Original Article

The effect of smartphone usage at bedtime on sleep quality among Saudi non- medical staff at King Saud University Medical City

Fahdah A. Alshobaili[1], Nada A. AlYousefi[1]

[1]*Department of Family and Community Medicine, College of Medicine, King Saud University, Fahdah Alshobaili, Riyadh, Kingdom of Saudi Arabia*

Abstract

Objective: This study's main objectives are to examine the prevalence of smartphone usage at bedtime and its effect on sleep quality among Saudi non-medical staff working in King Saud University medical city in Riyadh, Saudi Arabia. **Methods:** This cross-sectional study was carried out over the period from January 2016 to July 2016 A sample of 435 Saudi adults aged 21 years and above working in King Saud University Medical City in Riyadh, Saudi Arabia participated in a self-reported Arabic questionnaire about bedtime usage of smartphone and sleep quality. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). Data were analyzed using odds ratio. **Results:** More than 98% of the respondents owned a smartphone, and nine out of ten use their smartphones at bedtime. Social media was the most used service among participants. An increase in bedtime smartphone use specially more than 60 minutes makes participants at great risk of having poor sleep quality. **Conclusion:** our findings suggest that employees who use their smartphones more at bedtime have more risk of being poor sleepers. More attention should be drawn to the misuse of smartphones and its effect sleep quality, health and productivity of adults.

Keywords: Bedtime, Saudi, sleep quality, smartphone

Introduction

It was not s**o** long ago that smartphones were first introduced to the general public. In the late 90s', the leading communication technology companies started advertising for a mobile phone with internet access and multiple functionalities that is so called now "smartphone".[1] In 2007, companies started competing to develop new software systems and the market has been growing tremendously ever since.[2] With its limitless functionalities and the computing capabilities, smartphones have gained popularity among people all around the world. According to the Connected Consumer Survey of 2015, the percentage of people who use smartphone in Saudi has jumped from 60% in 2012 to 86% in 2015, where 92% of Saudis under the age of 25 use a smartphone; compared to the smartphone usage in the United States of America (71%), South Korea (83%) and Japan (54%).[3]

It has been shown in the literature that using smartphones have some potential health effects. A Saudi controlled clinical trial by Alsanosi *et al.* concluded that making a call for 60 minutes with a mobile phone had an immediate effect on hearing threshold levels examined by pure-tone audiogram in young adults.[4] Participants also reported headache, vertigo, tinnitus, fullness, and deafness. In another Saudi study by Alosaimi *et al.*, 43% of Saudi university students who are using smartphones for long hours had decreased sleeping hours with low energy the

Address for correspondence: Dr. Fahdah A. Alshobaili, Department of Family and Community Medicine, College of Medicine, King Saud University, Fahdah Alshobaili, P.O Box 301910, Riyadh - 11372, Kingdom of Saudi Arabia.
E-mail: fahdas@gmail.com

Received: 31-03-2019 **Revised:** 31-03-2019 **Accepted:** 15-04-2019

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_269_19

How to cite this article: Alshobaili FA, AlYousefi NA. The effect of smartphone usage at bedtime on sleep quality among Saudi non- medical staff at King Saud University Medical City. J Family Med Prim Care 2019;8:1953-7.

next day.[5] A study by Al-Khlaiwi and Meo showed that there's an association between mobile phone usage and symptoms like headache, dizziness and sleep disturbance.[6] Yogesh *et al.* have reported that a mobile phone use of more than 2 hours is related to poor sleep and decreased sleep time in medical students in India.[7] Depression was one of the findings in a study by Thomée *et al.* among young adults whose mobile phone usage was high.[8]

A large number of studies examined the health effects of sleep disturbance. There is evidence of an association between sleep deprivation and endothelial dysfunction, which is an established risk of cardiovascular diseases.[9] Sleep deprivation was also linked to increased risk of multiple metabolic disturbances like obesity, diabetes, and insulin insensitivity.[10] There is a growing evidence that sleep loss and persistent insomnia are associated with increased blood pressure and increased risk of hypertension.[11] Another effect of sleep disturbance was found in regards of memory consolidation and encoding which in turn play a major role in learning process.[12] A study by Oyetakin-White *et al.* indicates that poor sleep quality is associated with diminished skin barrier function and accelerated intrinsic skin aging.[13] Okun *et al.* linked poor sleep quality, both in early and late pregnancy with an increased risk of delivering preterm baby.[14]

Few researchers have explored the associations between bedtime usage of smartphone and sleep quality in adults both in Saudi Arabia and internationally. Al-Khlaiwi and Meo showed that there was an association between mobile phone usage and symptoms like headache, dizziness, and sleep disturbance but did not study the bedtime usage.[6] No Saudi nor regional studies have explored this issue. Few studies have examined the bedtime usage of smartphones mostly in adolescent age group. One Belgium study on Flanders adults found that those who were frequently using their mobile phones at bedtime had significant poor sleep quality with insomnia symptoms, fatigue and later rise times.[15] A nationwide Japanese study on 95,680 adolescents by Munezawa *et al.* showed that mobile phone use for calling and for texting after lights out was associated with short sleep duration, poor sleep quality, excessive daytime sleepiness, and insomnia symptoms.[16] White *et al.* indicated that problem mobile phone use using "Mobile Phone Problem Use Scale" is related to poor sleep quality, but not sleep length in American college students.[17] Young Swedish adults surfing the internet, texting and calling through smartphones had an increased risk of developing sleep disturbance.[18] However, a Chinese study on 791 secondary school adolescents showed a weak correlation between mobile phone viewing duration with sleep quality, duration, and daytime sleepiness.[19]

Minimal research has been conducted on the effect of bedtime usage of smartphones on sleep quality in adults. The international studies were focused more on adolescent age group, and there were no studies carried out locally nor regionally in this regard. Therefore, and due to the high usage of smartphone among Saudis and its health effects previously discussed especially on sleep, we were interested in examining this issue in Saudi adults. Moreover, if it was proven that it affects sleep quality, we would spread awareness about this habit, as it was found that instruction in good sleep hygiene can help workers achieve good quality sleep.[20]

We performed a study designed to test the hypothesis that there is an association between smartphones usage at bedtime and sleep quality.

Our objectives are to determine the effect and prevalence of smartphone usage at bedtime on sleep quality among Saudi non-medical staff working at King Saud University Medical City in Riyadh, Saudi Arabia.

Methods

Study design

A cross-sectional study design was used in our research. 369 non-medical Saudi employees aged 21 years and above at King Saud University Medical City (KSUMC) in Riyadh Saudi Arabia were handled a self-administrative questionnaire. Any medical, non-Saudi employee who had a sleeping disorder or didn't use a smartphone was excluded from the study. Medical staff were excluded to get the time-changing patterns of duties out of the way. The participation was voluntary. The sample size was calculated using an online sample size calculator.[21]

We have distributed the questionnaire to 435 participants. 66 were excluded, out of which 1 was non-Saudi, 4 did not complete the questionnaire, 6 do not use smartphones, 7 were diagnosed with sleep disorders and 48 were medical staff. We conducted this study over the period from January to July 2016. Questionnaires were distributed in a systematic random method. King Saud University Medical City has several buildings. Each building was divided into floors. Choosing one participant and skipping the next in each office. The study was conducted in accordance with the institutional review board (IRB) of KSUMC. Participants were reassured that their response to our questionnaire is strictly confidential.

Data sources/measurement

Self-administered Arabic questionnaire consisting of 4 sections was distributed. The first section is an introduction about the study purpose and reassurance of confidentiality. The second section is demographic data. The third part is about smartphone usage. The fourth and last section is an Arabic version of Pittsburgh sleep quality index (PSQI).

Bedtime smartphone usage

Participants were asked 7 questions. First, whether they use smartphones or not, and if yes, do they use it at bedtime. The smartphone is "a cell phone that includes additional software functions (as e-mail or an Internet browser)"[22],

and bedtime is defined as "the time at which you usually get into your bed in order to sleep".[23] How many times they used their smartphone at bedtime: 1-3 times per month, once a week, several times per week or every day. The fourth question is what they use it for calling, surfing the internet, text messaging, social networking, video games or watching videos like movies, series, shows etc., The fifth question was on the time spent using a smartphone at bedtime: 15 minutes or less, 16-30 minutes, 31 to 45 minutes, 46 to 60 minutes or more than 60 minutes. The sixth question is the subjective daytime dysfunction.

Pittsburgh sleep quality index (PSQI)

The Arabic version of Pittsburgh Sleep Quality Index (PSQI) was used, and permission was taken from the author to use it.[24] PSQI is a standardized measure of sleep quality.[25] It consists of 18 questions that has 7 rated components: 1) sleep quality, 2) sleep latency, 3) habitual sleep efficiency, 4) sleep duration, 5) use of sleeping medication, 6) sleep disturbances, and 7) daytime dysfunction. To calculate the score of the questionnaire, each question is assigned a score from 0 to 3. The item scores are used in calculating the 7 component scores, which are then added to produce a total score which can range from 0 to 21. If the total score obtained is 5 or greater, it suggests a poor sleep quality. Moreover, if it was less than 5, then this is considered to be good sleep quality.

The questionnaire was validated by two experts, and a pilot study was carried out before starting the data collection to make sure that it is understandable by participants. The questions that were ambiguous were altered accordingly.

Statistical methods

IBM SPSS version 21 was used for data analysis.[26] Google Sheets and Microsoft Excel for Mac version 15.18 were used to calculate the PSQI score, using formulas to combine and calculate the components of PSQI. Data cleaning was done before analyzing. Descriptive statistics presented as numbers and percentages. For analytical statistics, odds ratio and its 95% confident interval were used to test the risk of poor sleep quality among participants who used smartphones at bedtime.

Results

Demographics

More than 1/3rd of the participants (137 or 37.1%) are above 25 to 30 years, while 3% were above the age of 50. The majority being males 58.0% and the remaining were females.

Prevalence of smartphone usage at bedtime

More than 98% of participants own smartphones of which 92.4% use it at bedtime [Table 1]. 40% of them are between the age of 25 to 30 years, and more than 65% are males. About 96% of females use their smartphone at bedtime, and 90% of males do too. Social media was on the top of the usage list (80.5%). [Figure 1]. Table 2 shows that most of the participants used a smartphone at bedtime everyday (72.8%). 1/3rd of participants used their smartphones at bedtime for 16 to 30 minutes [Table 3].

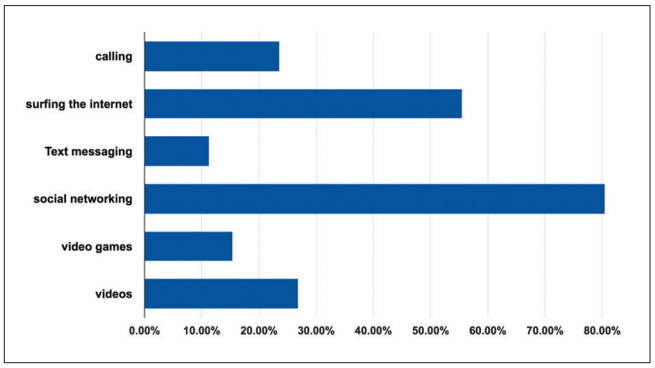

Figure 1: Prevalence of smartphone services use at bedtime among KSUMC non-medical employees, Riyadh, 2016

Table 1: Smartphone usage prevalence among KSUMC non-medical employees, Riyadh, 2016 (*n*=369)

	Number	Percentage
Smartphone usage		
Yes	375	98.4
No	6	1.6
Smartphone usage at bedtime		24.6
Yes	341	92.4
No	28	7.6

Table 2: Smartphone usage at bedtime\month among KSUMC non-medical employees, Riyadh, 2016 (*n*=369)

Number of times smartphone has been used at bedtime/month	Number	Percent
1-3 times a month	14	3.8
Once a week	24	6.5
Several times each week	62	16.8
Every day	269	72.9

Table 3: Smartphone usage at bedtime\day Among KSUMC non-medical employees, Riyadh, 2016 (*n*=369)

Time spent using smartphone at bedtime	Number	Percent
<=15 min	102	27.6
16-30 min	117	31.7
31-45 min	68	18.4
46-60 min	37	9.8
>60 min	46	12.5

Subjective daytime dysfunction

About 43% of participants who use their smartphone at bedtime think that it does not affect them next day, while 37.4% does not know if it affects them or not. Of those who think that bedtime usage of smartphone affects them next day, 63% think that they get tired the next day, while about 40% reports having a headache.

Sleeping habits

On average, participants usually go to bed at 9:32 PM, woke up at 6:04 AM and had about 6 hours of sleep every night. More than 24% of participants reported not getting to sleep within 30 minutes most of the days. Meanwhile, almost 90% of the staff did not use any medications to help them sleep. Half of the participants describe their overall sleep quality as fairly well, while 2.4% think that they have a very bad sleep quality.

Bedtime smartphone usage and Sleep quality

Our study showed that 41.7% of participants have poor sleep quality. Table 4 indicates that the risk of poor sleep quality is around two-fold among those who use a smartphone at bedtime for 16 to 30 minutes. For those who spent 31 to 45 minutes using their smartphones at bedtime, the risk for poor sleep quality is more than three-fold. While those spent 46 to 60 minutes had only 2.6-fold risk for the poor quality, participants who have spent more than 60 minutes had a 7.4-fold risk of being poor quality sleepers [Figure 2].

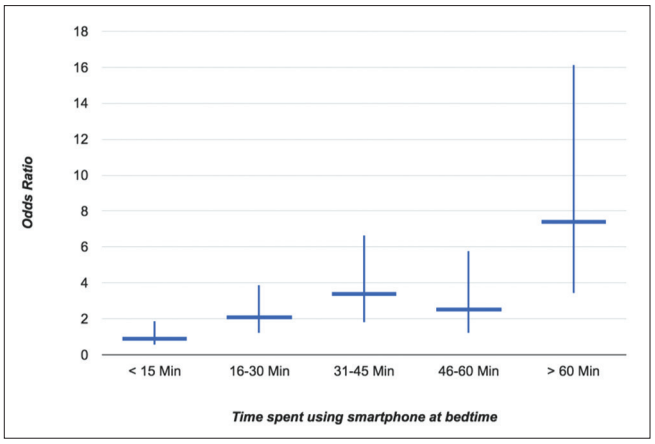

Figure 2: Odds ratio for sleep quality and time spent using smartphone at bedtime among KSUMC non-medical employees, Riyadh, 2016

Table 4: Odds ratio for sleep quality and time spent using smartphone at bedtime among KSUMC non-medical employees, Riyadh, 2016 (*n*=369)

Time spent using smartphone at bedtime	Sleep quality		OR	95%CI	*P*
	Good	Poor			
<15 min	78	24	1	0.5236-1.9098	-
15-30 min	70	47	2.1821	1.2118-3.9293	0.0093
31-45 min	33	35	3.4470	1.7817-6.6686	0.0002
46-60 min	20	16	2.6	1.1672-5.7918	0.0194
>60 min	14	32	7.486	3.4154-16.1571	<0.0001

Discussion

Our study revealed several points. We have found that employees who use their smartphones more throughout the night tend to be at more risk of being poor sleepers with a more obvious risk when using it for more than 60 minutes. These results are consistence with international studies done on adults and adolescents.[15,16,19] We also have found that the prevalence of smartphone usage at bedtime is very high with being more prevalent in those who are between the age of 25-30 years. The percentage of staff owning smartphones in our study was more than 98 compared to 86% which was found in the 2015 Connected Consumer Survey done on Saudis.[3] 92% of our respondents used their smartphones at bedtime while almost 60% of Belgian participants recruited in Exelmans *et al.* study.[15]

However, the mechanism of the effect of smartphone usage at bedtime on sleep quality is not clear. Some theories could explain poor sleep quality due to bedtime usage of the smartphone. It has been found in some studies that the use of smartphone affects sleeps through several mechanisms. One of them is sleep displacement; with the convenience of using a smartphone in bed, the time may fly without noticing and therefore displace the time of sleeping. According to Lemola *et al.*, adolescents who owned smartphones were more likely to go to bed later, with the sleep duration not being affected.[27] Another mechanism was experimented by Wood *et al.* and concluded that electromagnetic radiation emitted by mobile phones 30 minutes before sleeping was found to delay the onset of melatonin production which in turn might affect sleep.[28] A light-emitting diode (LED) emitted by smartphone screens was clinically experimented by Cajochen *et al.* and also reported to suppresses melatonin secretion which reduces sleepiness.[29] A third proposed mechanism is emotional arousal. Smartphones serve as a way of communication between people and thus makes it a way of conducting bad or good news or even communicating a conflict between people which might increase emotional arousal and night, therefore, affects sleep. However, it has not yet been experimentally tested.[16] Incoming notifications, when the smartphone is not turned into silent mode, may wake up the individual and disrupt his/her sleep.

Research suggests that using a smartphone at bedtime leads to sleep disturbance which in turn affects the productivity of employees next day.[30] Which is why our study is important in raising awareness of this issue to improve the health and productivity of staff working at KSUMC in specific and employees elsewhere as part of the job of any health care provider.

Although we have found a clear association between smartphone usage at bedtime and poor sleep quality, we do not know whether poor sleep quality leads to the use of a smartphone or vice versa. Thus, further research needed to unravel the causality in smartphones that lead to poor sleep quality.

Limitations

Our study has limitations. Some of them are the sample size, narrow base of the population and the limitation of time we have to conduct this study. Another factor is the study design, which is cross-sectional. This will not show a cause-effect of smartphone usage at bedtime on sleep quality, but might highlight the problem to stimulate other investigators to dig more into

it. Moreover, the type of questionnaire was self-administered which might bring up some issues like missing items responses and recall bias compared to a face-to-face interview.

Conclusion

Our findings suggest that employees who use their smartphones more at bedtime have more risk of being poor sleepers. This study does not state the causality since it is a cross-sectional study. Thus, further studies are needed with larger sample size, broader population, and a study design that would reveal the causality.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Budmar P. Why Japanese smartphones never went global: PC World; 2012 [cited 2016]. Available from: http://www.pcworld.idg.com.au/article/430254/why_japanese_smartphones_never_went_global/.
2. Mather J. iMania 2007 [cited 2016]. Available from: https://web.archive.org/web/20070303032701/http://www.rrj.ca/online/658/.
3. Patrick Rusby MS, Stephen Sale. The Connected Consumer Survey 2015: Analysys Mason Limited; 2015 [cited 2016 Jan 12]. Available from: https://www.consumerbarometer.com/en/trending/?countryCode=SA and category=TRN-NOFILTER-ALL.
4. Alsanosi AA, Al-Momani MO, Hagr AA, Almomani FM, Shami IM, Al-Habeeb SF. The acute auditory effects of exposure for 60 minutes to mobile's electromagnetic field. Saudi Med J 2013; 34:142-6.
5. Alosaimi FD, Alyahya H, Alshahwan H, Al Mahyijari N, Shaik SA. Smartphone addiction among university students in Riyadh, Saudi Arabia. Saudi Med J 2016; 37:675-83.
6. Al-Khlaiwi T, Meo SA. Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population. Saudi Med J 2004; 25:732-36.
7. Yogesh S, Abha S, Priyanka S. Mobile usage and sleep patterns among medical students. Indian J Physiol Pharmacol 2014; 58:100-3.
8. Thomee S, Harenstam A, Hagberg M. Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults--A prospective cohort study. BMC Public Health 2011; 11:66.
9. Kohansieh M, Makaryus AN. Sleep deficiency and deprivation leading to cardiovascular disease. Int J Hypertens 2015; 2015:615681.
10. Kim TW, Jeong JH, Hong SC. The impact of sleep and circadian disturbance on hormones and metabolism. Int J Endocrinol 2015; 2015:591729.
11. Palagini L, Maria Bruno R, Gemignani A, Baglioni C, Ghiadoni L, Riemann D. Sleep loss and hypertension: A systematic review. Curr Pharm Des 2013; 19:2409-19.
12. Walker MP. Cognitive consequences of sleep and sleep loss. Sleep Med 2008;9:S29-34.
13. Oyetakin-White P, Suggs A, Koo B, Matsui MS, Yarosh D, Cooper KD, *et al.* Does poor sleep quality affect skin ageing? Clin Exp Dermatol 2015; 40:17-22.
14. Okun ML, Schetter CD, Glynn LM. Poor sleep quality is associated with preterm birth. Sleep 2011; 34:1493-8.
15. Exelmans L, Van den Bulck J. Bedtime mobile phone use and sleep in adults. Soc Sci Med 2016; 148:93-101.
16. Munezawa T, Kaneita Y, Osaki Y, Kanda H, Minowa M, Suzuki K, *et al.* The association between use of mobile phones after lights out and sleep disturbances among Japanese adolescents: A nationwide cross-sectional survey. Sleep 2011; 34:1013-20.
17. Abbey G. White WB, Igou F. Mobile phone use and sleep quality and length in college students. Int J Humanit Soc Sci 2011; 1:51-8.
18. Thomée S, Eklöf M, Gustafsson E, Nilsson R, Hagberg M. Prevalence of perceived stress, symptoms of depression and sleep disturbances in relation to information and communication technology (ICT) use among young adults – an explorative prospective study. Comput Human Behav 2007; 23:1300-21.
19. Mak YW, Wu CS, Hui DW, Lam SP, Tse HY, Yu WY, *et al.* Association between screen viewing duration and sleep duration, sleep quality, and excessive daytime sleepiness among adolescents in Hong Kong. Int J Environ Res Public Health 2014; 11:11201-19.
20. Kakinuma M, Takahashi M, Kato N, Aratake Y, Watanabe M, Ishikawa Y, *et al.* Effect of brief sleep hygiene education for workers of an information technology company. Ind Health 2010; 48:758-65.
21. Raosoft I. Sample size calculator: Raosoft, Inc.; 2004 [cited 2016 Mar 20]. Available from: http://www.raosoft.com/samplesize.html.
22. Springfield: Merriam-Webster; 2016. Merriam-Webster's dictionary.
23. Cambridge. Cambridge: Cambridge University Press; 2016. Cambridge dictionary.
24. Suleiman KH, Yates BC, Berger AM, Pozehl B, Meza J. Translating the Pittsburgh sleep quality index into Arabic. West J Nurs Res 2010; 32:250-68.
25. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. Psychiatry Res 1989; 28:193-213.
26. IBMCorp. IBM SPSS Statistics for Macintosh. Version 21.0 ed. Armonk, NY: IBM Corp.; Released 2012.
27. Lemola S, Perkinson-Gloor N, Brand S, Dewald-Kaufmann JF, Grob A. Adolescents' electronic media use at night, sleep disturbance, and depressive symptoms in the smartphone age. J Youth Adolesc 2015; 44:405-18.
28. Wood AW, Loughran SP, Stough C. Does evening exposure to mobile phone radiation affect subsequent melatonin production? Int J Radiat Biol 2006; 82:69-76.
29. Cajochen C, Frey S, Anders D, Spati J, Bues M, Pross A, *et al.* Evening exposure to a light-emitting diodes (LED)-backlit computer screen affects circadian physiology and cognitive performance. J Appl Physiol (1985) 2011; 110:1432-8.
30. Lanaj K, Johnson RE, Barnes CM. Beginning the workday yet already depleted? Consequences of late-night smartphone use and sleep. Organ Behav Hum Decis Process 2014; 124:11-23.