# Impact of Smartphone Usage Before Bedtime On Sleep Among Singapore Undergraduates

# Content Page

**Abstract**

In today's Digital Age, smartphones have become a ubiquitous tool in our lives. With increasing smartphone usage, there is a concern that an individual's sleeping cycle may be disrupted, hence causing a deterioration in overall sleep quality. The objective of this study is to investigate the impact of smartphone usage before bedtime on sleep among Singapore undergraduates, where mobile penetration rate is high. 120 students from the School of Physical and Mathematical Sciences (SPMS), Nanyang Technological University (NTU), were chosen to complete an online survey, which comprised of demographic questions, the Pittsburgh Sleep Quality Index (PSQI) instrument and questions related to smartphone usage before bedtime. Regression analysis was used to analyse the data collected from the survey. Overall, the survey results revealed that increased smartphone usage prior to bedtime has a negative impact on both the quantity and quality of sleep. After taking into account for smartphone usage before bedtime, the division of a student was found to explain the variation in overall sleep quality, while the differences in gender and type of smartphone activities engaged were insignificant. The findings of this study reflect the need to raise awareness of the detrimental effects that smartphone usage before bedtime can have on sleep.

# 1 Introduction

With the advancement in technology, smartphones have become an integral part of our lives. This is especially relevant in Singapore, which is ranked first globally in terms of smartphone penetration (Deloitte 2016). According to a recent survey conducted by Deloitte (2016), Singaporeans were the most active users of instant messaging, in which 79% females and 73% males reported that they used instant messaging on their smartphones over the past 7 days. With the prevalence of smartphones today, there is a concern that intensity of smartphone usage may disrupt one's sleeping cycle, reducing overall sleep quality.

Sleep is a biological imperative that plays a vital role in the maintenance of mental and physical health (Goel et al. 2013). Studies have suggested that sleep is essential for learning and cognitive performance (Macquet 2001; Xie et al. 2013). This emphasises the importance of sleep amongst students, where learning may be impeded by the poor quality and quantity of sleep. As sleep deprivation results in depleted concentration, students would not be able to learn effectively, thus affecting their academic performance. This is evident from the strong correlation between sleep and academic performance in different sample groups (Mak et al. 2012; Zeek et al. 2015). The importance of sleep has led to a vast amount of research conducted on the various possible factors affecting the quantity and quality of sleep (Gellis and Lichstein 2009; Zhang et al. 2017). In particular, smartphone usage is a widely studied factor due to its increasing prevalence.

Demirci et al. (2015) reported that there was no direct relationship between high smartphone usage and sleep quality. This may suggest that an increase in smartphone usage does not have detrimental effects on sleep. However, in this study, the Smartphone Addiction Scale (Kwon 2013), was used as a measurement of smartphone usage. This measure may be too general because smartphone addiction is not directly linked to sleep physiology. In order to better assess the impact of smartphone usage on sleep, two major factors have been proposed to explain possible effects smartphone usage may have on sleep.

First, light is a key factor in sleep physiology as the human population has been better adapted for activities in the presence of light than in darkness (Siegal 2005). This determines one's circadian rhythm which plays a key role in the production of melatonin, a biochemical responsible for the process of falling asleep. However, with the use of smartphones before bedtime, light emitted from the smartphone would affect secretion of melatonin (Lavie 2001; Wood et al. 2006). As such, an individual's sleeping cycle would be disrupted where the usage of smartphone would result in the delay of one's supposed sleeping time.

Another key factor is sleep hygiene, which is defined as a variety of habits that ensures optimal sleeping quality (National Sleep Foundation 2017). Studies have shown that performing engaging activities prior to bedtime yields a negative impact on sleep (Gellis and Lichstein 2009). One particular instance of engaging activity that negatively affects sleep hygiene is smartphone usage (Brunborg et al. 2011). This may encourage cognitive activity prior to sleep, making an individual more awake, thereby inhibiting sleep.

A more direct investigation of smartphone usage on sleep was provided by Brunborg et al. (2011) and Lanaj et al. (2014), where pre-bedtime use of smartphones was examined instead. Brunborg et al. (2011) claimed that smartphone usage prior to bedtime negatively impacts sleep. It was found that respondents who often used smartphones in the bedroom at night tend to exhibit varying sleep-wake habits. This may result in decreased sleep quality and daytime functionality (Kang and Chen 2009). In another study by Lanaj et al. (2014), it was reported that late night use of smartphones amongst working adults resulted in depleted functionality the next morning due to poor sleep quality. These studies suggest that pre-bedtime smartphone usage may be play a major role in affecting one's sleep.

The relationship between smartphone usage before bedtime and sleep is an important research area due to the possible detrimental effects that can result from it. Previous researches have focused on working adults (Brunborg et al. 2011; Lanaj et al. 2014). Few studies have investigated the association between smartphone usage and sleep amongst undergraduate

students, in which deteriorated sleep may negatively impact academic performance. In particular, no studies have been conducted in Singapore, where mobile penetration rate is high. Hence, this study aims to investigate the impact of smartphone usage prior to bedtime on sleep of amongst Singapore undergraduate students. However, it should be noted that factors such as participants' caffeine intake and depression levels were not considered. Due to cost and time constraints, only the students of SPMS, NTU, were involved in this study.

The methodology of this study will be presented in the next section. This is followed by an analysis and discussion of the results obtained. Finally, the report will conclude with the limitations and practical implication of this study.

# 2 Methodology

## 2.1 Participants

A convenience sample of 120 undergraduates was taken. It consisted of 40 students from each of the 3 divisions of SPMS — Chemistry and Biological Chemistry, Mathematical Sciences and Physics and Applied Physics.

## 2.2 Procedure

A web-based questionnaire on smartphone usage before bedtime and sleep was administered using Google Forms over a week in March 2017. The use of an online platform ensured the confidentiality and anonymity of the data collected. Permission was granted by the relevant authority for the use of the PSQI instrument. The questionnaire consisted of three main sections, namely demographic questions, the PSQI instrument (Buysse et al. 1989), and smartphone usage prior to bedtime. Details of the survey can be found in Appendix A.

## 2.3 Measurements

The PSQI was chosen for the assessment of sleep in this study due to its reliability and validity (Molleyeva et al. 2016), and its wide usage amongst researchers (Demirci et al. 2015; Lanaj et al. 2014). It measures one's sleep quality in the preceding one-month period based on 19 self-rated questions. These questions are categorized into seven component scores with a scale of 0-3, which assess a variety of factors affecting sleep quality. The global PSQI score is then obtained by summing up the seven component scores, giving it a range of 0 to 21. A higher global PSQI score indicates worse sleep quality, and a score greater than 5 is associated with bad sleep quality. Details of the PSQI scoring can be found in Appendix B.

The smartphone usage component was assessed based on two questions, namely the duration of smartphone usage before bedtime, and the type of smartphone activity engaged.

## 2.4 Data Analysis

The survey data collected was analysed using R. Basic Software. Descriptive statistics, Pearson's Chi-square test and linear regression analysis were used to investigate the relationship between smartphone usage prior to bedtime and sleep quality. In addition, Analysis of Covariance (ANCOVA) was used to study the additional effects of gender, division of SPMS students, and smartphone activity engaged, on one's overall sleep quality.

# 3 Results

120 SPMS students were included in this study. 12.1% ($n = 13$) of the participants did not use their smartphones in bed prior to sleep while 87.9% ($n = 107$) did. In the following analysis, these two groups will be referred to as Group A and Group B respectively. Descriptive statistics for the PSQI scores of the two groups are presented in Table 1. It can be observed that the PSQI scores were higher in Group B than in Group A.

| | **Group A (n=13)** | | **Group B (n=107)** | |
|---|---|---|---|---|
| | **Median (1Q – 3Q)** | **Mean** | **Median (1Q – 3Q)** | **Mean** |
| **PSQI Subscales** | | | | |
| Sleep Duration | 1.0 (0.0 – 1.0) | 0.62 | 1.0 (1.0 – 2.0) | 1.11 |
| Sleep Disturbance | 1.0 (0.0 – 1.0) | 0.77 | 1.0 (0.5 – 2.0) | 1.35 |
| Sleep Latency | 1.0 (1.0 – 1.0) | 1.08 | 1.0 (1.0 – 2.0) | 1.41 |
| Daytime Dysfunction | 1.0 (1.0 – 2.0) | 1.31 | 1.0 (1.0 – 2.0) | 1.39 |
| Sleep Efficiency | 0.0 (0.0 – 1.0) | 0.46 | 1.0 (1.0 – 2.0) | 1.23 |
| Subjective Sleep Quality | 1.0 (0.0 – 1.0) | 0.54 | 1.0 (0.0 – 2.0) | 1.10 |
| Use of Sleep Medication | 0.0 (0.0 – 0.0) | 0.00 | 0.0 (0.0 – 0.0) | 0.19 |
| Global PSQI Score | 5.0 (4.0 – 6.0) | 5.00 | 8.0 (6.0 – 10.0) | 7.59 |

Table 1: Descriptive Statistics for PSQI Scores of Group A and Group B

Based on the cut-off point of 5 for the PSQI, a contingency table is presented in Table 2. It can be observed that there was a higher percentage of students with a PSQI of more than 5 for Group B (75.7%) as compared to Group A (30.8%). To determine whether there is a significant difference between the two groups, a Pearson's Chi-square test was conducted with the following null hypothesis:

$H_0$ : *There is no difference between the two groups in terms of overall sleep quality.*

The calculated $\chi^2$ statistic was 9.26, with a p-value of 0.0023. Hence, there was significant evidence that the use of smartphones prior to bedtime affects one's sleep quality.

| | **Group A (n=13)** | **Group B (n=107)** | **$\chi^2$ Statistic** | **p-value** |
|---|---|---|---|---|
| PSQI ≤ 5 n(%) | 9 (69.2) | 26 (24.3) | 9.26 | 0.0023 |
| PSQI > 5 n(%) | 4 (30.8) | 81 (75.7) | | |

Table 2: Pearson's $\chi^2$ Test for Overall Sleep Quality in Group A and Group B

To further evaluate the impact of smartphone usage before bedtime on sleep, subsequent analyses were conducted only on Group B.

The correlation between duration of smartphone usage before bedtime and the PSQI scores are presented in Table 3. Smartphone usage was found to be positively correlated for

almost all PSQI subscale scores ($p < 0.01$). Furthermore, there was a strong correlation between the PSQI global scores and smartphone usage with a Pearson correlation coefficient of 0.87 ($p < 0.01$). This implies that overall sleep quality may be affected negatively when students used their smartphones for a prolonged period.

| | **Smartphone Usage Before Bedtime** | |
|---|---|---|
| | **r** | **p-value** |
| **PSQI Subscale** | | |
| Sleep Duration | 0.37 | <0.01 |
| Sleep Disturbance | 0.38 | <0.01 |
| Sleep Latency | 0.34 | <0.01 |
| Daytime Dysfunction | 0.33 | <0.01 |
| Sleep Efficiency | 0.55 | <0.01 |
| Subjective Sleep Quality | 0.54 | <0.01 |
| Use of Sleep Medication | -0.06 | 0.53 |
| PSQI Global Score | 0.87 | <0.01 |

Table 3: Pearson Correlation Coefficients Between Smartphone Usage Before Bedtime and PSQI Scores

A linear regression analysis was performed to study how global PSQI score varies with respect to smartphone usage before bedtime and the results are reported in Table 4. It was revealed that the duration of smartphone usage before sleep was related to overall sleep quality ($\beta = 0.13$, $p < 0.01$).

| | Coefficient | Standard Error | t-value | p-value | $R^2$ | F | Model p-value |
|---|---|---|---|---|---|---|---|
| Intercept | 2.52 | 0.32 | 8.01 | <0.01 | 0.76 | 327 | <0.01 |
| Smartphone Usage Before Bedtime, $\beta$ | 0.13 | $7.19 \times 10^{-3}$ | 18.08 | <0.01 | | | |

Table 4: Linear Regression for Global PSQI Score Against Smartphone Usage Before Bedtime

ANCOVA was performed to study factors such as the gender, division of SPMS students, and the type of smartphone activity engaged. The results are presented in Table 5 in which the following null hypothesis was tested:

$H_0$ : *Additional factor does not help to explain overall sleep quality amongst students.*

It can be observed that all additional factors, except the division that a student belonged to, were insignificant, with p-values 0.22 and 0.47 for gender and smartphone activity engaged respectively. In addition, the direct effect of smartphone usage before sleep remained significant after inclusion of the aforementioned factors.

| | df | Sum of Squares | Mean Square | F | p-value |
|---|---|---|---|---|---|
| | | | | | |
| Smartphone Usage Before Bedtime | 1 | 726.59 | 726.59 | 328.58 | <0.01 |
| Gender | 1 | 3.34 | 3.34 | 1.509 | 0.22 |
| Residuals | 104 | 229.98 | 2.21 | | |
| | | | | | |
| Smartphone Usage Before Bedtime | 1 | 726.59 | 726.59 | 325.83 | <0.01 |
| Smartphone Activity Engaged | 5 | 10.31 | 2.06 | 0.93 | 0.47 |
| Residuals | 100 | 223 | 2.23 | | |
| | | | | | |
| Smartphone Usage Before Bedtime | 1 | 726.59 | 726.59 | 339.03 | <0.01 |
| Division of SPMS Student | 2 | 12.57 | 6.29 | 2.93 | 0.058 |
| Residuals | 103 | 220.74 | 2.14 | | |

Table 5: ANCOVA Table Analysing Various Factors on Global PSQI Score

# 4 Discussion

The relationship between duration of smartphone usage before bedtime and sleep documented in Section 3 coincides with the knowledge of the relevant factors relating to smartphone usage that affect overall sleep quality.

In terms of quantity of sleep, a significant correlation between smartphone usage prior to bedtime and PSQI subscale score for sleep duration was observed. This is because users may get too engrossed in the smartphone activities they are engaged in. According to Oulasvirta et al. (2011), the interactive characteristics of smartphones contains inducing and reinforcing features that promote excessive smartphone usage behaviours. Therefore, users' sleeping time may be delayed as they spend a longer time on their smartphones before bedtime. This may shorten the sleeping duration for students since they have to wake up at specified times for

their lessons.

In addition, the relationship between smartphone usage in bed and other categories of the PSQI can be attributed to the two major factors in sleep physiology mentioned previously. Light emitted from smartphone and the stimulated cognitive activity while using smartphone increase the possibility of disruptions in one's sleep. This may in turn deplete an individual's sleep latency and sleep efficiency. The aforementioned factors help to confirm the results obtained, in which an increased duration of smartphone usage before bedtime can have detrimental effects on the overall sleep quality.

The ANCOVA also revealed that there was an insignificant difference in overall sleep quality between the two genders after taking into account smartphone usage before bedtime. Existing studies (Brunborg et al. 2011; Sivertsen et al. 2009) suggested that females exhibited more symptoms of insomnia than males. This may indicate that the difference in overall sleep quality between genders is due to the different smartphone usage habits before bedtime. In order to verify this claim, there is a need to investigate the difference in smartphone usage before bedtime between males and females.

Next, the results suggested that the type of smartphone activity engaged had no effect on the overall sleep quality. However, activities which require higher concentration, such as games, may promote higher wakefulness than low intensity activities such as instant-messaging. This disparity may be attributed to the fact that the extent to which a particular smartphone activity can encourage wakefulness is subjective. Hence, to better evaluate overall sleep quality, further studies can consider the level of engagement of an individual.

Finally, there was a significant difference in overall sleep quality amongst the divisions of SPMS. One possible reason may be the different stress levels experienced by students of each division. In a study conducted by Schalkwijk et al. (2015), academic stress was found

to be negatively associated with overall sleep quality. This suggests that the varying academic demands in the different divisions may cause students' stress levels to differ across divisions. However, further studies should be conducted to verify the association between stress levels and the division of SPMS students.

# 5 Conclusion

The main purpose of this research was to determine the impact of smartphone usage prior to bedtime on sleep among Singapore undergraduates. The results of the study revealed that there was a negative association between smartphone usage before bedtime and overall sleep quality. In addition, the effect of other factors such as gender, smartphone activity engaged and students' division on sleep were also studied. It was found that students' divisions play a key role in predicting the overall sleep quality. This may be attributed to the differing workload and stress levels experienced by the different divisions.

However, several limitations in this study should be considered. Firstly, as the current study was based on a cross-sectional design, we were unable to conclude any causal relationship between smartphone usage before bedtime and overall sleep quality. Hence, longitudinal studies may be conducted to better study the cause and effect relationship between the two variables. Next, because a convenience sample was taken, the results obtained may not be representative of the Singapore undergraduate population. As such, future research can involve undergraduates from other disciplines and universities to have a more comprehensive analysis of the Singapore undergraduate population.

In conclusion, our findings revealed the potential detrimental effects smartphone usage before bedtime can have on sleep. This serves as a motivation for relevant authorities to raise awareness on the effects of pre-bedtime usage of smartphones amongst students, especially in Singapore where mobile penetration is high.

**(Word Count: 2511 words)**

# 6 References

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# A Survey Form

**Survey Form**

Thank you for participating in our survey! We are conducting a research on the impact of smartphone usage before bedtime on sleep. There will be three main sections in this survey, namely a basic demographic survey, the Pittsburgh Sleep Quality Index Questionnaire (Buysse et al., 1989) and some basic questions with regards to your smartphone usage patterns before bedtime. This short survey should only take 5 to 10 minutes to complete. Be assured that all your answers will be kept confidential.

**1. Demographics**

1. What is your gender?

   ◯ Male
   ◯ Female

2. Which SPMS Division are you from?

   ◯ Mathematical Sciences
   ◯ Chemistry and Biological Chemistry
   ◯ Physics and Applied Physics

**2. Pittsburgh Sleep Quality Index(PSQI)**[1]

What is PSQI, and what is it measuring?

The Pittsburgh Sleep Quality Index (PSQI) is an effective instrument used to measure the quality and patterns of sleep in adults. It differentiates "poor" from "good" sleep quality by measuring seven areas (components): subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month.

The following questions are asked in relation to your usual sleeping habits during the past month. Your answers should provide the most accurate response 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? (in 24 hours time format)

   _____

2. During the past month, how long (in minutes) did it take for you to fall asleep each night?

   ◯ 0-15 min
   ◯ 16-30 min
   ◯ 31-60 min
   ◯ More than 60 minutes

[1]The use of the PSQI instrument was approved by the relevant authority.

3. During the past month, what time have you usually gotten up in the morning? (in 24 hours time format)

_____

4. During the past month, how many hours of actual sleep did you get at night? (Each night)

_____

5. During the past month, how often did you have troubles sleeping because you (Please tick one box per row only):

| | Not during the past month | Less than once a week | Once or twice a week | Three or more times a week |
|---|---|---|---|---|
| a) Cannot get to sleep within 30 minutes | | | | |
| b)Wake up in the middle of the night or early morning | | | | |
| c) Have to get up to use the bathroom | | | | |
| d) Cannot breathe comfortably | | | | |
| e) Cough or snore loudly | | | | |
| f) Feel too cold | | | | |
| g) Feel too hot | | | | |
| h) Have bad dreams | | | | |
| i) Have pain | | | | |
| j) Other reasons | | | | |

6. During the past month, how would you rate your overall sleep quality?

◯ Very Good
◯ Fairly Good
◯ Fairly Bad
◯ Very Bad

7. During the past month, how often have you taken medicine (prescribed or ”over the counter”) to help you sleep?

◯ Not during the past month
◯ Less than once a week
◯ Once or twice a week
◯ Three or more times a week

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

   ◯ Not during the past month
   ◯ Less than once a week
   ◯ Once or twice a week
   ◯ Three or more times a week

9. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?

   ◯ No problem at all
   ◯ Only a very slight problem
   ◯ Somewhat of a problem
   ◯ A very big problem

**3. Smartphone Usage**

1. During the past month, did you use your smartphone before bedtime?

   ◯ Yes
   ◯ No (If "No", please proceed to submit the survey.)

2. During the past month, how many minutes, on average, did you spend on your smartphone before bedtime per day?

   _____

3. During the past month, which smartphone activity did you spend the most time on while using smartphone before bedtime?

   ◯ Social Media (E.g. Facebook, Twitter, Dayre, etc.)
   ◯ Videos (E.g. Youtube, etc.)
   ◯ Games (E.g. Candy Crush, Mobile Legends, etc.)
   ◯ Instant-messaging (E.g. Whatsapp, LINE, Telegram, etc.)
   ◯ Surfing the Internet
   ◯ Others (Please Specify): _____

***The end of the survey. Thank you for taking your time.***

# B PSQI Scoring

**Pittsburgh Sleep Quality Index (PSQI) Scoring (Buysse et al. 1989)**

**Form Administration Instructions**

The range of values for questions 5 through 9 are all 0 to 3.

Questions 1 through 9 are not allowed to be missing except as noted below. If these questions are missing then any scores calculated using missing questions are also missing. Thus it is important to make sure that all questions 1 through 9 have been answered.

In the event that a range is given for an answer (for example, '30 to 60' is written as the answer to Q2, minutes to fall asleep), split the difference and enter 45.

**Scores – reportable in publications**

**PSQIDURAT** **DURATION OF SLEEP**
IF Q4 $\geq$ 7, THEN set value to 0
IF Q4 < 7 and $\geq$ 6, THEN set value to 1
IF Q4 < 6 and $\geq$ 5, THEN set value to 2
IF Q4 < 5, THEN set value to 3
Minimum Score = 0 (better); Maximum Score = 3 (worse)

**PSQIDISTB** **SLEEP DISTURBANCE**
IF Q5b + Q5c + Q5d + Q5e + Q5f + Q5g + Q5h + Q5i + Q5j (IF Q5JCOM is null or Q5j is null, set the value of Q5j to 0) = 0, THEN set value to 0

IF Q5b + Q5c + Q5d + Q5e + Q5f + Q5g + Q5h + Q5i + Q5j (IF Q5JCOM is null or Q5j is null, set the value of Q5j to 0) $\geq$ 1 and $\leq$ 9, THEN set value to 1

IF Q5b + Q5c + Q5d + Q5e + Q5f + Q5g + Q5h + Q5i + Q5j (IF Q5JCOM is null or Q5j is null, set the value of Q5j to 0) > 9 and $\leq$ 18, THEN set value to 2

IF Q5b + Q5c + Q5d + Q5e + Q5f + Q5g + Q5h + Q5i + Q5j (IF Q5JCOM is null or Q5j is null, set the value of Q5j to 0) > 18, THEN set value to 3

Minimum Score = 0 (better); Maximum Score = 3 (worse)

**PSQILATEN** **SLEEP LATENCY**
**First, recode Q2 into Q2new thusly:**
IF Q2 $\geq$ 0 and $\leq$ 15, THEN set value of Q2new to 0
IF Q2 > 15 and $\leq$ 30, THEN set value of Q2new to 1
IF Q2 > 30 and $\leq$ 60, THEN set value of Q2new to 2

IF Q2 > 60, THEN set value of Q2new to 3
**Next**
IF Q5a + Q2new = 0, THEN set value to 0
IF Q5a + Q2new ≥ 1 and ≤ 2, THEN set value to 1
IF Q5a + Q2new ≥ 3 and ≤ 4, THEN set value to 2
IF Q5a + Q2new ≥ 5 and ≤ 6, THEN set value to 3

Minimum Score = 0 (better); Maximum Score = 3 (worse)

**PSQIDAYDYS** **DAY DYSFUNCTION DUE TO SLEEPINESS**
IF Q8 + Q9 = 0, THEN set value to 0
IF Q8 + Q9 ≥ 1 and ≤ 2, THEN set value to 1
IF Q8 + Q9 ≥ 3 and ≤ 4, THEN set value to 2
IF Q8 + Q9 ≥ 5 and ≤ 6, THEN set value to 3
Minimum Score = 0 (better); Maximum Score = 3 (worse)

**PSQIHSE** **SLEEP EFFICIENCY**
Diffsec = Difference in seconds between day and time of day Q1 and day Q3
Diffhour = Absolute value of diffsec / 3600
newtib =IF diffhour > 24, then newtib = diffhour – 24
IF diffhour ≤ 24, THEN newtib = diffhour
(NOTE, THE ABOVE JUST CALCULATES THE HOURS BETWEEN GNT (Q1) AND GMT (Q3))
tmphse = (Q4 / newtib) * 100

IF tmphse ≥ 85, THEN set value to 0
IF tmphse < 85 and ≥ 75, THEN set value to 1
IF tmphse < 75 and ≥ 65, THEN set value to 2
IF tmphse < 65, THEN set value to 3
Minimum Score = 0 (better); Maximum Score = 3 (worse)

**PSQISLPQUAL** **OVERALL SLEEP QUALITY**
Q6
Minimum Score = 0 (better); Maximum Score = 3 (worse)

**PSQIMEDS** **NEED MEDS TO SLEEP**
Q7
Minimum Score = 0 (better); Maximum Score = 3 (worse)

**PSQI** **TOTAL**
DURAT + DISTB + LATEN + DAYDYS + HSE + SLPQUAL + MEDS
Minimum Score = 0 (better); Maximum Score = 21 (worse)
Interpretation: TOTAL ≤ 5 associated with good sleep quality
TOTAL > 5 associated with poor sleep quality