

# The Effect of Duration of Mobile Phone Usage with Sleep Quality in Adolescents: A Systematic Review

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## ABSTRACT

**Objective:** Sleep quality is closely associated with lifestyle habits, including the use of the mobile phone. The mobile phone mostly used by humans worldwide. It is because the mobile phone has various functions in daily life. This study aimed to review the effect of the duration of mobile phone usage on sleep quality in adolescents.

**Methods:** This systematic review was performed on research articles published through database on PubMed and ProQuest between January 2014 and November 2019. The research was limited to the Journal with human subjects written in the English language. The abstract of articles with potentially relevant titles was reviewed, while the irrelevant articles were excluded. Data were analyzed with narrative synthesis.

**Results:** There are six studies analyzed by systematic review. High mobile phone use included bedtime use or mobile phone addiction, like playing games, using social media, or texting does increase the likelihood of sleep disturbance. It can have an overall impact on sleep quality and insomnia.

**Conclusion:** High usage of internet and social networks via mobile phones is related to poor sleep quality.

**Keywords:** Adolescent, Duration, Mobile Phone, Sleep Quality

## INTRODUCTION

In the last decade, there is an advancement of science and technology in the world, and one such promotion is in the field of mobile phone. Mobile phone or smartphone, not just communication tools, but with various function, it is more like a portable computer. The smartphone used for watching videos, listening to music, chatting with families or friends, playing games, and so on. It makes a lot of people used it in daily life.

In the past five years, there are about 1.4 billion smartphone users worldwide. In China and India has lower than 70 percent of owner smartphone.<sup>[1]</sup> In the United States of American, the owner of the smartphone is now 81%, up from just 35%

in the first survey of smartphone ownership conducted in 2011.<sup>[2]</sup> There are 19 % of age 65 and older, 49 % age 50 to 64 years, 74% age between 30 and 49, and the highest of smartphone owners is between age 18 and 29 years with 83%.<sup>[3]</sup> In Indonesia, mobile phone internet user was at 22.8% in 2013, and this is expected to almost double to 45.3 percent by 2018.<sup>[4]</sup> Research in Chinese undergraduate, several identified a gender effect, with females reporting more intensive use than males. Regarding age, some studies said that younger individuals are more likely to use the mobile phone than older.<sup>[3]</sup>

There are specific health effects of using a smartphone for a long duration, such as headaches, decreased attention, shortness

of temper, depression, and sleep disorders. In adolescent, sleep problem is very substantial. The prevalence of insomnia in adolescents is as high as 20-30%, and approximately 16% of high school students suffer from excessive daytime sleepiness. [4] It may be caused by smartphone usage for long periods.

The mobile phone has emitted the electromagnetic field. It can influence melatonin. Melatonin is a hormone produced by the pineal gland which can control many physiological processes occurring in daily or seasonal rhythms, such as sleep, metabolism, and reproduction. Melatonin can influence the circadian timing system in humans. [5] Under physiological conditions, the regulatory mechanisms ensure that this rhythm is properly entrained in the light-dark cycle. Therefore, the elevated night-time melatonin secretion can serve for all cells of the body as a clock and a calendar. Studies on humans have reported the adverse effects of electromagnetic field emitted by mobile phones reduced melatonin production. [6] In this case, the lower number of melatonin can cause a sleep problem. This study aimed to gain an effect on the duration of mobile phone usage with sleep quality in adolescents.

## MATERIAL AND METHODS

### Participants and Methods

This study was conducted on adolescents included men and women age 10-24 years old. Respondents lived with their families. The participants are between primary school to a college degree. The interviews using standardized questionnaires.

### Study design and research sample

This research is a systematic review by Preferred Reporting Items for Systematic Review - Meta-Analyses (PRISMA) statements. [7] This study aimed to determine the effect of the duration of mobile phone usage with quality disorders in adolescents. The research samples have published an article through a database on

PubMed and ProQuest between January 2014 and November 2019.

### Operational definitions

The independent variable in this research was the duration of usage of the mobile phone, and the dependent variable on the study was sleep quality.

### Research procedure

This study was conducted by collecting data through the database on Pubmed and ProQuest about the effect of duration mobile phone usage on sleep quality in adolescents (Figure 1).

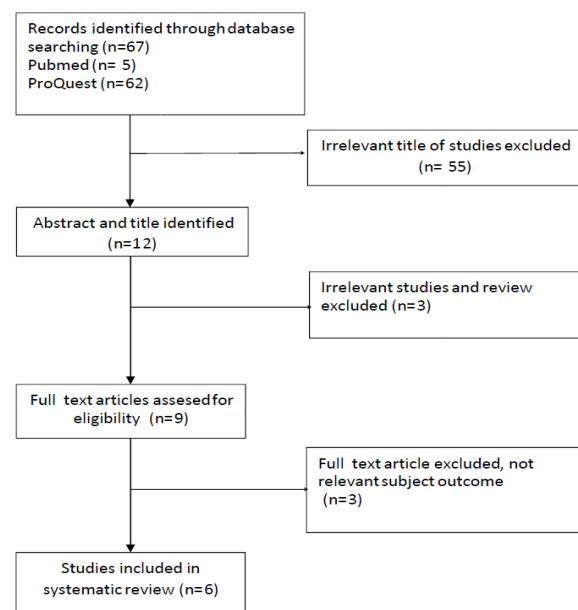


Figure 1: Prisma flow diagram

### Data collection technique

Search done by entering keywords as follows: on PubMed "student OR teenager OR adolescent AND duration smartphone usage OR duration mobile phone usage AND sleep quality", and on ProQuest "student AND duration smartphone AND sleep quality."

Articles would be excluded if not fulfill these criteria: a) did not get sleep disorders b) design used instead of cross-sectional study c) unavailability of data or inadequacy of research - online search used in data retrieval. The Data collected was an English article. The article type was an original article. The publication date of the article started from January 2014 to

November 2019. Research was limited to humans. Potential titles would be reviewed, abstract, and full text. The exclusion criteria of this article were: a) inadequacy of data in the full-text article on the study b) full-text unwillingness in the article c) the full-text article didn't specify any further data for processing. Articles that have been collected would be conducted tabulation according to the author's name, year of published writing, research location, research design, and the number of research samples.

### Data analysis

Data were analyzed with narrative synthesis and articles compared to another

article the conclusion was drawn thoroughly and provide recommendations at the end of synthesis.

### RESULTS

Identification on 67 articles, done by review the title of the articles, then reviewed abstract, the reviewed in full text form. Irrelevant articles are excluded. Selection of studies conducted to obtain 6 studies related to an effect of duration mobile phone usage with sleep wake disorders in adolescents (Table 1).

**Table 1: Systematic Review of the effect of duration mobile phone usage with sleep wake disorders in adolescents**

No	Authors, Years	Study Design	Outcome
1	Nursalam et al., 2018 <sup>[8]</sup>	A cross-sectional study	The frequency of SNS used at least four times and greater than 1 hour was reported 67.8% (122 respondents), duration used 5 hours or more per day was published in 125 respondents (69.4%). And 51,1% (moderate category) respondents felt the load school. Of all respondents, 53.3% experienced insomnia, and 46,7% didn't experience insomnia. This study reported that insomnia was associated with duration of SNS use (p=0,0011), academic stress (p=0,0013), and reasons for SNS usage (p=0,004). Meanwhile, the type of SNS (p=0,096), frequency of SNS use (p=0,645), and family support (p=0,096) were not associated with insomnia in adolescent.
2	Whipps et al., 2018 <sup>[9]</sup>	A cross-sectional study	Based on the Pittsburgh Sleep Quality Index (PSQI), there were no significant difference between male and female. The most reported of both sex going to bed was 11:00 PM and rise time was 08:00 AM. The average sleep duration was 7.26 ± 0.93 hours. The mean time spent in bed was 8.12 ± 0.83 hours. only 38,33% participants sleeping at least 8 hours per night and 25.4 % was slept 6.5 hours per night or less. The participant who has a optimal sleepers was 68 participant. Meanwhile, 26 participant has borderline sleep quality and 20 participants has poor sleep based on the PSQI scoring. Based on Nighttime Media Use Questions, almost all respondents have smartphones or tablet in their room and most of them use it as their alarm. 9 participants did not have their cell phone in their room.
3	Durusoy et al., 2017 <sup>[10]</sup>	A cross-sectional study	Among participants, 2021 (94.0%) were using mobile phones, and 129 (6.0%) were not. Among users,4% were speaking <10 min, and 52.2% were sending/receiving 75 or more messages per day. Headache, fatigue, and sleep disturbances were observed respectively 1.90 (95% CI 1.30–2.77), 1.78 (1.21–2.63) and 1.53 (1.05–2.21) times more among mobile phone users. Dose-response relationships were observed, especially for the number of calls per day, the total duration of calls per day, total number of text messages per day, the position and status of mobile phone at night, and making calls while charging as exposures. Headache, concentration difficulties, fatigue, and sleep disturbances as general symptoms and warming of the ear and flushing as local symptoms also observed.
4	Abolfazl et al., 2016 <sup>[11]</sup>	A cross-sectional study	The mean cell-phone addiction score was 48.18 ±17.5, and the sleep quality score was 5.38 ±2.31. The prevalence of over-use of cell-phone was 10.7%, and the prevalence of poor sleep quality was 61.7%, 45.6% of students used more than two hours daily. The total score of sleep quality showed a significant direct correlation (r=0.369, P<0.001) by cell-phone addiction score. Cell-phone addiction, male gender, and studying in general practitioner (GP) level are the most important predictors of poor sleep quality in medical students.
5	Exelmans et al., 2016 <sup>[12]</sup>	A cross-sectional study	Half of the respondents owned a smartphone, and six out of ten took their mobile phone calls them to the bedroom. They are sending/receiving text messages and/or phone calls after lights out significantly predicted respondents' scores on the PSQI. Bedtime mobile phone use predicted respondents' later self-reported rise time, higher insomnia score, and increased fatigue. An increase in bedtime mobile phone use was associated with more fatigue and later rise times among younger respondents.
6	Kim et al., 2018 <sup>[13]</sup>	A cross-sectional study	Among the participants, 26.0% (14,946), 31.1% (17,862), 29% (16,641), and 13.9% (7,977) slept for 6 h, 7 h, 8 h, and 9+h. Each type of internet use (for study or leisure) showed significant differences among the sleep time groups. Compared to the student who reported 9+ h sleep, less sleep was related to long internet use (2+ h) for leisure (AOR [95% CI] of sleep 6 h = 1.56 [1.44±1.70]; P < 0.001). Less sleep was also associated with internet use for leisure in the two hrs and one hrs groups (P < 0.001). Conversely, a relationship between less sleep and long internet use (2+ h) for study was not evident. The relationship between sleep time and internet use for the study showed significance only between internet use for 2+ h and sleep for six hrs.

Based on the results of a systematic review, there are six studies analyzed by

systematic review. High mobile phone use causes insomnia in the adolescent. More

frequently, nighttime media use was associated with reduced sleep quality. The frequent mobile phone was associated with difficulties falling asleep and poor sleeping habits. Mobile phone or cell phone addiction was the most important predictor of poor sleep quality. Bedtime mobile phone use was associated with insomnia. The weak sleep satisfaction group showed the correlation between sleep and internet use.

## DISCUSSION

Some researches will be explained in this part. For the first study by Nursalam et al., the participants were 180 students age 16 to 17 years in senior high school in Surabaya with female 117 respondents (65%) and male 63 respondents (35%). All respondents lived with their families. This study used four questionnaires that include frequency and duration of social media use, academic stress, insomnia, reasons for using social media, and family support. First, a questionnaire about social media sites addiction focused on the frequency and duration of SNS (social network site) use, and also, the phase of SNS addiction has been validated with reliability score Cronbach's  $\alpha = 0,907$ . Second, a questionnaire about family support (informational, emotional, instrumental, and appraisal support) adapted from Friedman's theory comprised 16 questions with a 4-point scale (never/sometimes/often/always/) that has been validated with reliability score Cronbach's  $\alpha = 0,925$ . Third, the questionnaire of school load mainly measures physical, role, task, and interpersonal comprised with a 4 point scale (very not agree/not agree/agree/very agree) that has been validated reliability score Cronbach's  $\alpha = 0,913$ . And the last questionnaire about insomnia to defined as insomnia and no insomnia. It was adapted from the Diagnostic and Statistical Manual of Mental Disorders (fifth edition) and measure sleep disturbance of insomnia that has been validated with reliability score Cronbach's  $\alpha = 0,919$ . This study showed

that insomnia was associated with duration of SNS use. <sup>[8]</sup>

Another study by Whipps et al. consists of 128 first-semester college student were 18-24 years old at the University of Wyoming, and only 114 students completed the study. The main age of participants is  $18.7 \pm 0.4$  years, 93% of participants (N=106) has Caucasian/white, and the other 7 % (N=8) has another ethnicity. The participants 54 % were female (N= 62) and male 46% (N=52). The quality and duration have been assessed using the Pittsburgh Sleep Quality Index (PSQI). The PSQI has 7 variables there are sleep quality, sleep duration, habitual sleep efficiency, sleep disturbances, use of medications assist with sleep and daytime dysfunction. The score range from 0-21. The higher score was the lower quality of sleep. Nighttime media usage has been assessed using seven questions, which has adopted from Chi-Mejia et al. The questions number 1-6 were score using the 1-5 point. 1 meaning never and 5 meaning all the time. And the question number 7 was about how many night using social media in a week. The score might lead up to 7 points. This study reported that texting in bed and device interruptions were moderately correlations with time spent in bed. <sup>[9]</sup>

In another study, Durusoy et al. reported that the subject was collected from all high school students in Bornova district of Izmir, Turkey with the sample size as 2530 students. The mean age of the participating students was  $15.6 \pm 1.3$ . This study used a questionnaire comprising 84 questions: 11 on student's socio-demographic characteristics, 24 on their mobile phone usage, one on the presence of a base station in their vicinity, 25 on their risk perception, and 23 on symptom frequencies. The students filled out the questionnaires in about 20–25 min, with a researcher and a teacher assisting in the classroom. This study found the association mobile phone use with headache, concentration difficulties, fatigue, and sleep disturbances. <sup>[10]</sup>

Meanwhile, Mohammadbeigi et al. study was conducted on 380 undergraduate students studying in term two or higher in January 2015 in Qom University of Medical Sciences, Qom, Iran consist of 69.5% were female, 11.7% were married, 49.6% were resident in university dormitories showed the cell-phone addiction, male gender and studying in general practitioner (GP) level are the most important predictors of poor sleep quality in medical students. Most of the students used a smartphone at night, which affected sleep and wake cycle due to the effect of melatonin, a hormone made by the Pineal gland, which increased during the darkness. People who are busy with a smartphone all night, the electromagnetic field emitted by the smartphone will reduce the production of melatonin. It can disturb sleep quality. [14] This study was collected by two standard questionnaires, including Cell-Phone Over-Use Scale (COS) and Pittsburgh sleep quality questionnaire. Another questionnaire was used the demographic characteristics and the status of use from mobile cell-phone social networks. The COS was validated by Iranian researchers, passed the validity tests and reliability tests by more than 90%, consist of 17 items scoring on a Likert scale between 1 and 5 for each item. The mobile cell-phone addiction score was categorized in three levels as higher 75 as over-use, 25 to 75 as normal, and lower 25 as lower normal. [11]

Another study by Exelmans et al. showed that it has a sample of 844 adults between 18 and 94 years old in Flanders, Belgium. 56.2 % of the sample were female. 20.7% had at least obtained a university degree, 31.8% had a college degree, 29.9% had a 12th grade (secondary school) certificate, and 5.7% had a 6th grade (primary school) certificate. Almost one in ten respondents (9.2%) were still studying, and 2.6% had no degree. Respondents who participated in face-to-face interviews using standardized questionnaires included the Pittsburgh sleep quality index (PSQI), Fatigue assessment scale (FAS) that

comprises ten items describe symptoms of fatigue on a 5-point scale (1 for never, 5 for always) with reliability score Cronbach's  $\alpha = 0.83$ . Then, Bergen insomnia scale (BIS) that comprises six items measuring different symptoms of insomnia with reliability score Cronbach's  $\alpha = 0.76$ , bedtime and rest time question to know what time they usually went to bed at night and got up in the morning, and bedtime mobile phone use that respondents were asked to indicate on a 6-point scale (1 for never, 2 for occasionally, 3 for sometimes, 4 for regularly, 5 for often, 6 for almost (every day)) them how frequently they (1) received or (2) sent text messages, and (3) received or (4) made phone calls after lights out. This study reported that bedtime mobile phone use predicted respondents later self-reported rise time, higher insomnia score, and increased fatigue. [12]

Research by Kim et al. that consists of 57,426 participants between 12 to 15 years old, 28,863 males, and 28,563 females from middle school students were investigated by The Institutional Review Board of the Centers for Disease Control and Prevention of Korea (KCDC) with informed consent for each participants. [13,15] As a result, the poor sleep satisfaction group showed stronger correlations with internet use for leisure. The good sleep satisfaction group was less correlated with internet use for leisure, although their sleep time was less than seven h. [13] Increased internet use may eliminate time for sleep physically; the absolute internet use time for study and leisure may have decreased the sleep time in the present study. Also, the content of the internet for leisure can influence sleep hygiene. [16]

These studies were focusing on nighttime media usage and sleep patterns in first-semester college students and sleep quality as one of the most important of smartphone addiction complications in medical students. The future studies should investigate daytime and nighttime smartphone usage and sleep quality in various semester college students. Also,

identify the relationship between smartphone addiction and complications, including headache, learning disability, memory diagnosis, aggressive behavior, and mental disorder in various students.

## CONCLUSION

Nighttime media usage such as texting, social media, gaming, etc. has correlations with time spent in bed and sleep interruptions. This study found high usage of internet and social networks via mobile phone is related to poor sleep quality and quantity. Future studies should focus on determining whether nighttime media usage and poor sleep hygiene do have a relationship with weight status and other markers of health, as well as determine the true directionality of the relationship between nighttime media usage and sleep quality. Furthermore, poor sleep quality potentiated the link between less sleep time and internet use for leisure.

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