference between duration of smartphone usage before sleep with severity of insomnia.

H3: There is significant association between insomnia and depression.

H4: There is significant relationship between exposure to smartphone before sleep with insomnia and depression.

1.6 CONCEPTUAL FRAMEWORK

Figure 1.1 shows the conceptual framework of the study. Basically there are internal and external factors that effect on the system of human body either physically or psychologically affected. Internal factors are the uncontrollable attribute such as age and gender while external factors are the factors that can be controlled and might be changed by the individual such as life style and living situation. In this study, researcher focused on one of the external factor which is smartphone usage before bedtime as one of the life style among the respondents.

Smartphone usage at least one hour before bedtime at night might give effect on human body either physiologically or psychologically. The researcher focused the effect of the exposures on insomnia and depression among undergraduate students of UPM. Besides that, the relationship between both the dependent variable itself was determined.

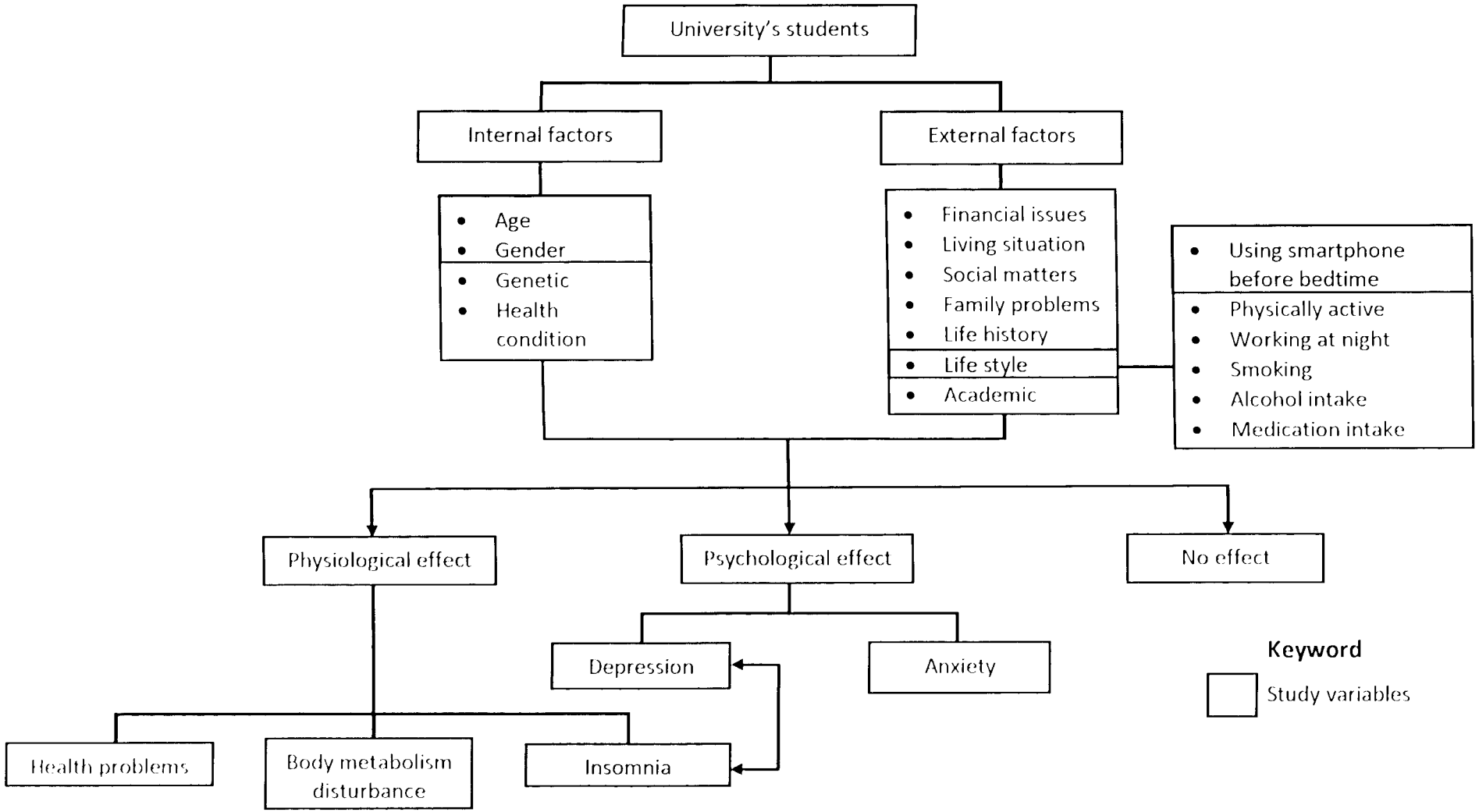


Figure 1.1 Conceptual Framework

1.7 TERM AND DEFINITION

1.7.1 CONCEPTUAL DEFINITION

i. Smartphone

A mobile phone that performs most of the functions of a computer, typically have ability for Internet access with touchscreen interface and an operating system capable of running downloaded apps (Oxford Dictionaries, 3rd Edition).

ii. Insomnia

Insomnia is difficulty falling asleep or more than 30 minutes to fall asleep. An individual with suffering insomnia might feel dissatisfied with their sleep and usually experience some symptoms such as fatigue, low energy, difficulty concentrating, mood disturbances, and decreased performance in work or at school (National Sleep Foundation, 2011).

iii. Depression

Depression is a condition in which a person feels discouraged, sad, hopeless, unmotivated, or do not interested in life in general. People with depression often experience symptoms such as irritability, nervousness, focusing and emotional instability (Anxiety and Depression Association of America, 2015).

1.7.2 OPERATIONAL DEFINITION

i. Smartphone

The smartphone used is define as the mobile phone that have basic ability for accessing the internet, operational system either Android, IOS or Windows mobile and have touch-screen interface.

ii. Insomnia

In this study, insomnia is define as the difficulty to fall asleep within the past two weeks and perception on poor sleep quality as one of the contributing factor is smartphone usage before bedtime. The scores of Insomnia Severity Index (Bastien el al., 2001) indicate the severity of insomnia of the respondents.

iii. Depression

Depression is defined as emotional dysregulation and changes within the past two weeks by using Beck Depression Inventory by Beck et al (1981). The higher the scores indicate the higher level of depression symptoms among the subjects involved.

CHAPTER 2

LITERATURE REVIEW

2.1 SMARTPHONE EMERGENCE

Recently, the used of mobile phone and advanced in smartphone design has undergoes rapid improvement. Some regions of the world specifically developed and developing countries have enjoyed rapid and high penetration of this technology. A total of 70% of individual in this global own at least one mobile phone. Mobile phone once was designed only for communication either through call or Short Message Service (SMS).

In Korea, market penetration of smartphone ownership has gradually increased from 23 million in 2012 to 33 million in January 2013 (Han et al., 2012). Based on the statistics issued by Global ICT Development in 2011 on United States population, instead of a book, their children currently are more prone to own a mobile in which 85% of the kids owning a mobile phone as to only 73% owning books. In meanwhile, 58% of Korean adults owned smartphones, while 84% of their college students used smartphones in 2011 (Park & Lee, 2012). The statistics show that most of the world's population having smartphone as their basic and essential needed.

dependency of citizen towards that technology. Without exception, Malaysia also exploring the evolution trending of smartphone and has gained similar momentum. A total of 85% of Malaysia's population own smartphone (Malaysian Communications and Multimedia Commission, 2007). Seven years onward, an established statistic in 2014 showed that more than 10 million out of 29 million of Malaysian were categorized as active smartphone users (Malaysian Communications and Multimedia Commission, 2014).

2.2 SMARTPHONE ADDICTION

The physical features of the smartphone that are easy to carry and handle with integrate functions of cameras and media players are one of the factors that people prone to use smartphone compared to laptop or notebook even though they have more or less similar function.

Present-day, smartphone are considered as crucial medium in keeping social relationship and performing the more challenging demand of daily activities (Junco and Cotton, 2012). A research suggests that the function of smartphone has become such an essential part of student life but they might not aware their dependency problems on smartphone (Moeller, 2010). National Information Society Agency of Korea had conducted a project on "Development of a Korean Smartphone Addiction Proneness Scale" aimed to clarify the definition and concept of smartphone addiction. The respondents of the project were divided into three groups based on their smartphone addiction level. Based on the finding, the smartphone addiction rate of

high risk and medium risk group were 3.2% and 16% respectively (Shin, Kim & Jung, 2011). The statistics demonstrate that the smartphone-related issues are too detracting to be neglected.

A study conducted by Stanford University's researcher found out that in 200 iPhone users among students, 40% of the respondents were addicted to their smartphone while 6% said they were not addicted to it at all. In addition, 75% of the respondents admitted they bring their smartphone to sleep every night, and 69% reported that they were more concerned to bring their smartphone instead of the wallet while going out (Hope, 2010).

Despite of the advantage of the mobile phone improvement, smartphone addiction is likely to cause not only physical problems but also psychosocial problems as well as internet addiction (Porter, 2010). Negative impact smartphones overuse can be clearly observed in today's modern society. People tend looking at smartphone when crossing the street and neglecting the traffic environment, are in the risk of being run-over by cars. Moreover, driver always stumbling with smartphone while driving may cause road accidents. A study conducted in Perth, Australia on 456 drivers who owned or used mobile phones and had been hospitalized due to a road crash between April 2002 and July2004. The study compare the driver's use of a mobile phone at the estimated time of the crash with the same driver's use during another suitable time period. The researcher found out that the risk was significantly different between those comparisons (McEvoy et al., 2005).

2.3 BLUE LIGHT FROM SMARTPHONE

Electromagnetic particles that travel in waves made up a range of light. These waves emit variety rate of energy with different range in length and strength. The energy of light are higher in shorter wavelength. These wavelengths is measured in nanometers (nm) and build up the electromagnetic spectrum of light. Every wavelength is grouped into the following categories: gamma rays, x-rays, ultraviolet (UV) rays, visible light, infrared light, and radio waves and represented by a different color.

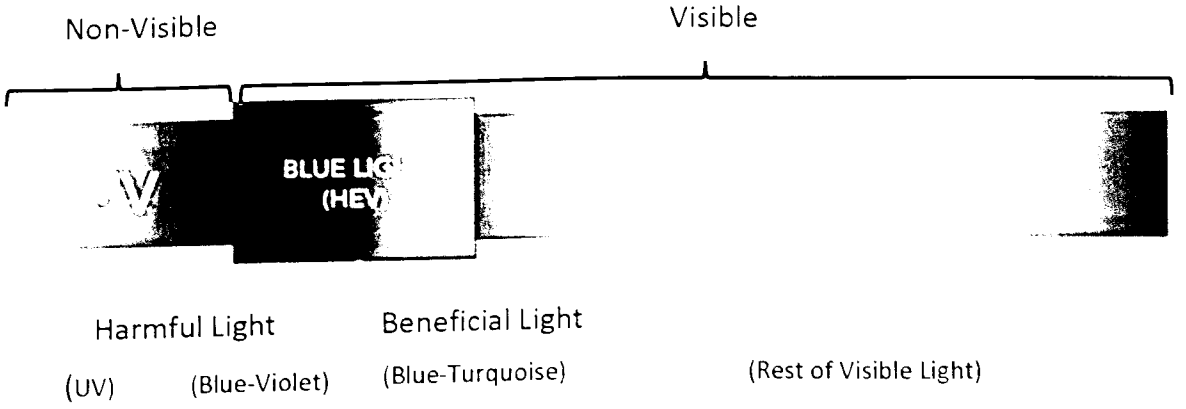


Figure 2.1: Electromagnetic spectrum of light

Referring to Figure 2.1, visible light is the range of electromagnetic spectrum comprise of violet, indigo, blue, green, yellow, orange and red. Human eye is sensitive to only this visible light. Blue light has a very short wavelength with a higher amount of energy. Blue light exist naturally everywhere. In the outdoor environment, light from the sun travels through the atmosphere. The sky look blue because the short and high energy of blue wavelengths collide with the air molecules causing blue light to scatter everywhere (Bohren, Craig and Alistair, 1985).

Nowadays, in order to help enhancing screen brightness and clarity, many of today's electronic devices such as smartphone, tablets, laptop computers and flat-screen televisions are just among a few of the devices use LED back-light technology and these LEDs emit very strong blue light waves. People are continuosly being exposed to more sources of blue light and for longer periods of time due to the wide-spread and popularity used of those technologies.

2.4 EFFECT OF BLUE LIGHT EXPOSURES AT NIGHT

Due to the short wavelength, these High Energy Visible (HEV) wavelengths of blue light flicker more easily compared to longer and weaker wavelengths. This kind of flickering creates a glare that can reduce visual contrast and affect sharpness and clarity. This prolong exposure to these flickering and glaring of electronic media screen may be one of the reasons for eyestrain, headaches, physical and mental fatigue (Viola et al., 2008) especially in these days of smartphone dependency. The blue light either naturally from sunlight or artificially from electronic media's screen cannot be filtered by natural filter of human eyes (Coroneo and Dain, 2014). Excessive and long term of exposure to blue light may cause age-related macular degeneration, which can lead to retinal damage and loss of vision (Geiger et al., 2015).

An article published by Harvard Medical School found out a study conducted by a group of researcher from University of Toronto in which they compared the melatonin levels of respondents exposed to bright indoor light who were wearing blue light - blocking goggles with the subjects exposed to regular dim light without wearing goggles. The researchers reported that the levels of the hormone were about the same,

hence strengthens the hypothesis that melatonin might be suppressed due to blue light exposures. In the other way, blue light can help in elevating mood and boost awareness, but long term exposure to blue light at night can lower the production of melatonin and disrupt the circadian rhythm (Beaute, Femke and Kort, 2014). Harvard researchers have linked exposure to blue light while working at night shift to several types of cancer such as breast cancer, heart diseases, diabetes, obesity and an increased risk for depression (Stevens et al., 2014). The researchers aren't exactly sure why exposure to blue light at night seems to have such detrimental effects on health, but the exposure to light suppresses the secretion of melatonin and lower melatonin levels might explain the association with these types of health problems.

2.5 SMARTPHONE USAGE BEFORE BEDTIME

Darkness is a natural cue to human bodies that it's time for sleep, but the eyes circumventing to fall asleep by staring at bright screens for hours after the sun has gone down. Without focusing in particular electronic devices, Cain and Gradisar (2010) proposed some mechanisms on how the electronic media including smartphone usage in the night especially before bedtime may reduce sleep duration and interfere with sleep quality. As the first mechanism, smartphone usage may displace sleep. As one of leisure activity with no fixed starting and stopping point, people tend to use smartphone in longer time, thus displacing sleep onset lateney (Van den Bulck, 2004). The second mechanism proposed was that the use of electronic media in bed before sleep may increase mental, emotional, or physiological arousal. This possible

mechanism has been proven by several research that examined the effects of playing video games (Weaver et al., 2010; King et al., 2013)

The short wavelength and high energy of blue light emitted by the smartphone screen has been reported to suppress the melatonin production and could lead to later sleep onset and sleep difficulties (Wood et al, 2006). LED back light screens emit an increased amount of light in the short wave-length spectrum of around 460 nm wherein the exposure might delay the melatonin production in the night and reduces signs of sleepiness (Cajochen et al. 2011). Some might ponder if the different brightness of electronic media screen used at late-evening will have different effect. A study conducted aim to compare the impact of three different condition of bright tablet screen exposure, short-wavelength filtered tablet screen exposure and dim tablet screen exposure on adolescents' for one hour. The researchers found only minimal differences on sleepiness signage, and daytime functioning of their respondents. No evidence is yet available indicating whether the different tablet screen exposure might have a different effect on adolescents' sleep (Heath et al., 2014). In another study, the majority of students sleep deprivation at least one time within the previous seven days due to interference of mobile phone use before bedtime (Massimini & Peterson, 2009). In addition, the respondents who attained less sleep during the week, perceived themselves as more stressed and helpless than those who acquired more sleep.

2.5 SLEEP PROBLEMS

Most of college students comprised of late adolescent and early adult ages. Their sleep patterns and sleep problems could be various from those of non-students at their ages (Fukuda and Ishihara, 2001). College students typically have sleep deprivation and resulting in excessive daytime sleepiness (Yang et al., 2003). There were a total of 71% of college students expressed dissatisfaction with their sleep (Hicks et al., 2001) while 50% of students complained on daytime sleepiness (Oginska et al., 2006).

Sleep problems are common in the general population, and approximately one-third of adults reported some form of insomnia (Mellinger et al., 1985). National Sleep Foundation (2008) reported that 59% of adults reported sleep difficulties and described themselves as night-owls. A typical coping technique for dealing with sleep deprivation is to attempt to make up for lost sleep by increasing sleep duration on the weekends, a practice that actually worsens the problem (Wolfson and Carskadon, 2003).

The impact of sleep problems can lead to adverse consequences in daily life. Many research globally proved that sleep problems have been associated with poor academic performance and deficits in attention (Pagel, 2007), risk-taking behaviour and depression, impaired social relationships, (Charney et al., 2006) and disengaged with daily performance (Smaldone et al., 2007).

2.6 DEPRESSION

According to American Psychiatric Association, depression is serious medical illness that negatively affects the way a person feel, feel, how they think and their action. This common illness causes feelings of sadness and/or a loss of interest in activities once enjoyed. Left unattended, depression might lead to variety of emotional, physical problems and minimize the performance of an individual. A standardized scale assessing the extent of disability caused by all major medical disorders, including stroke and heart disease, ranked depression in fourth overall in terms of worldwide disability impact (Murray and Lopez, 1996).

Referring to the past studies, the prevalence of depression are considerably very low before puberty. However the cases gradually increases to the end of adolescence age (Kessler et al., 2001). Lewinsohn (1993) reported that around 20% of the adolescents that involved in his study has experienced a depressive occasion when turning 18 years old and the risk keep increasing in adulthood.

According to a study conducted by Lui and his colleagues (2007), depression have to be associated with sleep problems in which 73 % of adolescents with depressive disorder also suffering from a sleep disorder. Furthermore, some studies found out sleep disturbance is significantly and positively correlated with depressive symptoms among the range age of adolescents to adulthood (Short et al., 2013; Lemola et al., 2011).

A study conducted by Kadir, Mehmet and Abdullah (2015) found the relationship between sleep difficulties and depression among the smartphone users. The finding showed that excessive usage of smartphone and poor sleep quality contribute to depression. In other way, depression might contributed to poor sleep quality.

Table 2.1 Summary of literature review

Title	Author (s)	Summary
The association between social media use and sleep disturbance among young adults	Jessica C. Levenson, Ariel S., Jaime E. et al. (2016)	• The duration and frequency spent on social media before sleep and sleep disturbance was determined among 1788 of young adults (19-32 years old). • There were significant association between duration and frequency spent on social media before bedtime with sleep disturbance and there were significant different between the different duration of social media accessed at night with sleep difficulties.
Relationship of smartphone use severity with sleep quality, depression and anxiety in university students	Kadir D., Mehmet A., & Abdullah A. (2015)	• Smartphone addiction, depression, anxiety and sleep quality were determined among 319 university's students. • The respondents were categorized into two groups based on their smartphone addiction scale (low and high users). • The results indicate that depression, anxiety, and sleep quality may be associated with smartphone overuse. Such overuse was found to be associated with depression and anxiety, which in turn result in sleep problems.
Adolescents' Electronic Media Use at Night, Sleep Disturbance, And Depressive Symptoms in the Smartphone Age	Lemola S., Perkinson GN., Brand S., et al. (2015)	• The changes on sleep pattern and electronic media used due to smartphone ownership was determined among 362 adolescents (12 – 17 years old). • The respondents reported more frequent usage of electronic media through smartphone and the smartphone usage had caused later bedtimes. • Sleep disturbance mediated the relationship between electronic media used before bedtime with depression.

Sleep and use of electronic devices in adolescence: results from a large population-based study	Mari H., Stale P., Astri J.L et al. (2015)	• The electronic devices used in daytime and before bedtime in relation with sleep was determined among 9846 adolescents aged from 16 to 19 years old. • The use of electronic devices either during daytime or before bedtime were both related to sleep measures, with an increased sleep deficiency, long sleep onset latency and increased risk of short sleep duration.
The Association Between Use of Electronic Media in Bed Before Going to Sleep and Insomnia Symptoms, Daytime Sleepiness, Morningness, and Chronotype	Ingrid NF., Linn TN., Sunniva SS. et al.	• The frequency and average duration of media used were determined, as well as daytime sleepiness, insomnia symptoms, sleep and wake up hour in typical days among 532 college students age 18 to 39 years old. • The finding showed positive association between mobile phone usage before bedtime with insomnia, but negatively associated with daytime sleepiness.
Poorer sleep quality is associated with lower emotion-regulation ability in a laboratory paradigm	Iris BM., Allison S., & Monique K. et al.	• Sleep quality within the past 7-days and past 24-hours was determined among 156 participant and cognitive reappraisal was measured. • The study showed that the poor sleep quality for the past 7-days and within the past 24-hours was associated with poor cognitive reappraisal ability (emotional regulation ability)
Mobile Phone Use and Sleep Quality and Length in College Students	Abbey G., Buboltz W., & Frank I.	• Sleep practice and mobile phone usage behaviour were determined among three hundred and fifty college students by using Sleep Quality Index and Mobile Phone Used Problem Scale. • Many aspects of mobile phone behaviour such as problem in mobile phone use, text messaging addiction, problematic texting and pathological texting are related to sleep quality.

CHAPTER 3

METHODOLOGY

3.1 STUDY DESIGN

This was a cross-sectional study carried out from April 2016 to June 2016. The data was collected for hypothesis testing of relationship; both the independent variable (smartphone usage before bedtime) and dependent variables (insomnia and depression) among undergraduate students of Universiti Putra Malaysia.

3.2 STUDY LOCATION

The research was conducted in the main campus of Universiti Putra Malaysia (UPM) in Serdang, a district in the state of Selangor Darul Ehsan. It is located close to Malaysia's administrative capital city, Putrajaya. UPM is a public local university being one of a research university in Malaysia.

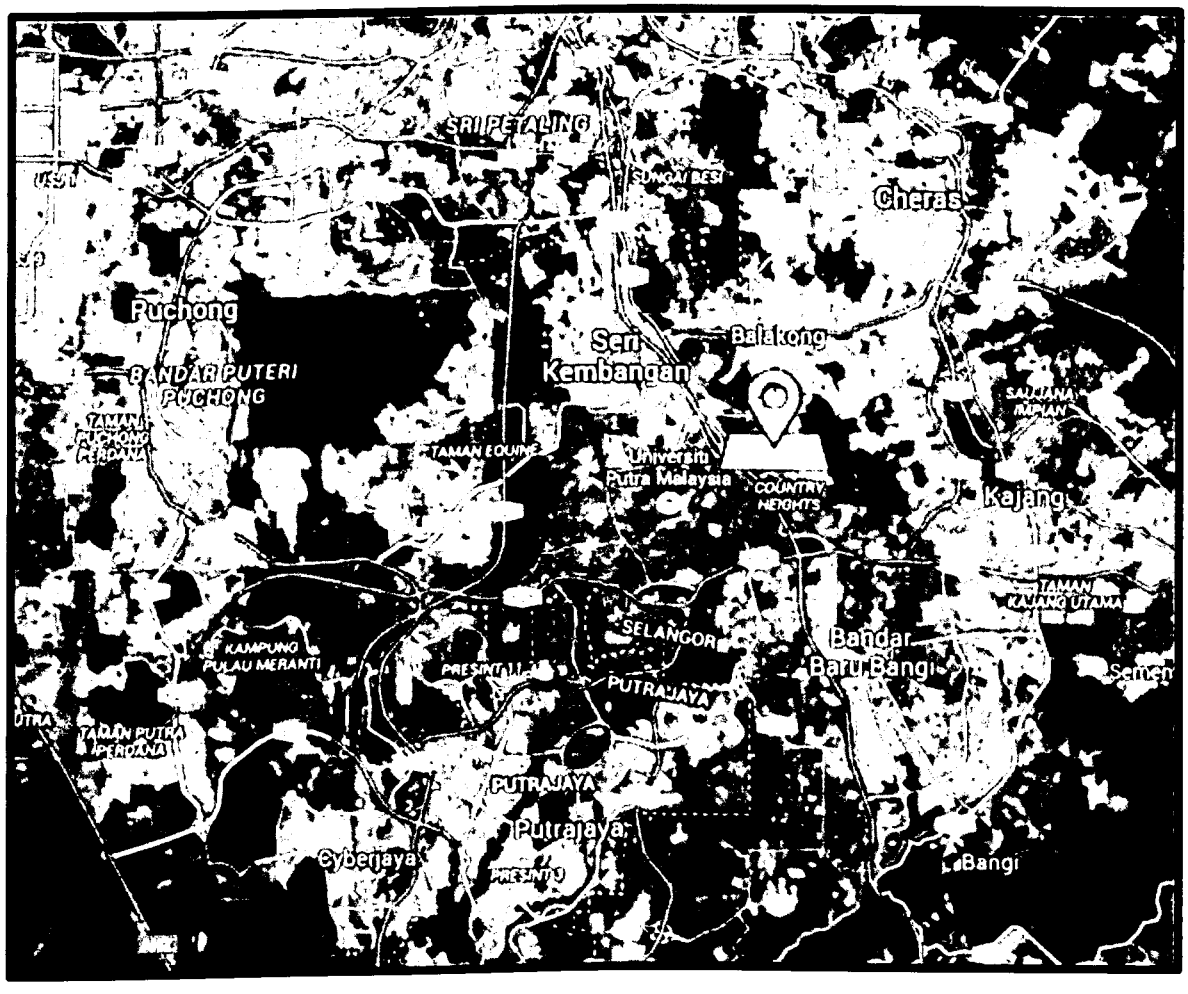


Figure 3.1: Location of Universiti Putra Malaysia in Serdang, Selangor
(Google Maps, 2016)

3.3 SAMPLING METHOD

3.3.1 SAMPLING DESIGN

There are 15 faculty for undergraduate students in UPM Serdang. The respondents were recruited by using stratified sampling method in which 23 respondents were selected from each faculty.

3.3.2 SAMPLING POPULATION

The sampling population of this study is the entire students of Universiti Putra Malaysia.

3.3.3 SAMPLING FRAME

Sampling frame for this study are the full time undergraduate students of UPM, Serdang.

3.3.4 SAMPLING UNIT

The sampling unit for this study are the undergraduate students of UPM based on the following inclusion and exclusion criteria.

3.3.4.1 INCLUSION CRITERIA

Inclusion criteria are the characteristics that must be fulfilled by the subject in order to be eligible in this study. The inclusion criteria were as follow:

1. Malaysian
2. Undergraduate students
3. Smartphone users

3.3.4.2 EXCLUSION CRITERIA

Exclusion criteria are the features that invalidate the subjects to be the participant in a conducted study. These assigned criteria might affect the sleeping pattern and depression symptoms of the individual. The exclusion criteria were as follow:

1. Under consistent medication intake (example: Alpha-blockers, corticosteroids)
2. Working on part-time or full-time job at night
3. Athlete or routinely perform exercise on evening/night
4. Smokers and/or alcohol consumers

3.3.5 SAMPLE SIZE

The sample size was calculated based on a formula proposed by Daniel (1999) as follow:

$$N = \frac{Z^2_{1-\alpha/2}\,(p)\,(1-p)}{d^2}$$

α = possibility of Type 1 error to occur

= 0.05, $Z_{1-\alpha/2}$ = 1.96

p = the prevalence of sleep difficulties among youth due to mobile phone use

= 23% (Sara et al., 2010)

d = the largest difference estimated proportion that could be accepted in the research (±5%)

$$N = \frac{1.96^2(0.23)(1\text{-}0.23)}{0.05^2}$$

N = 272 respondents

In order to expect non-response, the calculated sample size were assumed as 80% of response rate. A further 20% respondents were increased as follow:

80% = 272 respondents

100% = N

$$N = \frac{272 \times 100}{80}$$

N = 340 respondents

A total of 340 respondent among the undergraduate students were involved by using stratified sampling method in which 23 respondents were recruited from each faculty. However, 26 out of 340 respondents did not answered the questionnaires completely. Thus, in total, 314 students were counted with a final response rate of 92%.

3.4 STUDY INSTRUMENTATION

Basically, the study instrumentation was used in this research were pre-screening survey form and a set of questionnaire.

3.4.1 PRE-SCREENING SURVEY

This survey aimed to determine the inclusion and exclusion criteria among the approached subjects. From this survey, the subjects with inclusion criteria were selected as the respondents whereas the subjects with exclusion criteria were excluded. A sample of pre-screening survey was attached in Appendix 1.

3.4.2 QUESTIONNAIRE

A set of questionnaire comprised of four section including two adopted inventory; Insomnia Severity Index (Bastien et al., 2001) and Beck Depression Inventory (Beck et al., 1988). General questions on socio-demographic background and smartphone usage duration were determined in the questionnaire. The questionnaires were in English language. A sample of questionnaire used is attached in Appendix 2. The content of the questionnaire were as follow:

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

In this section, socio-demographic information including age, ethnic, gender, marital status, faculty and year of study were collected.

SECTION B: SMARTPHONE USAGE DURATION AND INFORMATION

In this section, estimated time spent on smartphone on a typical day and the duration of smartphone usage particularly before bedtime also were determined in this section. The type of applications commonly accessed in the use of smartphone within one hour before bedtime were also determined.

SECTION C: SLEEPING PATTERN

In this section, the questions were adopted from Insomnia Severity Index by (Bastien et al., 2001). Basically this section include the details on sleeping pattern in term of timing and trouble experienced while sleeping or during the duration to fall asleep within the past two weeks from the time of answering the questionnaires. The total score of this section indicate the level of insomnia among the respondents in which the higher the score, the more the severity of insomnia. The insomnia scores were categorized as follow:

Table 3.1 Category of Insomnia severity scores

Insomnia Severity Scores	Insomnia Severity Category
0 – 7	No clinical insomnia
8 – 14	Subthreshold insomnia
15 - 21	Moderate severe insomnia
22 – 28	Severe insomnia

SECTION D: DEPRESSION INVENTORY

This questionnaire was adopted from Beck Depression Inventory (Beck et al., 1981). This section comprise of 21 questions that evaluate the severity of depression of the respondents. The purpose of this inventory is to determine the symptoms and changes in mood over the past two weeks, with a 4-point scale. The higher the score indicate the more severe of the depression. The depression scores were then categorized as follows:

Table 3.2 Category of Beck Depression Inventory scores

Beck Depression Inventory Scores	Beck Depression Inventory Category
1-10	Normal
11-16	Mild depression
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
41-63	Extreme depression

3.5 DATA COLLECTION PROCEDURE

3.5.1 ETHICAL CONSIDERATION

INSTITUTIONAL APPROVAL

An ethical clearance for this research to be conducted was obtained from Ethical Committee of UPM. The letter of approval dated on 4th April 2016 with a reference number UPM/TNCPI/RMC/1.4.18.1 is attached in Appendix 3.

INDIVIDUAL CONSENT

Before the distribution of the questionnaire, the respondents filled up a form consenting to participate in the study and had been briefed regarding the research objectives and procedures. Sample of consent form for the respondents is attached in Appendix 4.

3.5.2 PREPARATORY

In this phase, a set of questionnaire including two inventory were prepared. Pre-test was carried out to determine whether all the questions in the survey form can be understood well by the study population. A total of 10% of population with similar criteria of sampling population were chosen to involve in the pre-test to ensure the reliability and internal consistency of the questionnaire.

3.5.3 QUESTIONNAIRE SURVEY

Potential respondents were approached in each of the 15 faculties where 23 respondents were sampled based on the inclusion and exclusion criteria of this study. The subjects were approached in their lecture room while they are waiting for the lecturer. A pre-screening survey was conducted for each approached subjects. The students fulfilled inclusion criteria were proceeded with the next step. Then the questionnaire was distributed to the selected respondents.

Figure 3.2: The respondents completing the questionnaire

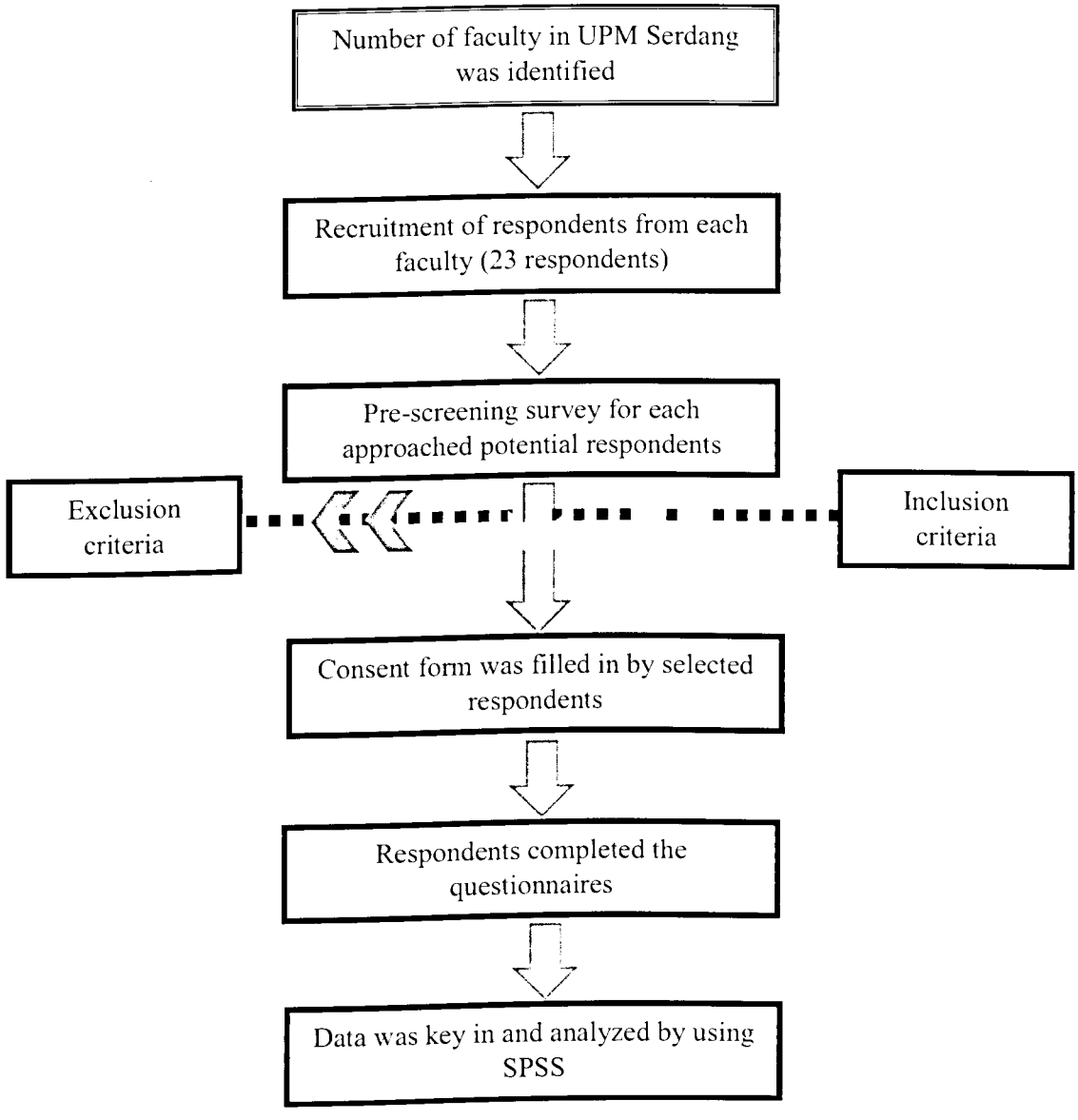


Figure 3.3: Flowchart of data collection procedure

3.6 QUALITY CONTROL

Pre-test was conducted using total of 10% of the sample size from another population who have the similar criteria to the sampling population. The pre-test aimed to ensure that the questionnaire can be easily understood by the respondents and necessary reliability to produce an acceptable result and to detect any potential problems or issues in the administrative planning during data collection. The Cronbach's alpha was 0.75 indicated an acceptable reliability of coefficient.

3.7 DATA ANALYSIS

The data collected was analyzed by using "Statistical Package for Social Sciences" (SPSS) Version 22.0. SPSS is a software package used for statistical analysis. Table 3.3 summarized the statistical tests which were conducted for the data collected.

Table 3.3 Summary of the statistical tests

Objectives	Data Analysis
	Normally Distributed
To determine socio-demographic distribution of the respondents	Descriptive Analysis
To determine the sleeping pattern among university students	
To determine duration of smartphone usage among the respondents	
To determine the prevalence of insomnia among the respondents	
To determine the prevalence of depression among the respondents	
To determine the association between smartphone usage before bedtime with insomnia	Chi-Square
To compare the different duration of smartphone usage before bedtime with severity of insomnia	
To determine the association between severity of insomnia with depression	
To determine the correlation between study variables	Pearson Correlation Coefficient
To determine the relationship between smartphone usage immediately before sleep with insomnia and depression	Logistic Regression

3.7.1 UNIVARIATE ANALYSIS

The distribution of respondent's sociodemographic including age, gender, ethnicity, marital status, year of study and faculty of study were analyzed by using univariate statistical test analysis. In addition, distribution of continuous variable (age) was reported in mean and standard deviation.

Univariate analysis also was performed to analyze the distribution of smartphone usage (smartphone usage immediately before sleep, duration of smartphone usage before sleep and generally in a whole day), application accessed while using smartphone before bedtime, sleeping pattern, sleeping problems and depression among the respondents.

3.7.2 BIVARIATE ANALYSIS

Bivariate analysis was performed for the purpose of determining the empirical relationship between two variables.

3.7.2.1 CHI-SQUARE TEST

Chi-square statistical test analysis was performed to determine the association between smartphone usage before sleep with insomnia. Besides that, the test also was used to determine the association between severity of insomnia with depression.

3.7.2.2 KRUSAL-WALLIS H TEST

The Kruskal-Wallis H test is a rank-based non-parametric test that can be used to determine if there are statistically significant differences between the different duration of smartphone usage immediately before bedtime with the severity of insomnia.

3.7.2.3 CORRELATION

The Pearson product-moment correlation coefficient (or Pearson correlation coefficient, for short) was conducted to determine the relationship between study variables including age, smartphone usage before bedtime, time taken to fall asleep, sleep difficulties, insomnia severity score, and depression index score. The strength of association according Pearson's Rules of Thumb stated in Table 3.4.

Table 3.4 Strength of association

Correlation Coefficient (r)	Strength
< 0.20	Negligible
0.20 – 0.40	Low
0.41 – 0.70	Moderate
0.71 – 0.90	High
>0.90	Very High

3.7.3 MULTIVARIATE ANALYSIS

Multiple logistic regression was performed to determine how the independent variable (sociodemographic, smartphone usage duration and application used before bedtime) predict the dependent variable (insomnia, depression).

CHAPTER 4

RESULTS

4.1 Socio-demographic Background

Table 4.1 shows the descriptive statistics of socio-demographic background. The mean age of the respondents was 21.97 ± 1.193 years old in the range of 20 to 24 years old. It is the common age of undergraduate students since most of them start entering the college for undergraduate level after matriculation or pre-university including STPM and diploma at the age of 19 to 21 years old. Majority of the respondents were female (72.9%) compared to male (27.1%).

The respondents encompassed all the major ethnicity in Malaysia; the highest being Malay (78.7%), followed by Chinese and other ethnics (8.0%, respectively), and Indian (5.4%). In term of current year of study, most of the respondents are in their third year of study (31.8%) while the least one were fourth year of study (18.8%). The rest of the respondents were from first year (20.7%) and second year (28.7%) students.

Table 4.1 Socio-demographic background

Variables	Total	%
Age		
20 – 22 years old	270	86.0
23 -25 years old	44	14.0
Current Year of Study		
First	65	20.7
Second	90	28.7
Third	100	31.8
Fourth	59	18.8
Gender		
Male	85	27.1
Female	229	72.9
Ethnicity		
Malay	247	78.7
Chinese	25	8.0
Indian	15	5.4
Others	25	8.4

Mean age: 21.97 ± 1.193

N = 314

4.2 Smartphone usage information

Table 4.2 shows the behaviour and duration of using smartphone in a typical day within the past two weeks. Two aspects of using duration were identified; duration of smartphone usage for each typical day and duration of usage immediately before bedtime or falling asleep.

Most of the respondents (55.1%) reported more than 6 hours of smartphone usage in a typical day while 14.6% for 2 to 4 hours, 27.4% for 4 to 6 hours and only 2.9% used their smartphone for less than 2 hours in a typical day.

Furthermore, all the respondents reported that they had used smartphone in bed at least once within the past two weeks before they fall asleep with different frequency. Table 4.2 also shows that most of the respondents (71.7%) consistently used their smartphone immediately before sleeping while 24.8% sometimes and 3.5% were rarely used.

In term of duration of smartphone usage in bed before falling asleep, 29.9% of the respondents reported less than 15 minutes of usage, 39.2% between 15 to 30 minutes of usage while the rest of the respondents (30.9%) reported more than 30 minutes of smartphone usage before bedtime.

All the respondents did not installed any software or hardware on their smartphone and none of them did wore spectacle that have the characteristic of UV or blue light filter that might help in filtering the blue light emitted from smartphone.

Table 4.2 Smartphone usage information

Variable	Total	(%)
Use of smartphone 1 hour before sleep		
Always (everyday)	225	71.7
Sometimes (4 to 6 times per week)	78	24.8
Rarely (1 to 3 times per week)	11	3.5
Duration of smartphone use before sleep		
< 15 minutes	94	29.9
15-30 minutes	123	39.2
> 30 minutes	97	30.9
Duration of smartphone used per day		
< 2 hours	9	2.9
2 – 4 hours	46	14.6
4 – 6 hours	86	27.4
> 6 hours	173	55.1
Blue light filter or applications installed		
No	314	100
Yes	0	0
Wore blue light protection spectacle		
No	314	100
Yes	0	0

N = 314

4.3 Activities of Using Smartphone before sleep

Figure 4.1 shows the application commonly accessed by the respondents while using smartphone at least within one hour before sleeping hour. The percentage of the respondents were determined according to the frequency of usage for each application. For the use of communication application either through WhatsApp, Telegram or Short Message Service (SMS), a total of 91.7% of the respondents always used those application, whereas there were 81.9% of the respondents were always get accessed to social media before falling sleep and 32.5% always watching movies or drama before bedtime. The least percentage of the media that always accessed by respondents is videogames (20.4%).

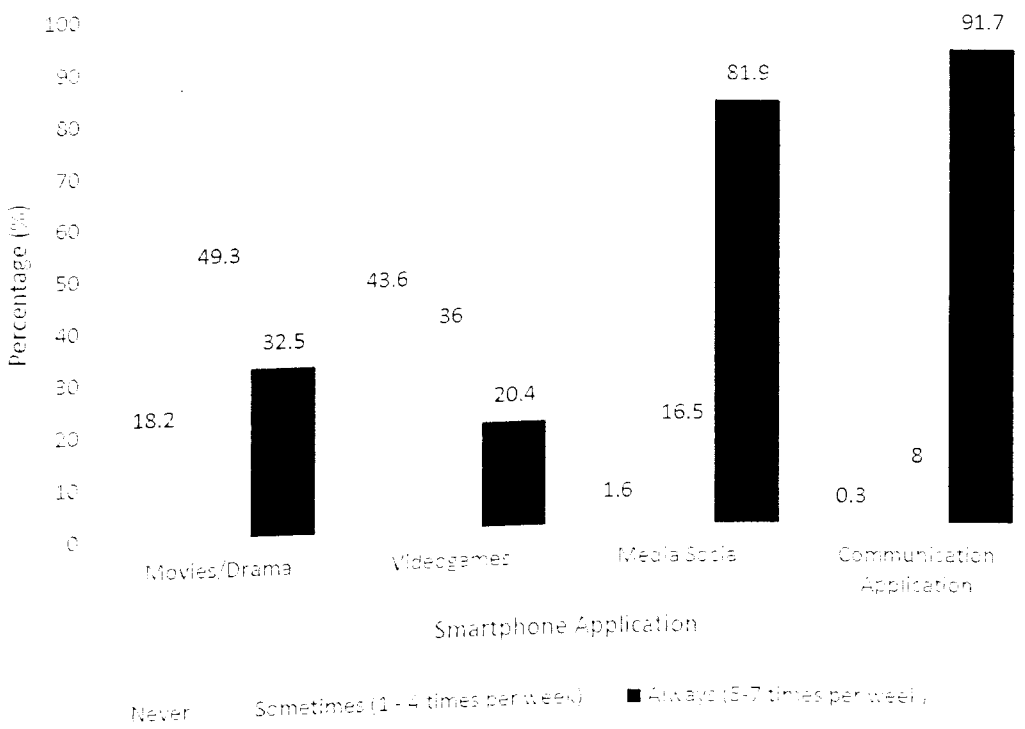


Figure 4.1 Activities of using smartphone before sleep

4.4 Sleeping Pattern

Table 4.3 shows the sleep and wake pattern among respondents in the past two weeks when they answer the questionnaire. Most of the respondents (43.0%) went to bed within 12.00 am to 3.00 am whereas 34.1% of the respondents went to their bed before 12.00 am, and the rest of the respondents (22.9%) usually went to their bed after 3.00 am.

Most of the respondents (33.4%) reported 15 to 30 minutes to fall asleep, followed by 30 to 60 minutes (29.9%), less than 15 minutes (29.0%) and only minority of the respondents took more than one hours to fall asleep (7.6%).

Majority of the respondents (58.3%) estimated 4 hours to 6 hours of sleep, while several of them (11.1%) reported less than 4 hours of sleep, and the rest of 30.6% of the respondent guessed that have more than 6 hours of sleep.

Table 4.3 Sleeping Pattern

Variable		Total	(%)
Time went to bed			
	Before 12.00 am	107	34.1
	12.00 am – 3.00 am	135	43.0
	After 3.00 am	72	22.9
Time taken to fall asleep			
	< 15 minutes	91	29.0
	15 – 30 minutes	105	33.4
	30 – 60 minutes	94	29.9
	>1 hours	24	7.6
Estimated sleeping hour			
	< 4 hours	35	11.1
	4 – 6 hours	183	58.3
	> 6 hours	96	30.6

N = 314

4.5 Difficulty of falling asleep

Based on the Insomnia Severity Index (ISI) questionnaire tabulated in Table 4.4, prevalence of insomnia among the respondents is 83.4% (46.5% with subthreshold symptoms and 36.9% moderate symptoms). None of the respondents reported severe clinical symptoms of insomnia, whereas 16.6% were categorized as no clinically significant insomnia. The mean score of ISI is 12.4 ± 4.8.

Focusing on sleep difficulties (one of element in ISI) experienced within the past two weeks, 34.4% of the respondents perceived severe sleep difficulties while 50% with moderate sleep difficulties and the rest of the respondents (15.6%) perceived no sleep difficulties.

The result in Table 4.4 also shows that only a minority of the respondents (7.3%) perceived that the use of smartphone before sleep is not a contributing factor of their sleep difficulty whereas majority of the respondents (92.7%) perceived that the smartphone usage in bed before sleep was contributed to sleep difficulties (32.2% always, 39.5% sometimes and 21.0% rarely).

Table 4.4 Difficulty of falling asleep

Variable	Total	(%)
Insomnia Severity Index		
No Clinically Significant Insomnia	52	16.6
Subthreshold Insomnia	146	46.5
Moderate Clinical Insomnia	116	36.9
Severe Clinical Insomnia	0	0.0
Sleep Difficulties		
None	49	15.6
Moderate	157	50.0
Severe	108	34.4
Perception of smartphone usage contributing to sleep difficulty		
Always (everyday)	101	32.2
Sometimes (4-6 times per week)	124	39.5
Rarely (1 – 3 times per week)	66	21.0
Never	23	7.3

Insomnia index scored: Mean ± SD = 12.4 ± 4.8

N = 314

4.6 Category of depression

Figure 4.2 presents the category of depression among respondents based on Beck Depression Index (Beck et al, 1988). The prevalence of depression among the respondents is 52.5% (24.8% have mild degree of depression. 24.2% in the borderline of the clinical depression, 13.1% have moderate depression symptoms and 3.5% of the respondents have severe depression symptoms). The rest of the respondents (47.5%) were classified as no depression. The mean score of depression index is 12.2 ± 8.9.

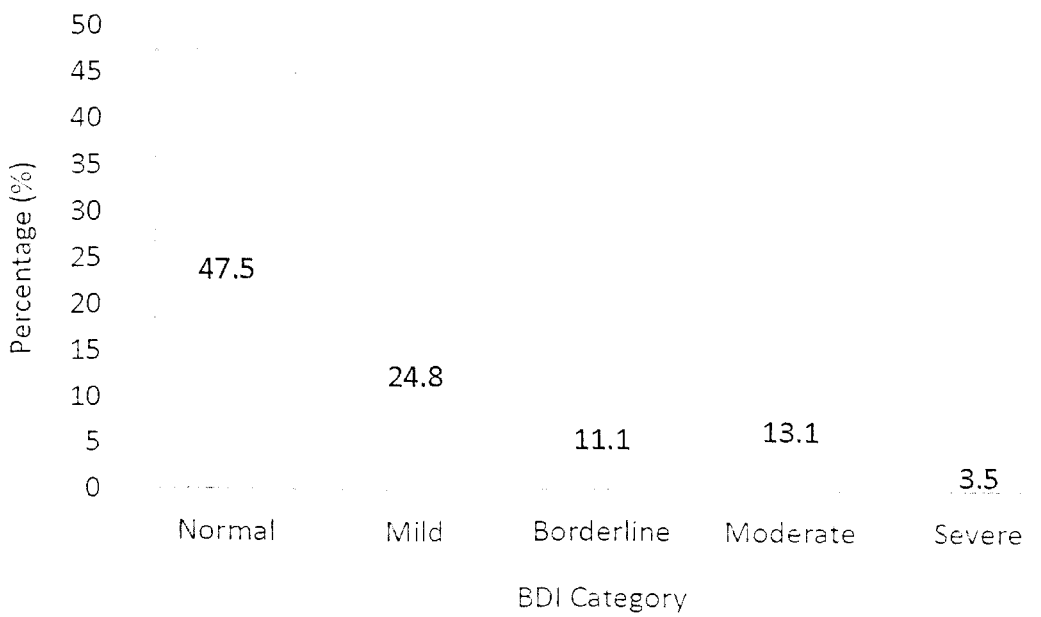


Figure 4.2: Beck Depression Index

4.7 Association between smartphone usage before sleep with insomnia

The result of the chi-square test analysis is tabulated in Table 4.5. The finding reported significant association between the smartphone usage before sleeping with insomnia ($\chi^2 = 13.162$, $p < 0.05$). According to Cohen's Rule of Thumb, Phi value of the analysis (0.205) showed a small to medium strength of association between the smartphone usage before sleep with sleep difficulties among the respondents. Therefore, the hypothesis (H1) of this study was accepted, in which exposure to the from smartphone usage immediately before bedtime is significantly associated with insomnia.

Table 4.5 Association between smartphone usage before sleep with insomnia

	Insomnia Severity					
Smartphone usage 1 hour before sleep	No Clinically Insomnia	Subthreshold Insomnia	Moderate Severe Insomnia	Total	χ^2	*p*-value
Always	27	108	90	225		
Sometimes	22	32	24	78	13.162	0.011*
Rarely	3	6	2	11		
Total	52	146	116	314		

Phi (φ) = 0.205 (small to medium strength of association according to the Cohen's Rule of Thumb relationship)
χ^2 = Chi-square test
**p*-value is significant at < 0.05 level

4.8 Comparison of different duration of smartphone usage before sleep with insomnia

Previously, the smartphone usage before sleep have showed the significant association with severity of insomnia. Using Kruskal Wallis H test, the results in Table 4.6 shows that there is a significant difference comparing the different duration of smartphone usage at least within 1 hour before bedtime with the different severity of insomnia (χ^2 = 6.546, $p < 0.05$).

Table 4.6 Comparison of different duration of smartphone usage before sleep with insomnia

Variable	Duration of Smartphone Usage	Mean Rank	χ^2	*p*-value
Severity of insomnia	< 15 minutes	140.30	6.546	0.038
	15 – 30 minutes	160.26		
	> 30 minutes	170.66		

χ^2 = Kruskal-Wallis H Test
*p-value is significant at < 0.05 level
Mann-whitney test showed that there is significant different of insomnia severity between less than 15 minutes and more than 30 minutes of smartphone usage duration ($p < 0.05$).

4.9 Association between severity of insomnia with depression

Table 4.7 shows that there is a significant association between severity of insomnia and depression by using chi-square test ($\chi^2 = 66.553$, $p < 0.001$). According to Cohen's Rule of Thumb, Phi value of the analysis (0.460) showed a medium to large strength of association between the smartphone insomnia and depression among the respondents.

Table 4.7 Association between severity of insomnia with depression

Variable	**Severity of Insomnia**					
Beck Depression Inventory	No Clinical Insomnia	Subthreshold	Insomnia	Total	χ^2	*p*-value
Normal	41	77	31	149		
Mild	8	44	26	78		
Borderline	3	10	22	35	66.553[a]	< 0.001
Moderate	0	10	31	41		
Severe	0	5	6	11		
Total	52	146	116	314		

Phi (φ) = 0.460 (medium to large strength of association according to the Cohen's Rule of Thumb relationship χ^2 = Chi-square test*
p-value is significant at < 0.05 level

4.10 Correlation between study variables

Table 4.8 presents the results of correlation for participants' age, duration of smartphone usage before bedtime, time taken to fall asleep, sleep difficulties severity, insomnia severity scores and depression index scores.

Age was negatively correlated to all the variable tested except for depression index score. The correlation value showed the positive correlation between age and depression index score. However, the correlation was not significant ($r = 0.037$, $p = 0.510$). Duration of smartphone usage before sleep was positively and significantly related to time taken to fall asleep ($r = 0.303$, $p < 0.01$), sleep difficulties ($r = 0.170$, $p = 0.002$), insomnia severity score ($r = 0.177$, $p = 0.002$) and depression index score ($r = 0.136$, $p = 0.016$). Sleep difficulties were positively related to insomnia severity score ($r = 0.762$, $p < 0.01$) and depression index score ($r = 0.349$, $p < 0.01$). Insomnia severity score also showed the positive correlation with depression index score with significant correlation ($r = 0.445$, $p < 0.01$).

Table 4.8 Correlation between study variables

Variables	Age	Duration of smartphone usage before sleep	Time taken to fall asleep	Sleep Difficulties	Insomnia Severity Score
Age	-				
Duration of smartphone usage before sleep	-0.052	-			
Time taken to fall asleep	-0.096	0.303**	-		
Sleep Difficulties	-0.005	0.170**	0.530**	-	
Insomnia Severity Score	-0.013	0.177**	0.457**	0.762**	-
Depression Index Score	0.037	0.136*	0.293**	0.349**	0.445**

**correlation is significant at $p < 0.01$ level (2-tailed)

*correlation is significant at $p < 0.05$ level (2-tailed)

4.11 The relationship between smartphone usage behaviour and Insomnia Severity Index score

Figure 4.3 represents the regression model testing the relations between smartphone usage before bedtime (independent variable), depression index score (mediator) and insomnia severity score (dependent variable). The regression model revealed that smartphone usage before bedtime was related to the higher score of insomnia severity (β = 1.260, t = 3.704, $p < 0.001$, R^2 = 0.042). Moreover, the model showed that smartphone usage before bedtime was related to higher score of depression and significantly related (β = 1.437, t = 2.246, $p < 0.05$). The effect of smartphone usage before bedtime on insomnia severity score remain significant after inclusion of the mediator (depression index score) to the regression model (β = 0.930, t = 3.003, $p < 0.05$, $R^2 = 0.221$).

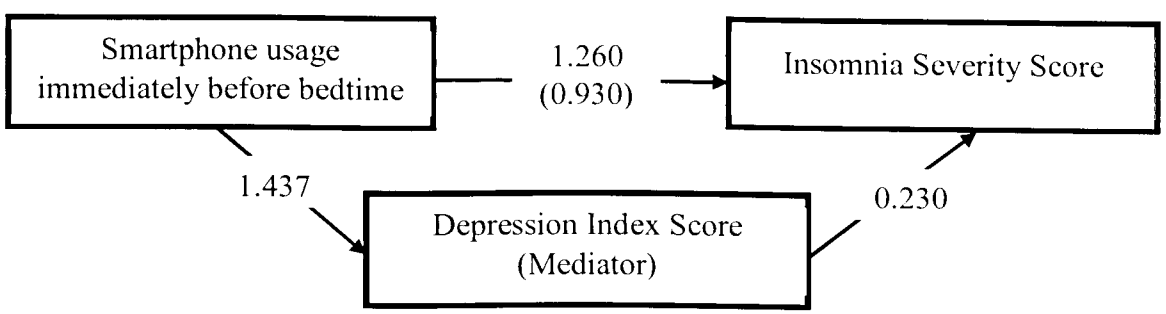


Figure 4.3 Mediation of the relationship between smartphone usage in bed before sleep and Insomnia Severity Score by Depression Index Score. The coefficient in brackets represents the standardized regression coefficient when the mediator is also in the model.

CHAPTER 5

DISCUSSION

5.1 Association between smartphone usage before sleep with insomnia

The finding in this study is corroborated with a previous studies which similarly found that the use of mobile phone immediately before falling asleep is significantly associated with self-perceived of sleep difficulties (Sugannuma et al., 2007). In addition, a research that studied on late-evening access of internet through mobile phone also found a significant association with impaired sleep (Canan et al., 2013). Furthermore, this finding is supported by other research conducted among adolescents found that the smartphone ownership was significantly associated with later bedtimes but was unrelated to sleep disturbance whereas the respondents reported smartphone usage before their bedtime (Lemola et al.,(2014). In a biochemistry study by Chang (2015), the neuroscientist from Harvard University proposed that the exposure to blue light emitted from smartphone at late evening suppresses the production of melatonin affecting circadian rhythm and thus causing later sleep onset.

social media or media) usage, the longer the smartphone usage in bed before fall asleep, the severe the insomnia among the respondents. The results is supported by findings in Table 4.8 where the duration of smartphone usage before bedtime is positively and significantly related with insomnia scores which indicate the longer the duration of usage, the higher the score of insomnia.

Furthermore, the findings was in agreement with the theoretically model as described by Cain and Gradisar (2010). In an extensive study, Lemola et al. (2015) similarly found significant difference of sleep difficulty comparing not only the different durations of smartphone and electronic media usage among high school students in the nights but also between weekdays and weekend, in which the students tend to use electronic media longer during weekend compared to weekdays.

5.3 Association between severity of insomnia with depression

This finding was in line with a study conducted among adolescents and young adult that showed a significant association between severity of insomnia and depression (Short et al., 2013). Besides that, the comorbidity of depression with sleep problems is very high, as was investigated in this study has been described in previous study by Lui et al. (2007) where 73% of the respondents with depressive symptoms are concurrently suffering from the sleep difficulties at most of the typical night. The poor sleep quality might cause mood disturbance which consequently lead to depression.

5.4 Correlation between study variables

Consistent with one of the hypothesis in this research, smartphone use in the bed before sleep was positively significantly related to longer time taken to fall asleep which was consistent with a study among adolescents by Ingrid et al. (2014).

The positive correlation found in this research between sleep difficulties and depression is in line with one of finding in a previous research (Sing et al., 2010). Various studies in the past has also the relationship between sleeping difficulties with depression. Notably, Lovato and Gradisar (2014), Lemola et al. (2011) and Kadir et al. (2014) found that sleep difficulties was significantly and positively correlated with depression. Moreover, the finding of this test also in line with similar issued concerning young adults (Brunborg et al., 2011) although the latter further commented that the relationship between depression and smartphone usage before bedtime is rather shady. Other mechanism have to explore further on how the smartphone can directly cause depression such as the disturbance of hormone production and body metabolism.

5.5 Relationship between smartphone usage with sleep difficulties and depression

In terms of the relationship between duration of smartphone usage before sleeping and insomnia severity index with depression as mediating variable, the results shown in Figure 3.1 was similar to findings by Cain and Gradisar (2010) and consistent with study by Lemola et al. (2015) suggested that electronic media use before sleep was related to shorter sleep duration and sleep difficulties. Primark et al. (2009) in their study has established evidence of depression as predictive variable to sleep difficulties.

Particularly, the authors found that depression substantially increased the relationship between smartphone usage before bedtime and severity of insomnia when added to the regression model (the reduction of the criterion variance explained smartphone usage before bedtime was from $R^2 = 4.2\%$ to $R^2 = 22\%$ when depression was factored into the regression model indicating that the severity of insomnia increased when mediated by depression mediated by depression).

CHAPTER 6

CONCLUSION, LIMITATION AND RECOMMENDATION

6.1 CONCLUSION

In general, the finding from this study suggested smartphone usage at least within one hour before sleep contribute to sleep difficulties among the smartphone users.

Corresponding to the technological advancement in smart and mobile computing, it is undeniable that smartphone has emerged as an essential need in our daily life. Amongst students, smartphones became more than a telecommunication devices. It is a medium used for e-learning, entertainment, social and lifestyle adaptation and much more. However, a pertinent question in to ponder is if the risk outweigh the benefit. The prevalence of insomnia and depression among the smartphone users are very high. Based on the findings in this study, most of the undergraduate students were having not only sleeping difficulties to the extent of potentially clinical insomnia but also depression which is correlated with the duration of smartphone usage where majority of them tend to use smartphone for more than 6 hours in a day. Thus, this could be a cause for concern considering the potential of undergraduate students being successive generation of the future leaders and being of their productive age group.

6.2 STUDY LIMITATION

Among the limitation of this study is the study design applied was cross sectional. The results from this study has limited application and cannot be generalized as the data collected were among specific group of population and during a specific point of time only. There were also various other factors which were not taken into consideration. Specifically, academic routines or learning environments in different part of the semester that might affect the sleep pattern and depression of the respondents such as more assignments, examination or replacement class at night.

Besides that, as this study was conducted among university students, the results might not be applicable to another population except youth or adolescent population between 16 years old to 28 years old in Malaysia. In addition, as the association between sleep disturbance and depression are very complex, the relationship between those elements might be misinterpreted. In addition, the data was collected only by using questionnaire without taking any measurement or biological sample to show any quantitative indicator that the respondents were affected by the blue light exposure through smartphone usage before sleep. Furthermore, there is a chance of bias from the response of the subjects since it was the self-reported feedback through the questionnaire provided.

6.3 RECOMMENDATION

In light of the results of this studies, it is recommended that the student should aware on the duration of smartphone usage especially at night or late evening. Researchers from Harvard Medical Schools has suggested that exposure to blue light from smartphone or any other electronic devices should be avoided 2 to 3 hours before bedtime. Besides that, smartphone users can also download and use applications which are specifically developed to reduces or filter the blue light intensity by placing a red overlay which changes the colour temperature of display to red hue. Besides that, as important as the education and awareness program on any chronic diseases, sleep hygiene education and practice for adolescents and young adult might be taught in and shall be informed regarding the risk and possible strategies to reduce adolescents' electronic media use at night and a good practice of sleep. Besides that, the harmful of excessive usage of smartphone shall be emphasized among the students.

Besides that, there are also several recommendation in order to improve the study design and hence the results from this study. Different comparative group should be studied where sampling should be randomized. In addition, it is also suggested that biological sample being used as specific indicator of stress - such as saliva to determine the level of melatonin and cortisol to determine the sign of stress and depression. Extensively, the intensity of the blue light from phone should also be measured in order to determine quantitatively the dose exposed to the respondents.

REFERENCES

Anxiety and Depression Association of America (2015, October).

Baum, K. T., Desai, A., Field, J., Miller, L. E., Rausch, J., & Beebe, D. W. (2014). Sleep restriction worsens mood and emotion regulation in adolescents. Journal of Child Psychology and Psychiatry, 55, 180–190.

Beute, Femke., & Kort, Y. A. (2014). Salutogenic effects of the environment: Review of health protective effects of nature and daylight. *Applied Psychology: Health and Well-Being*, *6*(1), 67-95.

Bohren, C. F., & Fraser, A. B. (1985). Colors of the sky. *Phys. Teach*, *23*(5), 267-272.

Brown, F.C., Buboltz, W.C., &Soper, B. (2002). Relationship of sleep hygiene awareness, sleep hygiene practices, and sleep quality in university students. *Behavioral Medicine, 28,* 33-38.

Brunborg, G. S., Mentzoni, R. A., Molde, H., Myrseth, H., Skouveroe, K. J. M., Bjorvatn, B., et al. (2011). The relationship between media use in the bedroom, sleep habits and symptoms of insomnia. Journal of Sleep Research, 20, 569–575.

Buboltz, W.C., Brown, F., &Soper, B. (2001). Sleep habits and patterns of college students: A preliminary study. *Journal of American College Health, 50,* 131-135.

Cain, N., & Gradisar, M. (2010). Electronic media use and sleep in school-aged children and adolescents: A review. Sleep Medicine, 11, 735–742.

Cajochen, C., Frey, S., Anders, D., Spati, J., Bues, M., & Pross, A. (2011). Evening exposure to a light-emitting diodes (LED) backlit computer screen affects circadian physiology and cognitive performance. Journal of Applied Physiology, 110, 1432–1438.

Canan, F., Yildirim, O., Sinani, G., Ozturk, O., Ustunel, T. Y. & Ataoglu, A. (2013). Internet addiction and sleep disturbance symptoms among Turkish high school students. *Sleep and Biological Rhythms, 11*(3), 210–213.

Ching SM, Yee A, Ramachandran V, Sazlly Lim SM, Wan Sulaiman WA, Foo YL, et al. (2015) Validation of a Malay Version of the Smartphone Addiction Scale among Medical Students in Malaysia.

Coroneo, M., & Dain, S. (2014). The sun and eyes: sunlight-induced eye disease and its prevention. *Sun, Skin and Health*, 113.

Emad AS, Haddad E (2015) The Influence of Smart Phones on Human Health and Behavior: Jordanians' Perceptions. International Journal of Computer Networks and Applications 2 (2): 52–56.

Geiger, P., Barben, M., Grimm, C., & Samardzija, M. (2015). Blue light-induced retinal lesions, intraretinal vascular leakage and edema formation in the all-cone mouse retina. *Cell death & disease*, *6*(11)

Groupe Speciale Mobile Association. (2016). The Mobile Economy 2016.

Han YS, Choi JK, Hwang BH. (2012). A study on elderly for improvement of usability on smart phone. J Soc e-Bus Stud, 17: 39–52.

Hope D. (2010). IPhone addictive, Survey reveals: Live Science.

Heath, M., Sutherland, C., Bartel, K., Gradisar, M., Williamson, P., Lovato, N., et al. (2014). Does One Hour of Bright or Short-Wavelength Filtered Tablet Screen-Light Have A Meaningful Effect On Adolescents' Pre-Bedtime Alertness, Sleep, And Daytime Functioning? Chronobiology International, 31, 496–505.

Infocomm Development Authority of Singapore. (2008). Annual Survey on Infocomm Use in Households and By Individuals.Singapore: Infocomm Development Authority of Singapore press. 22–28.

International Data Corporation (IDC). (2013). Third-Quarter Report 2013.

Junco, R. & Cotton, S. R. (2012). No A 4 U: The relationship between multitasking and academic performance. *Computers & Education, 59,* 505–514

Kadir M., Mehmet A., & Abdullah A. (2015). Relationship of smartphone use severity with sleep quality, depression and anxiety among university students. *Journal of Behavioural Addictions 4* (2): 85-92

Kessler, R. C., Avenevoli, S., & Ries Merikangas, K. (2001). Mood disorders in children and adolescents: An epidemiologic perspective. Biological Psychiatry, 49, 1002–1014.

King, D. L., Gradisar, M., Drummond, A., Lovato, N., Wessel, J., Micic, G., et al. (2013). The impact of prolonged violent videogaming on adolescent sleep: An experimental study. Journal of Sleep Research, 22, 137–143.

Kubiszewski, V., Fontaine, R., Rusch, E., & Hazouard, E. (2013). Association between electronic media use and sleep habits: An eight-day follow-up study. International Journal of Adolescence and Youth.

Kuss, D. J., Griffiths, M. D., & Binder, J. F. (2013). Internet addiction in students: Prevalence and risk factors. *Computers in Human Behavior*, *29*(3), 959-966.

Kwon, M., Kim, D. J., Cho, H. & Yang, S. (2013). The smartphone addiction scale: Development and validation of a short version for adolescents. *PloS One, 8*(12), e83558.

Lai, P. P., & Say, Y. H. (2013). Associated factors of sleep quality and behavior among students of two tertiary institutions in Northern Malaysia *Med J Malaysia, 68*(3), 195-203.

Lee, H., Ahn, H., Choi, S. & Choi, W. (2014). The SAMS: Smartphone Addiction Management System and Verification. *Journal of Medical Systems, 38*(1), 1–10.

Lemola, S., Brand, S., Vogler, N., Perkinson-Gloor, N., Allemand, M., & Grob, A. (2011). Habitual computer game playing at night is related to depressive symptoms. Personality and Individual Differences, 51, 117–122.

Lemola, S., Perkinson, N., Brand, S., Dewald-Kaufmann, JF., & Grob, A. (2015). Adolescents' Electronic Media Use at Night, Sleep Disturbance, and Depressive Symptoms in the Smartphone Age. *Journal of Youth Adolescence*, 44: 405-418.

Lewinsohn, P. M., Hops, H., Roberts, R. E., Seeley, J. R., & Andrews, J. A. (1993). Adolescent psychopathology: I. Prevalence and incidence of depression and other DSM-III-R disorders in high school students. Journal of Abnormal Psychology, 102, 133.

Lonn S, Ahlbom A, Hall P, et al. (2004). Mobile phone use and the risk of acoustic neuroma. Epidemiology, 15:653-9.

Lovato, N., & Gradisar, M. (2014). A meta-analysis and model of the relationship between sleep and depression in adolescents. Recommendations for future research and clinical practice. Sleep Medicine Reviews.

Lui, X., Buysse, D. J., Gentzler, A. L., Kiss, E., Mayer, L., Kepornai, K., et al. (2007). Insomnia and hypersomnia associated with phenomenology and comorbidity in childhood depression. Sleep, 30, 83–90.

Lund, H.G., Reider, B.D., Whiting, A.B., &Prichard, R.J. (2009). Sleep patterns and predictors of disturbed sleep in a large population of college students. *Journal of Adolescent Health*, 1-9.

Malaysian Communications and Multimedia Commission (2014) Hand phone Users Survey 2012.

Malaysian Communications and Multimedia Commission (2012) Hand phone Users Survey 2011.

Massimini, M. & Peterson, M. (2009). Information and communication technology: Effects on U.S. College Students. *Cyberpsychology: Research on Cyberspadce, 3*(1), 1-15.

McEvoy, S.P. et al. (2005). *Role of mobile phones in motor vehicle crashes resulting in hospital attendance; a case-crossover study*. In: British Medical Journal, July 12, 2005

Mosa, A.S., Yoo, I., & Sheets, L. (2012). A Systematic Review of Healthcare Applications for Smartphone. BMC Medical Informatics and Decision Making 12: 67.

Motomura Y., Mishima K. (2014). Sleep and Emotion: The Role Of Sleep In Emotion Regulation, 66(1):15-23.

Munezawa T, Kaneita Y, Osaki Y. (2011). The Association between Use of Mobile Phones after Lights Out and Sleep Disturbances among Japanese Adolescents: A Nationwide Cross-Sectional Survey. *Sleep,* 34(8):1013–1020.

National Sleep Foundation. (2011). Sleep in America poll. Washington, DC: National Sleep Foundation.

Oh, J. H., Yoo, H., Park, H. K., & Do, Y. R. (2015). Analysis of circadian properties and healthy levels of blue light from smartphones at night. *Scientific reports*, *5*.

Park, N. & Lee, H. (2012). Social implications of smartphone use: Korean college students' smartphone use and psychological well-being. *Cyberpsychology, Behavior, and Social Networking, 15*(9), 491–497.

Porter, G., "Alleviating the "dark side" of smart phone use," in *Technology and Society (ISTAS), 2010 IEEE International Symposium on* , vol., no., pp.435-440, 7-9 June 2010 doi: 10.1109/ISTAS.2010.5514609.

Primack, B. A., Swanier, B., Georgiopoulos, A. M., Land, S. R., & Fine, M. J. (2009). Association between media use in adolescence and depression in young adulthood: A longitudinal study. Archives of General Psychiatry, 66, 181–188

Rashvand HF, Hsiao KF (2015) Smartphone intelligent applications: A brief review. Multimedia Systems 21(1):103–119

Rush S. (2011). Problematic use of smart phones in the workplace: An introductory study.BArts (Honours) thesis. Central Queensland University, Rockhampton.

Segen's Medical Dictionary. (2012).

Shin KW, Kim DI, Jung YJ (2011) Development of Korean smart phone addiction proneness scale for youth and adults. Seoul: Korean National Information Society Agency press.42–53

Short, M. A., Gradisar, M., Lack, L. C., Wright, H. R., & Dohnt, H. (2013). The sleep patterns and well-being of Australian adolescents. Journal of Adolescence, 36, 103–110.

Sing, C. Y., & Wong, W. S. (2010). Prevalence of insomnia and its psychosocial correlates among college students in Hong Kong. Journal of American college health, 59(3), 174-182.

Skye G., & Kevin L. (2015, September 14). How Smartphone Affects Your Brain and Body. Retrieved from: http://www.techinsider.io/how-smartphone-light-affects-your-brain-and-body-2015-9

Smith, A. (2013). *Smartphone ownership—2013 update*. Washington, DC: Pew Research Center.

Song, H. K., Jeong, M. H., Sung, D. J., Jung, J. K., Choi, J. S., Jang, Y. L. & Lee, J. S. (2010). Internet addiction in adolescents and its relation to sleep and depression. *Sleep Medicine and Psychophysiology, 17*(2), 100–108.

Steve, M & Matthew, M. (2012). *While You're Sleeping*. New York: Scholastic Paperbacks.)

Stevens, R. G., Brainard, G. C., Blask, D. E., Lockley, S. W., & Motta, M. E. (2014). Breast cancer and circadian disruption from electric lighting in the modern world. *CA: a cancer journal for clinicians*, *64*(3), 207-218

Suganuma, N., Kikuchi, T., Yanagi, K., Yamamura, S., Morishima, H., Adachi, H., Takeda, M. (2007). Using electronic media before sleep can curtail sleep time and result in self-perceived insufficient sleep. Sleep and Biological Rhythms, 5, 204–214.

Thomee, S., Harenstam, A., & Hagberg, M. (2011). Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults e a prospective cohort study. BMC Public Health, 11:66.

Union, I.T. Global ICT Developments. (2011, April).

Viola, A. U., James, L. M., Schlangen, L. J., & Dijk, D. J. (2008). Blue-enriched white light in the workplace improves self-reported alertness, performance and sleep quality. *Scandinavian journal of work, environment & health*, 297-306.

Van den Bulck J. (2007). Adolescent use of mobile phones for calling and sending text messages after lights out: Results from a prospective cohort study with a one-year follow up. *Sleep,* 30(9):1220–1223.

Weaver, E., Gradisar, M., Dohnt, H., Lovato, N., & Douglas, P. (2010). The effect of presleep video-game playing on adolescent sleep. Journal of Clinical Sleep Medicine, 6, 184–189.

White, A. G., Buboltz, W., & Igou, F. (2011). Mobile phone use and sleep quality and length in college students. International Journal of Humanities and Social Science, 1(18), 51-58. Chicago

Wood, A. W., Loughran, S. P., & Stough, C. (2006). Does evening exposure to mobile phone radiation affect subsequent melatonin production? International Journal of Radiation Biology, 82, 69–76

Yang, C. K., Kim, J. K., Patel, S. R., & Lee, J. H. (2005). Age-related changes in sleep-wake patterns among Korean teenagers. *Pediatrics*, *115* (Supplement 1), 250-256.

APPENDICES

APPENDIX 1

PRE-SCREENING SURVEY FORM

RELATIONSHIP BETWEEN SMARTPHONE USAGE BEFORE SLEEP WITH INSOMNIA AND DEPRESSION

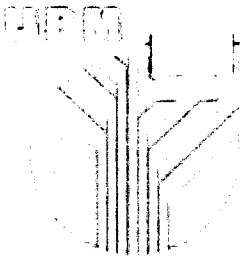
PRE-SCREENING SURVEY

Criteria	Yes	No
1. Are you a smartphone user?		
2. Do you have prescribed for medication intake within the past two weeks?		
3. Do you perform any part time job at night?		
4. Are you smoking?		
5. Are you an alcohol consumers?		
6. Are you currently an athlete or doing exercise in daily evening?		

Status of current education: Foundation / Undergraduate / Postgraduate

APPENDIX 2

SELF-ADMINISTERED QUESTIONNAIRE



UNIVERSITI PUTRA MALAYSIA

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

FACULTY OF MEDICINE AND HEALTH SCIENCES

SURVEY ON RELATIONSHIP BETWEEN SMARTPHONE USAGE BEFORE BEDTIME WITH INSOMNIA AND DEPRESSION AMONG UPM'S STUDENTS

RESPONDENT ID:

DATE:

SECTION A: SOCIO-DEMOGRAPHIC BACKGROUND

1) Age : _____ years old 2) Gender: Male ☐ Female ☐

2) Faculty : _____ 3) Year of Study: _____

4) Races :
- ☐ Malay
- ☐ Chinese
- ☐ Indian
- ☐ Bumiputera Sabah/Sarawak
- ☐ Others

SECTION B: INFORMATION ON SMARTPHONE USE

1) How long are you using your smartphone in a typical day?
- ☐ Less than 2 hours
- ☐ 2 – 4 hours
- ☐ 4-6 hours
- ☐ More than 6 hours

2) Do you use smartphone while **you are already in bed before fall asleep?**

☐ Always ☐ Sometimes ☐ Rarely ☐ Never

3) How long do you spent using smartphone at bed before fall asleep?
- ☐ Less than 15 minutes
- ☐ 15 – 30 minutes
- ☐ More than 30 minutes

4) Did you installed any blue light filter on your smartphone?

☐ Yes ☐ No

5) Did you wearing spectacle with blue light protector when using smartphone?

☐ Yes ☐ No

6) The questions below aim to determine your electronic media activities while **you're already in bed before fall asleep**: (Please tick (/) only one for each row)

	Never	Once a week	Twice a week	3 – 4 times per week	Always (More than 5 times per week)
Watching movies or drama (either through television, laptop or smartphone)	○	○	○	○	○
Playing video games	○	○	○	○	○
Communication by phone/SMS/Whatsapp	○	○	○	○	○
Media social (facebook/twitter/Instagram/blogwalking/etc)	○	○	○	○	○

SECTION C: SLEEP AND WAKE PATTERN

INSTRUCTIONS: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, what time have you usually gone to bed at night?

   _____

2. During the past month, how long (in minutes) has it usually takes for you **to fall asleep** each typical night?

   ☐ Less than 15 minutes

   ☐ 15-30 minutes

   ☐ 30 – 60 minutes

   ☐ More than 1 hour

3. During the past month, how many hours of **actual sleep** did you get at night? (This may be different than the number of hours you spent in bed)

   ☐ Less than 4 hours ☐ 4 – 6 hour ☐ More than 6 hours

4. Do you ever experienced that the use of smartphone before fall asleep contribute to your sleep difficulties?

☐ Always ☐ Sometimes ☐ Rarely ☐ Never

5. Is/Are there another environmental sources that cause difficulties in your sleeping at night?

☐ None ☐ Noise ☐ Lighting ☐ Bedroom ☐ Privacy

6. The following questions aimed to indicate any Insomnia symptoms. The Insomnia Severity Index has seven questions. For each question, **please CIRCLE** the number that best describes your answer. Please rate the **CURRENT** (i.e. LAST 2 WEEKS) SEVERITY of your sleep problem(s).

Sleep Problem	None	Mild	Moderate	Severe	Very Severe
1. Difficulty falling asleep	0	1	2	3	4
2. Difficulty staying asleep	0	1	2	3	4
3. Problems waking up too early	0	1	2	3	4

i. How **SATISFIED/DISSATISFIED** are you with your CURRENT sleep quality?

Very Satisfied	Satisfied	Moderately Satisfied	Dissatisfied	Very Dissatisfied
0	1	2	3	4

ii. How **NOTICEABLE** to others do you think your sleep problem is in terms of impairing the quality of your life?

Not Noticeable at	A Little	Somewhat	Much	Very Much Noticeable
0	1	2	3	4

iii. How **WORRIED/DISTRESSED** are you about your current sleep problem?

Not worried at all	A Little	Somewhat	Much	Very Much
0	1	2	3	4

iv. To what extent do you consider your sleep problem to **INTERFERE** with your daily functioning (e.g. daytime fatigue, mood, ability to function at daily chores, concentration, memory, etc)

Not Interfering at all	A Little	Somewhat	Much	Very Much Interfering
0	1	2	3	4

****Note: Insomnia severity will be calculated from the total score of Question 6.**

SECTION D: DEPRESSION INVENTORY

Instruction: This section consist of 21 groups of statements. Please read each group of statements carefully and then pick out the **ONE statement** in each group that best describes the way you have been feeling during the past **TWO WEEK including TODAY**. Circle the number beside the statement you have picked. Be sure you do not choose more than one statement for any group.

a)	0	I do not feel sad.
	1	I feel sad
	2	I am sad all the time and I can't snap out of it.
	3	I am so sad and unhappy that I can't stand it.
b)	0	I am not particularly discouraged about the future.
	1	I feel discouraged about the future.
	2	I feel I have nothing to look forward to.
	3	I feel the future is hopeless and that things cannot improve.
c)	0	I do not feel like a failure.
	1	I feel I have failed more than the average person.
	2	As I look back on my life, all I can see is a lot of failures.
	3	I feel I am a complete failure as a person.
d)	0	I get as much satisfaction out of things as I used to.
	1	I don't enjoy things the way I used to.
	2	I don't get real satisfaction out of anything anymore.
	3	I am dissatisfied or bored with everything.
e)	0	I don't feel particularly guilty
	1	I feel guilty a good part of the time.
	2	I feel quite guilty most of the time.
	3	I feel guilty all of the time.

f)	0	I don't feel I am being punished.
	1	I feel I may be punished.
	2	I expect to be punished.
	3	I feel I am being punished.
g)	0	I don't feel disappointed in myself.
	1	I am disappointed in myself.
	2	I am disgusted with myself.
	3	I hate myself.
h)	0	I don't feel I am any worse than anybody else.
	1	I am critical of myself for my weaknesses or mistakes.
	2	I blame myself all the time for my faults.
	3	I blame myself for everything bad that happens.
i)	0	I don't have any thoughts of killing myself.
	1	I have thoughts of killing myself, but I would not carry them out.
	2	I would like to kill myself.
	3	I would kill myself if I had the chance.
j)	0	I don't cry any more than usual.
	1	I cry more now than I used to.
	2	I cry all the time now.
	3	I used to be able to cry, but now I can't cry even though I want to.
k)	0	I am no more irritated by things than I ever was.
	1	I am slightly more irritated now than usual.
	2	I am quite annoyed or irritated a good deal of the time.
	3	I feel irritated all the time.
l)	0	I have not lost interest in other people.
	1	I am less interested in other people than I used to be.
	2	I have lost most of my interest in other people.
	3	I have lost all of my interest in other people.
m)	0	I make decisions about as well as I ever could.
	1	I put off making decisions more than I used to.
	2	I have greater difficulty in making decisions more than I used to.
	3	I can't make decisions at all anymore.
n)	0	I don't feel that I look any worse than I used to.
	1	I am worried that I am looking old or unattractive.
	2	I feel there are permanent changes in my appearance that make me look unattractive
	3	I believe that I look ugly.

o)	0	I can work about as well as before.
	1	It takes an extra effort to get started at doing something.
	2	I have to push myself very hard to do anything.
	3	I can't do any work at all.
p)	0	I can sleep as well as usual.
	1	I don't sleep as well as I used to.
	2	I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
	3	I wake up several hours earlier than I used to and cannot get back to sleep.
q)	0	I don't get more tired than usual.
	1	I get tired more easily than I used to.
	2	I get tired from doing almost anything.
	3	I am too tired to do anything.
r)	0	My appetite is no worse than usual.
	1	My appetite is not as good as it used to be.
	2	My appetite is much worse now.
	3	I have no appetite at all anymore.
s)	0	I haven't lost much weight, if any, lately.
	1	I have lost more than five pounds.
	2	I have lost more than ten pounds.
	3	I have lost more than fifteen pounds.
t)	0	I am no more worried about my health than usual
	1	I am worried about physical problems like aches, pains, upset stomach, or constipation
	2	I am very worried about physical problems and it's hard to think of much else.
	3	I am so worried about my physical problems that I cannot think of anything else
u)	0	I have not noticed any recent change in my interest in sex.
	1	I am less interested in sex than I used to be
	2	I have almost no interest in sex.
	3	I have lost interest in sex completely.

****Note: Level of depression will be calculated from the total score of Depression Inventory**

This is the end of the questionnaire

Thank you for your cooperation! May God bless you.

APPENDIX 3

INSTITUTIONAL APPROVAL

APPENDIX 4

RESPONDENT CONSENT FORM

JAWATANKUASA ETIKA UNIVERSITI UNTUK PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE:

Relationship between Smartphone Usage before Bedtime with Insomnia and Depression among UPM's Students.

2. INTRODUCTION:

Troubled sleep is considered both a predictive sign and symptom of many illnesses, and is associated with substantial decrements in the quality of life. Sleep disturbance is an important risk factor for the development of depression among youth. Meanwhile, the usage of smartphone has increased rapidly in recent years, and this has brought about addiction. Excessive smartphone use at night is a risk factor for both youths' sleep disturbance and depression. Therefore, this study is conducted to investigate the relationship between smartphone use prior to bed with sleep difficulties and depression among university students.

3. WHAT WILL YOU HAVE TO DO?

You are require to answer questions this questionnaire according to your duration setting. Basically this set of questionnaire comprise of four section. Most of the questions require you to recall back your routine of life within the past two weeks. Please recall back your routine as accurate as you can so that the result of the study will be valid for the research purpose.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

Post-graduate students, medical students, smokers, athlete and students working at night should not participate in this study.

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

Respondents are able to determine if they have the symptoms of Insomnia and depression by answering the inventory in this questionnaire. In addition, they can get inform that the exposure of smartphone before sleep might contribute to sleep disturbance and in turn might lead to depression.

(b) TO THE INVESTIGATOR?

Researcher can identify the smartphone sleeping difficulties and depression

9. CONSENT

I ..... Identity Card No. .....

address.....

... .hereby voluntarily agree to take part in the research stated above *(clinical /drug trial/video recording/ focus group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible adverse

effects and complications (as written in the Respondent's Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature .....
(Respondent)

Date :.....

Signature .....
(Witness)

Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-mentioned research.

Date .....

Signature .....
(Researcher)