



ASSOCIATION OF EXCESSIVE MOBILE PHONE USAGE WITH SLEEP QUALITY AND FATIGUE SEVERITY: AN EPIDEMIOLOGIC SURVEY IN SAUDI POPULATION

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ABSTRACT

OBJECTIVE: To determine the effect of mobile phone usage on sleep quality and fatigue severity through standard questionnaires in Saudi Arabia mobile phone users.

METHODS: This cross-sectional study was conducted in Riyadh, Saudi Arabia on 251 mobile phone users from September 2019 to January 2020. Volunteer mobile phone users aging 15-65 years were selected by nonprobability convenience sampling technique from the Riyadh city community. The subjects were interviewed about the knowledge, attitude and practice of mobile phone use and were assessed through Pittsburg Sleep Quality Index (PSQI) and Fatigue Severity Scale (FSS). Spearman's correlations and Linear regression were applied for statistical analysis through SPSS V.22.

RESULTS: Mean age of the participants was 32.43 ± 12.80 years, while mobile phone usage was 11.7 ± 4.6 years. Median PSQI score was 6.0 and interquartile range (IQR) was 5. Median FSS score was 3.0 (IQR=3). There was a significant increase in PSQI and FSS with the increase daily mobile usage. When participants exceeded one-hour daily usage, PSQI (<1h=3.75, 1-2 h=5.78, >2h=6.85, $p=0.001$) and FSS (<1h= 2.25, 1-2h= 3.17, >2h= 3.61, $p=0.008$) exceeded acceptable scores. Moreover, placing mobile phone inside bedroom was associated with the increase of PSQI (Near Pillow=6.93, Inside Bed=6.16, Outside bed=5.75, $p=0.001$) and FSS (Near Pillow=3.65, Inside Bed=3.39, Outside Bed=2.58, $p=0.008$). Significant correlation was observed between high PSQI and FSS with daily usage ($r=0.213$, $p=0.001$ & $r=0.171$, $p=0.01$ respectively).

CONCLUSION: Inappropriate and excessive mobile phone usage is associated with poor sleep quality and excessive fatigue in Saudi Arabian population.

KEY WORDS: Cell Phone (MeSH); Sleep disturbance (non-MeSH); Radiation (MeSH); Fatigue (MeSH); Fatigue severity scale (FSS) (non-MeSH); Pittsburg Sleep Quality index (PSQI) (non-MeSH).

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INTRODUCTION

Functionality of mobile phone is exceeding its purpose of making calls and sending SMS. Many social media users are facing great challenges to setup personal limits from using social media. This can be maladaptive behavior as smart phone users want to stay connected round-the-clock by documenting their personal life via personal account,

interacting with friends, following celebrities' stories, etc. Although there are many advantages of having readily accessible internet connections in hand, however; the adversity of carrying mobile phone to the bedrooms has its negative implications. The International Classification of Sleep Disorders (ICSD-3) has defined insufficient sleep as consistent deprivations of sleep manner for a period of three months on a daily span, along with, sleepiness complaints

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during the daytime.¹ In 2012, The Centers for Disease Control and Prevention released data about how sleep duration among adults decreased since 1985, and the percentage of adults who are sleeping less than six hours per day increased from 22% to about 30%.² The National Sleep Funding (NSF) in United States recommends at least 8-10 hours of sleep is required for a healthy adolescent.

The research data is quite alarming as smart phones and social media applications have developed rapidly since 2012. Lack of self-discipline on smart phone use has many negative health implications including sleep disorders. A study conducted in 844 participants aged 18-94 years old showed that six out of ten people are carrying on the use of smart phones to bed at the cost of adequate time of sleep. Therefore, effecting sleeping pattern, which was reported by participants as sleep disturbance, daytime fatigue, tiresome and dysfunction due to having less sleep hours.³ Another study conducted on adults who were indulging themselves on social media use in-bed showed symptoms like insomnia, sleepiness during the day, mood dysfunction.⁴ Lack of sleep leads in adults to worrisome health morbidities such as likely to suffer from overweight, diabetes mellitus, and premature mortality due to vehicle crash, workplace accidents and cardiovascular disorders.⁵ Adults who did not have adequate sleep duration have adverse job performance. A study that tackled how job performance is affected by lacking sleep showed that employees who do not have enough

TABLE I: SPEARMAN'S CORRELATIONS BETWEEN PSQI AND FSS WITH MOBILE USE DURING SLEEP, WISH TO QUIT MOBILE USE, METHOD OF USAGE, DAILY USAGE AND MOBILE DEPENDENCY

Variables	PSQI	FSS	Daily usage	Method of usage	Mobile during sleep	Mobile dependency	Desire to quit mobile use	Mobile while calling	Mobile while not calling
PSQI	1.000	.263**	.213**	-.053	-.085	-.057	.052	.017	.066
FSS	.263**	1.000	.171**	.001	-.133*	-.061	.158*	.078	.018
Daily usage	.213**	.171**	1.000	.017	-.238**	-.234**	.083	-.053	-.066
Method of usage	-.053	.001	.017	1.000	-.049	-.016	.056	.074	.030
Mobile during sleep	-.085	-.133*	-.238**	-.049	1.000	.277**	-.012	.132*	-.048
Mobile dependency	-.057	-.061	-.234**	-.016	.277**	1.000	-.067	.013	.079
Desire to quit mobile use	.052	.158*	.083	.056	-.012	-.067	1.000	.055	-.028
Mobile while calling	.017	.078	-.053	.074	.132*	.013	.055	1.000	.208**
Mobile while not calling	.066	.018	-.066	.030	-.048	.079	-.028	.208**	1.000

PSQI: Pittsburg sleep quality index. FSS: Fatigue severity scale

sleep are more likely to make mistakes and prone to job related injuries.⁶

A study included about 700 adolescents has shown that the majority of the respondents are using the smartphones excessively before the bedtime and equal number have shown initial signs of insomnia, poor academic achievements, lack of social interaction, and depression.⁷ Another study has examined that the participants who are using mobile phones before bedtime are sleeping less than 8 hours a day, which is less than what has been recommended by the NSF. Moreover, those adolescents have complaints about difficulties to enjoy school, tiredness during the day, difficulties to get ready to go to school and difficulty to sleep.⁸ It has been found that night-time duration use of smartphone by teens has great adversity on mental health, as the child will be more emotionally drained.⁹ Many research studies have revealed that adolescents who are using cellphones for long time at nighttime have inadequate sleep duration, weak academic performance, drowsiness and sleepiness during the daylight.¹⁰⁻¹³ However, up to the best of our knowledge there is no study showing relationship between mobile phone usage and sleep disturbance and fatigue using Pittsburg Sleep Quality index (PSQI) and Fatigue severity scale (FSS) in Saudi Arabia to explore the gaps in

knowledge between mobile phone usage, sleep and fatigue. Therefore, this study was conducted to determine the association of mobile phone, sleep quality, and fatigue on Saudi Arabia mobile phone users by using PSQI and FSS.

METHODS

This cross-sectional study was conducted at Department of Physiology, King Saud University Medical City, King Saud University, Riyadh, Kingdom of Saudi Arabia from September 2019 to January 2020. Two hundred and fifty-one volunteer mobile phone users, ranging in age from 15-65 years were selected by non-probability, convenience sampling technique from the Riyadh city community. Mobile phone users with history of known psychiatric disorders, central nervous system disorders, or living near high voltage electricity towers, and malignancy were excluded from the study. Mobile phone users who were regularly smokers were also excluded since smoking acts as a confounder for sleep and fatigue patterns. The study followed the "Declaration of Helsinki" guidelines. It was approved by the "Institutional Review Board, Ethics Committee," College of Medicine Research Centre, King Saud University (E-19-4232).

Detailed clinical history was obtained from the study participants. Knowledge, attitude, and practices were assessed by

interview using a pre-designed questionnaire in both Arabic and English languages. One aspect of our study project, addressing smart mobile phone usage and cognitive function impairment in same population has already been published.¹⁴

We used PSQI to assess sleep quality patterns (PSQI score less than 5 is considered normal). FSS was used to assess fatigue severity (FSS less than 4 is considered normal). The participants were grouped according to the PSQI and FSS severity scales for comparing different variables related to mobile phone usage as explained in the results sections. The total time of the interview was around 15 minutes. All the participants signed a written consent form.

SPSS V. 22 was used for data entry and analysis. ANOVA was used for multiple comparisons. Spearman's correlations were determined between PSQI, FSS and mobile phone usage indices. Linear regression model was created to determine significant predictors of poor sleep quality and fatigue severity.

RESULTS

Mean age of the participants was 32.43 ± 12.80 years, while mobile phone usage was 11.7 ± 4.6 years. Demographic details were given in our already published article from same project.¹⁴ The present study shows the relationship of mobile

TABLE II: LINEAR REGRESSION MODEL WITH PITTSBURG SLEEP QUALITY INDEX SCORES AS DEPENDENT VARIABLE ADJUSTED FOR GENDER AND AGE

Model Dependent Variable: PSQI	Unstandardized Beta Coefficients	Standardized Beta Coefficients	t	Sig.
Daily usage	1.380	.227	3.451	.001
Method of usage	-0.132	-.036	-.584	.559
Mobile dependency	-0.124	-.027	-.409	.683
Desire to quit mobile use	0.125	.027	.439	.661
Mobile during sleep	-0.066	-.013	-.188	.851

PSQI: Pittsburg sleep quality index

phone usage with sleep patterns and fatigue severity. We observed a significant increase in PSQI and FSS with the increase daily mobile usage.

Median PSQI score was 6.0 and interquartile range (IQR) was 5. Median FSS score was 3.0 (IQR=3).

More than 54% of the participants place their mobile phone near their pillow while sleeping (obtained from our previous study mentioned earlier).

Figure 1 showed PSQI scores and FSS in mobile phone users according to daily usage. PSQI scores increased progressively significantly when participant's daily mobile phone usage increased. When participants exceeded one-hour daily usage, PSQI exceeded normal score of 5 (cut off PSQI score is 5), while when it was less than one hour, the PSQI score was less than 5 which is normal (<1h=3.75, 1-2 h=5.78, >2h=6.85 with $p=0.001$). When mobile daily usage increased, fatigue severity score increased progressively (<1h= 2.25, 1-2h= 3.17, >2h= 3.61 with $p=0.008$).

Figure 2 showed the PSQI scores and FSS according to the placement of the mobile phone while sleeping; The PSQI score decreased (NP= 6.93, IB= 6.16, OB= 5.75 with $p=0.001$) and FSS decreased (NP=3.65, IB=3.39, OB=2.58 with $p=0.008$) when participants placed their mobile away from their body. Even though the effect of the placement of the mobile phone during sleep did not bring the scores to the normal level (PSQI less than 5, FSS less than 4), but at least there was a significant difference between the groups.

Spearman's correlations were determined between PSQI and FSS with mobile use during sleep, wish to quit mobile use, method of usage, daily

usage and mobile dependency (table I). Significant correlation was observed between high PSQI and FSS with daily usage ($r=.213$, $p=0.001$ and $r=.171$, $p=0.01$ respectively). Also, desire to quit mobile use correlated significantly with high FSS. Afterwards, age and gender adjusted linear regression models were created with PSQI scores and FSS as dependent variables while, mobile use during sleep, wish to quit mobile use, method of usage, daily usage and mobile dependency as predictors (table II & III). ANOVA from both models gave significant values. The significant predictor for PSQI was daily mobile phone usage while the predictors for FSS were daily mobile phone usage and desire to quit mobile use.

DISCUSSION

This study investigated the association between the mobile phone usage and sleep disturbance and fatigue severity in Saudi Arabia. In this study, it was

identified that the sleep disturbance and fatigue severity increase with the increase daily usage of mobile phone. In addition, in the present study, the occurrence of sleep disturbance and increase fatigue severity is associated with the location of the mobile phone while sleeping. Exposure to Radiofrequency Electromagnetic Field Radiation (RF-EMFR) has several effects on human health including fatigue, tension, headache¹⁴, sleep disturbance,^{15,16} physiological and psychological problems,¹⁷ hearing and vision complaints,¹⁸ and risk of type 2 diabetes mellitus.¹⁹ Extensive fixing of MPBSTs in densely populated commercial, residential areas, and school buildings has started community concerns about adverse effects on human health,¹⁹ mainly brain function.²⁰ Recently, the association between mobile phone usage and cognition impairment was identified.²¹

This novel study is the first study that investigated the association between

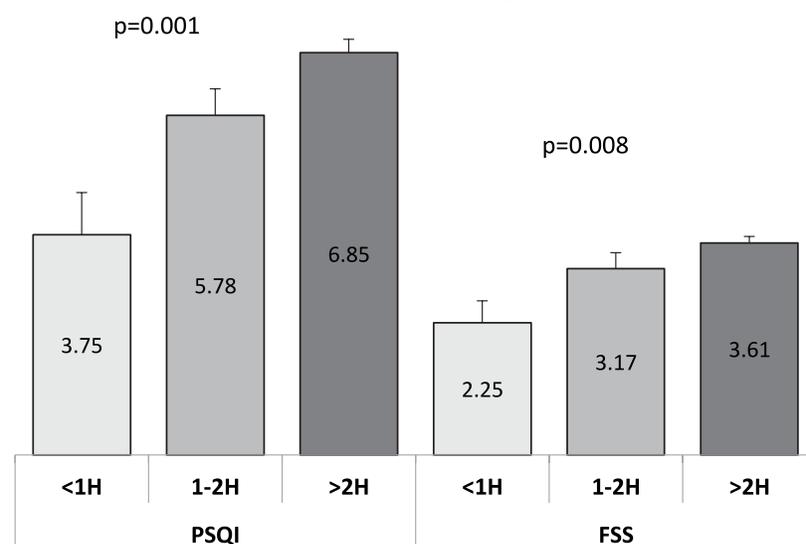


Figure 1: Pittsburg Sleep Quality Index (PSQI) scores and Fatigue Severity Scale (FSS) in mobile phone users according to daily usage in hours

TABLE III: LINEAR REGRESSION MODEL WITH PITTSBURG SLEEP QUALITY INDEX SCORES AS DEPENDENT VARIABLE ADJUSTED FOR GENDER AND AGE

Model Dependent Variable: FSS	Unstandardized Beta Coefficients	Standardized Coefficients Beta	t	Sig.
Daily usage	0.537	.175	2.675	.008
Method of usage	0.001	.001	.010	.992
Mobile dependency	-0.007	-.003	-.046	.963
Desire to quit mobile use	0.364	.157	2.545	.012
Mobile during sleep	-0.306	-.116	-1.741	.083

FSS: Fatigue severity scale

the mobile phone usage and sleep disturbance and fatigue severity in Saudi Arabia. It was observed that more than 61% of the participants have been using the mobile phone for more than 10 years which is most striking.

This is a fact in Saudi Arabia that even kids in grades five and six have mobile phones which became very difficult for us to find participants that do not use the mobile for less than one year. More than 80% of the participants use the mobile phone for more than two hours daily which became a well-established habit in the society. In addition, participants use handheld mode for calling (>61%) which is consistent with the lack of the awareness of putting the mobile phone away from your body¹⁴. In addition, more than 54% of the participants put their mobile phone near their heads while sleeping which can be associated with the sleep disturbance

and eventually affecting the fatigability of the participants.

In this study, it was identified that sleep disturbance increased with the increase of mobile phone usage. Also, fatigue severity increased with the daily increase of mobile phone which could be due to direct effect of the radiation omitted by the mobile phone on the participants or due to the sleep disturbance which increases fatigability eventually. Our results are consistent with the results of other studies that concluded the relationship of inappropriate mobile phone usage and sleep disturbance.^{3,22,23} In addition, our results indicate that even small changes in the attitude and the practices of mobile phone usage can affect the sleep quality and fatigability. According to our results, one should not exceed one-hour of daily usage of mobile phone. In addition, in our report, the co-existence

of sleep disturbance and increase fatigue severity was significantly related and associated with the position of mobile placement during sleeping hours. This could be due to the effect of the radiation of the device or due to the distraction of the mobile phone of participants from healthy sleep pattern by keeping them awake. Tattamanti G, et al, found that sleep disturbance was not due RF-EMFR but due to highest call-time category.²⁴

STUDY STRENGTHS AND LIMITATIONS

To the best of our knowledge this is the first report on the effect of excessive use of mobile phone on sleep patterns and fatigue severity in Saudi Arabia. Possible limitations could be its cross-sectional design and small number of subjects. Finding participants with mobile phone usage of less than 60 min daily was a challenge and it shows that it has become a common habit of our society. More researches at larger scale are needed to explore the effects of mobile phone usage on sleep and fatigue and also to determine preventive measures for its side effects.

CONCLUSION

The present study reveals that excessive use of mobile phone is associated with sleep disturbance and increase fatigue severity assessed by PSQI and FSS. Arguably enough, although there are many factors that are contributing to sleep disorders, however; sleep disorder that is caused by excessive smartphone use is undeniably alarming and affecting both adults and children worldwide which raise global health concerns.

Mobile phone becomes nowadays one of the major pillars of modern life and it would be so difficult to quit using it.

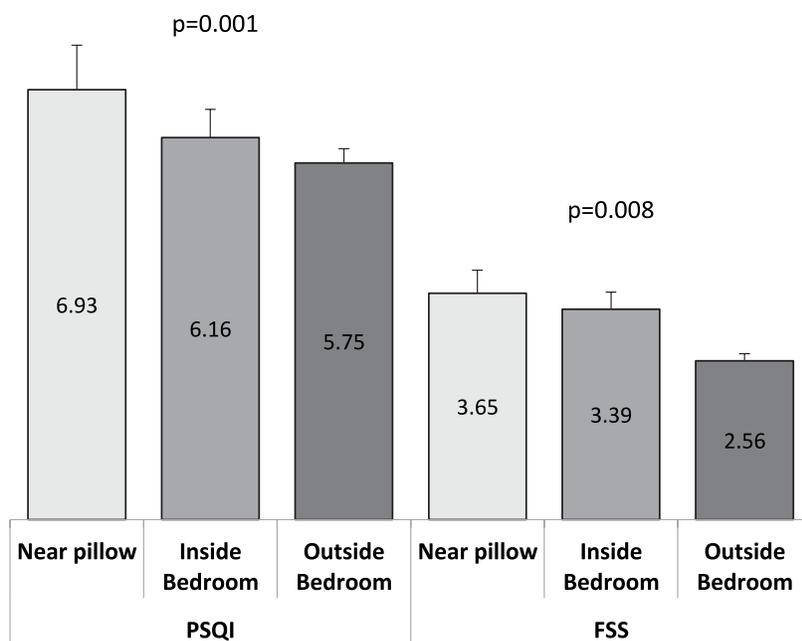


Figure 2: Pittsburgh Sleep Quality Index (PSQI) scores and Fatigue Severity Scale (FSS) in all participants according to mobile phone location while sleeping

Mobile phone usage should be restricted highly important works and organized. Health care providers and ministry of education should educate the public sector about the hazardous effects of inappropriate usage.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

TA: Conception and study design, acquisition of data, drafting the manuscript, critical review, approval of final version to be published

SSH: Acquisition, analysis and interpretation of data, drafting the manuscript, approval of final version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.



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