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ORIGINAL ARTICLE

Examining the Association between Cell Phone Use Addiction and Sleep Quality: A Cross-Sectional Study of Medical Sciences Students

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Abstract

Purpose A growing body of evidence has indicated an association between cell phone use and psycho-pathological behavior. However, there is little information available on the association between cell phone use addiction (CUA) and sleep quality. The current study aimed at examining the association between CUA and sleep quality among students at Neyshabur University of medical sciences (NUMS).

Methods This cross-sectional study involved the measurements of Cell Phone Overuse Scale (COS) and the Pittsburgh Sleep Quality Index (PSQI) from April to July 2019 to measure CUA and sleep quality, respectively, in 550 students studying at NUMS, Iran. Univariate and multiple logistic regression models were performed to assess the association between CUA and sleep quality.

Results The mean ± standard deviation for the age of the participants was 22.7 ± 5.9 years and most of them were female (60.2%). Out of 550 participants, 155 (28.2%) were found to be addicted to cell phone and 206 (37.5%) reported poor sleep quality. Based on the multiple logistic regression models, it was observed that CUA significantly increased the odds of poor sleep quality by more than twofolds in the study population (odds ratio = 2.09, 95% confidence interval: 1.38, 3.15, $P < 0.001$).

Conclusion The results showed that that more than one-fourth of the study population were addicted to cell phone and more than one-third were poor sleepers. Also, it was observed that CUA is positively associated with poor sleep quality. Hence, educational programs must be provided especially for students to improve their sleep quality.

Keywords Cell phone use · Sleep quality · Pittsburgh Sleep Quality Index (PSQI)

1 Introduction

Due to the ubiquity and ample applicability essence of technology, it has brought about an enormous revolution in both individuals' usual and academic lives. The strength of its penetration has been extended to people's lifestyles and identities [1]. Cell phones as the most up to the minute means of technology have attracted attention of more than 2.5 billion users which characterize 43% of the worldwide population [2]. Among the users, young individuals are considered as the highest proportion, stretching this subject into the pedagogical milieu, university students as literate emerging adults tend to access and utilize the latest technology of cell phones more than any other age groups [3]. Having become a global phenomenon, cell phones are accounted as the most critical means of communication in setting up a dependency on authentic internet use to sundry applications, straightforward interaction, and accessibility; perchance, the

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superfluous use has paved the way to the emergence of cell phone addiction [4].

Growing cell phone use rates leads to the emergence of cell phone use addiction (CUA) category in the behavioral addiction classification [4]. Psychologically speaking, as a multifaceted construct, CUA is defined as "excessive behavior in using technology tools such as smartphones, android applications or its entertainments" [5]. With such far-reaching repercussions, CUA has sparkled its adverse beams not only over addiction disorders but mental well-being [6, 7]. Among the very detrimental consequences of CUA, poor sleep quality as a trait of chronic insomnia and intricate sleep incident has been spotted as one of the integral aftereffects of CUA [4].

The vitality of sleeping for humankind at any age cannot be waived for life and health quality. The key notion of sleep quality has been contributed to numerous environmental factors namely, social life and health status [8, 9]. Having enjoyed idiosyncratic needs and milieu, novel learning experiences will be shaped as students approach the university. Through the emergence of many significant responsibilities, students undergo higher levels of pressure and stress accompanied by more disordered schedules; thus, various factors would affect their sleep quality [10]. In line with illuminating the justification, research has indicated that the majority of university students do not enjoy sleep requirements; pieces of evidence from Lund and co-workers' study revealed that 71% of Midwestern university students sleep less than the required range of 8 h [11].

Making a bridge between the theoretical background with empirical traces, a flourishing body of evidence has painted colors on a positive correlation between CUA and psychopathology symptoms like poor sleep quality, anxiety, and depression [4, 6, 12]. Reviewing the related literature, there might be a concluded positive relationship between CUA and poor sleep quality [13–15].

As medical students enact momentous roles in securing and saving people's lives; perchance, mental and physical threatening factors like anxiety, boredom resulting from lack of enough sleep, and physical weakness propel the individuals toward suffering from low job quality. Due to these reasons, the current study has centralized its aim at examining the potential relationship between CUA and sleep quality in students of Neyshabur University of medical sciences (NUMS).

2 Material and Methods

2.1 Participants and Procedure

This cross-sectional study was conducted among 550 students of NUMS who were randomly selected to participate. The whole process of data collection was carried out from April to July, 2019. Prior to the beginning of filling out the questionnaires, participants were informed and explained about the aims of the study and announced their consent to take part in the study.

2.2 Measures

The data collection instruments consisted of a socio-demographic checklist and Persian versions of the Cell Phone Overuse Scale (COS) and the Pittsburgh Sleep Quality Index (PSQI). The required data were gathered online via sending a link to the participants.

2.3 Cell Phone Overuse Scale (COS)

To measure the participants' level of cell phone use addiction (CUA), a 23-item self-rated scale called COS was employed. All 23 items were rated in the range of 1–6. After calculating the CUA score, participants were divided into three levels (low, normal, and high users) based on percentiles of 25 and 75. Then according to DSM criteria for pathological gambling, two categories of CUA were constructed: (a) light users (including low and normal users) and; (b) heavy users (including high users) [16]. The reliability and validity of this scale have been evaluated in Iran, it has been translated and validated for the Iranian context. Cronbach's alpha and test–retest reliability coefficients for COS were 0.903 and 0.71 [17].

2.4 Pittsburgh Sleep Quality Index (PSQI)

To examine the participants' level of sleep quality, a 19-item self-rated scale called *PSQI* was employed. Each item has a range of 0–3 points. The scale measures seven components namely subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disorders, use of sleep medication, and daytime dysfunction. The aggregated scores of the seven components make up the total score (ranging from 0 to 21) where higher scores (>5) showed worse sleep quality and lower scores (≤ 5) represented better sleep quality. The reliability and validity of this scale have been approbated in Iran. Further, it has been translated and validated for the Iranian context and held the Cronbach's alpha of 0.70–0.78 [18].

2.5 Covariates

Some factors included gender (male vs. female), age (≤ 22 years old vs. >22 years old), marital status (married vs. single), field of study (non-clinical vs. clinical),

education grade (first 2 years vs. second 2 years), local residence (family house vs. student house vs. dormitory), monthly family income (≤ 1500$ vs. > 1500$), tobacco use (no vs. yes), body mass index (BMI) (< 25 kg/m^2 vs. ≥ 25 kg/m^2), daily use of electronic device (< 5 h vs. ≥ 5 h), and daily use of an cell phone (< 3 h vs. ≥ 3 h) were considered covariates in this study.

2.6 Ethical Consideration

The authors confirm that research presented in this article met the ethical guidelines, including adherence to the legal requirements, of Iran and received approval from NUMs committee for ethics (Ethical code: IR.NUMS.REC.1398.017).

2.7 Statistical Analysis

After collecting data, statistical analyses were applied using STATA software version 14. A descriptive analysis including frequencies, percentages, means, and standard deviations (SDs) of studied factors is reported. The univariate logistic regression model was used to examine the association between sleep quality and surveyed variables. Afterward, a multiple logistic regression model was applied to investigate the independent association of CUA with sleep quality after adjusting the effect of the covariates. The significance level was considered at $P < 0.05$.

3 Results

The mean ± SD age of the participants was 22.7 ± 5.9 years. The majority of the study population were female (60.2%), and 51.1% were in the non-clinical field of the study. The mean daily use of cell phone was 4.2 ± 2.5 h. The prevalence of CUA and poor sleep quality was 28.2 and 37.5%, respectively. Table 1 presents all the studied characteristics of the participants. Table 2 illustrates that the use of social networks was prevalent in our study population. Accordingly, the majority of students used WhatsApp (55.5%), Telegram (89.6%), and Instagram (71.8%) applications on their cell phones. As shown in Table 2, the mean score of sleep quality was significantly different between Instagram users and non-users ($P = 0.006$). The results of the unadjusted association (univariate analysis) between the studied factors and sleep quality are shown in Table 3. According to this analysis, marital status, daily use of cell phone, and CUA were associated with sleep quality in the study population ($P < 0.05$). In this regard, there was not any significant association between other studied factors (gender, age, field of study, education grade, local residence, monthly family income, tobacco use, BMI, and daily use of electronic devices) and sleep quality ($P > 0.05$). Table 4 shows the results

Table 1 Characteristics of study population ($n = 550$)

Variables	Characteristics	*n*	%
Gender	Male	219	39.8
	Female	331	60.2
Age	≤ 22 years old	371	67.5
	> 22 years old	179	32.5
Marital status	Single	454	82.5
	Married	96	17.5
Field of study	Non-clinical	281	51.1
	Clinical	269	48.9
Education grade	First 2 years	153	27.8
	Second 2 years	397	72.2
Local residence	Family house	186	33.8
	Student house	57	10.4
	Dormitory	307	55.8
Monthly family income	≤ 1500 $	327	59.5
	> 1500 $	223	40.5
Tobacco use	No	494	89.8
	Yes	56	10.2
BMI	< 25 kg/m^2	438	79.6
	≥ 25 kg/m^2	112	20.4
Daily use of electronic device	< 5 h	231	42.0
	≥ 5 h	319	58.0
Daily use of cell phone	< 3 h	156	28.4
	≥ 3 h	394	71.6
CUA	No	395	71.8
	Yes	155	28.2

BMI body mass index, *CUA* cell phone use addiction

Table 2 Prevalence of using social networking in the study population

Social networks	*n*	%	Sleep quality score		*P* value
			Mean	SD	
WhatsApp					
No	245	44.5	4.8	3.1	0.142
Yes	305	55.5	5.2	2.9	
Telegram					
No	57	10.4	5.0	3.1	0.986
Yes	493	89.6	5.0	3.0	
Instagram					
No	155	28.2	4.5	3.0	0.006
Yes	395	71.8	5.3	3.0	
Others					
No	519	94.4	5.0	2.9	0.004
Yes	31	5.6	6.5	3.9	

SD standard deviation

Table 3 Univariate logistic regression model of factors associated with sleep quality

Variables	Sleep quality		OR	(95% CI)	*P* value
	Good ($n=344$)	Poor ($n=206$)			
Gender					
Female	208	123	1 (ref)	–	–
Male	136	83	1.03	(0.73, 1.47)	0.861
Age					
≤ 22 years old	233	138	1 (ref)	–	–
> 22 years old	111	68	1.03	(0.72, 1.50)	0.857
Marital status					
Single	70	26	1 (ref)	–	–
Married	274	180	0.57	(0.35, 0.92)	0.022
Field of study					
Non-clinical	176	105	1 (ref)	–	–
Clinical	168	101	1.01	(0.71, 1.42)	0.965
Education grade					
First 2 years	254	143	1 (ref)	–	–
Second 2 years	90	63	1.24	(0.85, 1.82)	0.263
Local residence					
Family house	126	60	1 (ref)	–	–
Student house	36	21	1.22	(0.66, 2.28)	0.521
Dormitory	182	125	1.44	(0.98, 2.11)	0.061
Monthly family income					
≤ 1500 $	205	122	1 (ref)	–	–
> 1500 $	139	84	1.02	(0.71, 1.44)	0.932
Tobacco use					
No	314	180	1 (ref)	–	–
Yes	30	26	1.51	(0.87, 2.64)	0.145
BMI					
< 25 kg/m^2	270	168	1 (ref)	–	–
≥ 25 kg/m^2	74	38	0.83	(0.53, 1.28	0.388
Daily use of electronic device					
< 5 h	154	77	1 (ref)	–	–
≥ 5 h	190	129	1.36	(0.95, 1.93)	0.090
Daily use of cell phone					
< 3 h	110	46	1 (ref)	–	–
≥ 3 h	234	160	1.63	(1.10, 2.44)	0.016
CUA					
No	269	126	1 (ref)	–	–
Yes	75	80	2.28	(1.56, 3.33)	< 0.001

OR odds ratio, *CI* confidence interval, *BMI* body mass index, *CUA* cell phone use addiction

of the adjusted association between CUA and sleep quality based on the multiple logistic regression model. According to this model, when it was adjusted for studied covariates, it was observed that CUA has a strong significant association with sleep quality in the study population ($P<0.001$) (Table 4). So, CUA increased the odds of poor sleep quality by more than twofolds (odds ratio = 2.09, 95% confidence interval: 1.38, 3.15).

4 Discussion

This study aimed to investigate whether there is any association between CUA and sleep quality in students of NUMs. With regard to the data collected through questioning the daily cell phone use and sleep, we performed an analysis on the CUA level and its association with sleep quality using the univariate and multiple logistic regression models.

The analysis considering the cell phone use suggested that the prevalence of CUA among the students was 28.2%

Table 4 Multiple logistic regression model of factors associated with sleep quality

Variables	OR	(95% CI)	*P* value
Gender (male)	0.86	(0.56, 1.31)	0.475
Age (> 22 years old)	1.12	(0.72, 1.76)	0.608
Marital status (married)	0.60	(0.34, 1.05)	0.073
Field of study (clinical)	1.10	(0.74, 1.63)	0.645
Education grade (second two years)	1.13	(0.72, 1.79)	0.599
Local residence			
Student house	0.98	(0.50, 1.94)	0.964
Dormitory	1.19	(0.78, 1.81)	0.4.9
Monthly family income (> 1500$)	1.03	(0.71, 1.49)	0.874
Tobacco use (yes)	1.46	(0.81, 2.64)	0.207
BMI (≥ 25 kg/m^2)	0.96	(0.61, 1.53)	0.879
Daily use of electronic device (≥ 5 h)	0.98	(0.64, 1.49)	0.912
Daily use of cell phone (≥ 3 h)	1.19	(0.73, 1.93)	0.483
CUA (yes)	2.09	(1.38, 3.15)	< 0.001

OR odds ratio, *CI* confidence interval, *BMI* body mass index, *CUA* cell phone use addiction

which was higher than that reported in previous studies [19–21]. Moreover, in the same studies in Saudi Arabia [22], the prevalence of CUA among medical students was found to be 36.5%. With regard to the CUA, many research papers were relevant to our study in that they have been referred more extensively to the concepts of mobile phone dependency and problematic smartphone use. In these concepts, in comparison with the current findings, the studies conducted among medical students in India (85.40%), Indonesia (58.24%), Egypt (53.6%), and China (62.7%) have reported a much higher severity of smartphone overuse [23–26]. The high prevalence of CUA among individuals especially medical students has been getting a widespread problem. The differences reported in prevalence across the studies may likely be due to varying using cell phone by individuals in different conditions.

According to this study, compared to other kinds of social networks, "Telegram" as a messaging, photo, and video-sharing social networking service has allocated itself the highest prevalence use (89.6%). Our estimated prevalence is consistent with the previous studies. As put forward in the study of Bozargpanah et al. who examined the role of social media utilization and the detrimental effects on students of Kurdistan University of Medical Sciences, we found that Telegram (94.1%) was the most used platform among the students who participated in their study [27]. A similar conclusion reached by Mehdipour revealed that by spending an average of 2 h and 40 min per day, Telegram (87%) has the highest usage among students of Zahedan University of Medical Sciences [28]. Through reviewing relevant conclusions, the study suggests that Telegram has enjoyed a high potential in message exchanging and educational capacities in the Iranian context and the most frequently cited reason for its prevalent use is to meet social needs [29–32].

Considering the poor sleep quality, the reported prevalence in the current study is 37.5% which is lower than that in the study of medical students of Qom where it was reported at 61.7% [19]. Our finding is consistent with a study wherein Kurugodiyavar et al. put the prevalence of poor sleep quality among Indian medical students at 48.75% [33]. The studies on medical students of Colombia have shown that more than 79% experienced poor sleep quality [34, 35]. In a recent survey conducted in North India to assess how overusing the smartphone was related to sleep quality among medical universities of tertiary teaching hospital care, a high frequency of poor sleep quality (63.39%) was reported [36]. With an overall prevalence of higher than 70% according to a study that investigated the relationship between smartphone addiction and sleep quality among Mexican medical students, sleep quality is becoming an important public health issue [37]. Unlike the above-mentioned studies, the results for poor sleep quality displayed lower rates of prevalence in Japan (23.5%), China (16.1%), and the U.S. (25%) [38–40]. These variations in rates of prevalence may partly be explained by the nature of the study population.

A further finding is that gender, age, marital status, field of study, education grade, local residence, income, tobacco use, BMI, daily use of cell phone, and electronic devices as surveyed variables paved their statistical way toward no significant relationship to sleep quality in the context of the current study.

With regard to the gender and sleep quality relationship, our finding is contrary to earlier studies. Akçay concluded that 65% of the population and to be more specific, males encountered many difficulties in sleeping [41]. The findings in the Iranian context revealed that poor sleep quality in female students was significantly more than in the counter group [42] whereas, in contexts other than Iran, poor sleep quality was attributed to male students [41, 43, 44]; however, in another study, the researchers reported no significant difference in poor sleep quality between male and female students [45].

Many studies have, also, investigated the link between age and sleep quality among individuals. Contrary to our expectation, the prior studies in all ages revealed that the sleep quality deteriorated and individuals suffered from worse sleep quality as the age advanced [46–50].

Approached from the earlier studies, a significant relationship was found between BMI and sleep quality [51, 52]. Derakhshani et al. found that cell phone usage was negatively associated with sleep quality [53]. Daily use of cell phone indicated a significant relationship with sleep quality [54, 55]. With studies conducted among university students, it seemed that poor sleep quality probably was more

common among students in medical universities than those in non-clinical universities [56, 57]. Studies on marital status have represented that poor sleep quality was negatively influenced by being a bachelor or unmarried [58, 59]. Moreover, the research has identified the other socio-demographic factors as the significant factors for poor sleep quality [60–63].

In examining the major hypothesis (the association between CUA and sleep quality), the unadjusted and adjusted association results elucidated that CUA was positively associated with poor sleep quality ($P < 0.05$). This study provides further support to growing body evidence that one of the most obvious consequences of CUA has been on sleep quality [4, 25, 64, 65]. Simply put, individuals who spent more and equal to 3 h with cell phones suffered higher levels of poor sleep quality. These results go beyond previous reports, representing that increased dependency on smartphones has an obvious deleterious effect on sleep quality [66–68]. This relationship remains significant in studies to show that extensive use of a cell phone is terminated into low sleep quality and possibly would accelerate smartphone (internet) dependency [6, 69, 70]. These results are in line with Compensatory Internet Use Theory, expounding that boosted cell phone use (online activities) leads to arousal of negative emotions and sleep disturbance [71]. However, cell phone use and possession among young people especially those attending colleges and universities are on the increase that has been shown to be associated with various aspects of sleep quality [4, 72]. The result now provides a piece of evidence that convenient access to cell phone usage lends a hand in boosting the chance of sleep disturbances in students [73]. In simple words, the college students who were using their cell phone longer had experienced worse sleep length and quality [72, 74, 75]. A similar finding was found in a study by Mohamed et al., suggesting a link between addiction to the smartphone to the sleep quality among medical students [43]. Following Ghosh et al., who conducted a study on nursing students, smartphone addiction would be apparently a major influencing factor for sleep quality [76]. Similarly, Kurugodiyavar et al. stated that smartphone addiction was considered to be an important factor of sleep quality in undergraduate medical students [33]. However, when comparing our results to those of previous studies, no association was found between cell phone use and sleep problems [77, 78]. From this respect, a multitude of research proved that the detriments of cell phone (Internet) addiction have been extended to not only poor sleep quality, but also other disorders such as headache, learning defects, disturbing behavior, psycho-pathological disorders, and higher exposure to heart diseases and diabetes [18, 69, 73].

This demonstration is justified under the shade of the fact that smartphone utilization is not good not detrimental per se, though should not be over-pathologized, and thus usage and the milieu are of great significance [59, 60, 73, 79].

Medical university students are at danger of experiencing sundry of disturbances in their circadian cycle; these disturbances can be attributed to the high stress level of the academic environment [80]. These problems which are considered the most common among medical students intensified by habits such as the Internet surfing, alcohol and tobacco using, and television watching [81, 82]. Concerning the fact that other factors could detrimentally affect job quality and academic performance; however, impairment, the emotional aspect, and socio-demographic variables have been found to be the most frequent and in sleep quality directly impacts medical university students' academic and professional performance [83, 84].

4.1 Limitations and Strengths

Despite the contributions of the study, the current study suffers several shortcomings. One limitation is tied to the string of the cross-sectional essence of the study. Due to the fact that all the required data were collected at a one-time interval, future studies might exert a longitudinal approach to verify the findings. In this regard, collecting data at various time intervals could provide a more robust picture of casual deductions. Second, in the context of the present study, the participants were of one group of university students; thus, more studies need to be conducted to investigate the potential effect of CUA and sleep quality through a hybrid lens (medical sciences universities and non-medical ones). Another concern about our findings was that we have limited the study to psychosocial and socio-demographic aspects of CUA on sleep quality. To the best of the researchers' knowledge, other probable biophysical associations, personality traits, and some other factors have not been investigated so far; hence, conducting studies in this regard seems timely.

One of the strengths of the current study is that the data were collected from an adequate sample size of students studying at NUMs using a validated and widely used scale to make generalized claims about the larger population of students. Then to calculate the relatively pure association between CUA and sleep quality, a multiple logistic regression model was used.

5 Conclusion

Results from our study showed that among the study population, more than one-third were poor sleepers and more than one-fourth were addicted to cell phone. Given the significant association between CUA and sleep quality, it would seem that students may be at a greater risk of poor sleep quality by increasing access to and use of the cell phone.

By and large, students who have devoted more and equal to 3 h to cell phone use were found to be poor sleepers.

The combination of findings provides some support for the conceptual premise that the daily continuous utilization of cell phones may bring about desynchronization in sleeping procedures and consequently negatively affect sleep quality and habits. In the current study, notable results were obtained which would be efficacious to the present literature on the association between CUA and sleep quality in the academic context. Lightening the future scope of our study, the researchers highlighted that identifying those groups of students at risk of poor quality of sleep is regarded as the initial and integral stage, and later implement remedial actions and tailored interventions to prevent deleterious and long-term mental health factors in medical students.

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Author Contributions AG and RB researched literature and conceived the study. AG, RB, and AR were involved in protocol development. RB, AR, and RD contributed to the data collection. AA, AG, MH and EM wrote the first draft of the manuscript. AG analyzed the data and revised the manuscript critically. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

Data availability Data will be available upon request to the corresponding author.

Declarations

Conflict of Interest The authors declare that they have no competing interests.

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