ABSTRACT

Objective: Research shows that poor sleep quality and smartphone addiction are common problems among university students. This study was planned to evaluate the quality of sleep in students at Pamukkale University and to investigate its relationship with smartphone addiction.

Methods: This cross-sectional study was carried out at the university campus in 2017-2018. Its dependent variable was low sleep quality. Independent variables were smartphone addiction, features related to smartphone addiction, socio-demographic features and other questioned features. The total number of students attending normal education in seven faculties and two colleges for four years was 20862. The minimum sample size of the study was calculated as 1088. Smartphone Addiction Scale-Short Version (SAS-SV) and Pittsburgh Sleep Quality Index (PSQI) were used. The data were analyzed with the SPSS program.

Results: The mean age was of the participants 21.39 ± 2.21. The sleep quality of students with a PSQI total score of more than five was defined as ‘poor’. The frequency of poor sleep quality was 52.4%. The frequency of smartphone addiction was 34.6% according to the SAS-SV scale. It was found that the frequency of poor sleep quality was significantly higher in students with smartphone addiction compared to others.

Conclusion: Smartphone addiction was found as one of the risk factors for poor sleep quality.

KEYWORDS: Smartphone addiction, Cell phone, Sleep, Students.
METHODS

This cross-sectional study was planned to be conducted with university students and at faculties in the campus in the 2017-2018 academic year. The dependent variable of the study was a poor sleep quality, and Pittsburgh Sleep Quality Index (PSQI) score higher than five indicates bad sleep quality. The minimum sample size was calculated as 1088 with a 95% confidence level and 80% power after examining the findings of other studies, with Open Epi (Open Source Epidemiologic Statistics for Public Health) Version 3.01.7,8 This number was increased by 20% to prevent possible problems that may occur. Hence, we aimed to reach 1306 students. A multistage cluster sampling method was used to recruit university students. Schools and faculties were accepted as clusters, and five faculties and one vocational school and students in all classes, which were selected randomly among seven faculties and two colleges were located in the Kinikli campus. There were a total of 14 faculties and three colleges in Pamukkale University Kinikli Campus. There were no students in some of the classes. Five faculties and one college with students from only normal education were selected among seven four-year faculties and two colleges with students from all grades. In the 2017-2018 academic year, the total number of students in seven four-year faculties and two colleges attending normal education was 20862. The questionnaire used in the study consisted of three sections that included a 30-item survey, a Smartphone Addiction Scale Short Form, and the Pittsburgh Sleep Quality Index. Smartphone Addiction Scale Short Form was developed by Kwon et al.9 Turkish validity and reliability was performed by Noyan et al. and Cronbach’s alpha coefficient was 0.867.10 The Likert type scale was scored from one to six. The lowest and highest scores to be obtained from the scale were 10 and 60, respectively. The risk of smartphone addiction increased in line with the scale score. The cut off score was identified as 31 for men and 33 for women in SAS-SF, which did not have a sub-scale. The Pittsburgh Sleep Quality Index which evaluated the sleep quality the last month. It was developed by Buysse et al.7 The Turkish scale validity and reliability study was conducted by Aaargun et al and Cronbach’s alpha coefficient was 0.80.9 A total score of above five which ranges between 0 and 21 indicates a poor sleep quality. Ethical committee approval was obtained from Pamukkale University Non-Interventional Clinical Research Ethics Committee numbered 60116787-020/8328(2018) and Statistical Package for Social Sciences (SPSS) for Windows 17.0 package program was used for analysis.

RESULTS

Of the 1545 participant 56.8% were females and 43.2% were males. The mean age of students was 21.39 ± 2.21. Students’ total PSQI mean score was 6.17 ± 3.03, and the mean SAS-SF score was 28.63 ± 10.15 (Table-I). Of the students 52.4% had a PSQI total score higher than five and their sleep quality was poor. According to smartphone addiction cut-off points (31 points and above for men, 33 points and above for women), the frequency of addiction of students was 34.6% (35.9% for females and 33.0% for males). Six students who did not use smartphones were included in the group without smartphone addiction. In the study group, the frequency of having poor sleep quality was 64.5% for those with smartphone addiction and 45.9% for those without. The frequency of poor sleep quality was significantly higher in students with smartphone addiction compared to those without smartphone addiction (Table-II).

| Variable                  | Sleep Quality                  | p    |
|---------------------------|--------------------------------|------|
|                           | Poor Number (%)                | Well Number (%) |      |
| Smartphone Addiction      | 345 (64.5)                     | 190 (35.5)     | <0.001|
| Not smartphone user       | 464 (45.9)                     | 546 (54.1)     |      |

Table-I: Students’ PSQI and SAS-SF scores.

Table-II: Comparison of students’ sleep quality according to their smartphone addiction status.
Table-III: Comparison of students' sleep quality with other important variables.

| Variable                              | Poor Number (%) | Well Number (%) | p      |
|---------------------------------------|-----------------|-----------------|--------|
| **Perceived income level**            |                 |                 |        |
| Income less than expenditure          | 195 (58.7)      | 137 (41.3)      | 0.016  |
| Income equal to expenditure           | 452 (51.1)      | 432 (48.9)      |        |
| Income more than expenditures         | 156 (49.4)      | 160 (50.6)      |        |
| **Smoking status**                    |                 |                 |        |
| Never smoked                          | 469 (48.7)      | 495 (51.3)      | <0.001 |
| Quit smoking                          | 53 (54.6)       | 44 (45.4)       |        |
| Occasionally smokes                   | 104 (56.8)      | 79 (43.2)       |        |
| Regular smoker                        | 183 (61.0)      | 117 (39.0)      |        |
| **Alcohol use in the past month**     |                 |                 |        |
| Never uses                            | 584 (50.6)      | 570 (49.4)      | 0.002  |
| Less than 1 day a week                | 137 (52.7)      | 123 (47.3)      |        |
| Consumes 1 day or more per week       | 85 (67.5)       | 41 (32.5)       |        |
| **Doing Regular Exercise**            |                 |                 |        |
| Yes                                   | 228 (48.1)      | 255 (51.9)      | 0.006  |
| No                                    | 481 (55.7)      | 382 (44.3)      |        |
| **Physical activity for at least 150 minutes moderate or 75 minutes intense or an equivalent combination of the two in the last week** | | | |
| Yes                                   | 289 (50.6)      | 312 (49.4)      | 0.004  |
| No                                    | 481 (55.7)      | 382 (44.3)      |        |
| **Weekly coffee consumption**         |                 |                 |        |
| Not Consuming                         | 91 (42.3)       | 124 (57.7)      | <0.001 |
| 1-10 cups or cups / week              | 516 (52.1)      | 475 (47.9)      |        |
| > 10 glasses or cups / week>          | 176 (63.3)      | 102 (36.7)      |        |
| **Weekly caffeinated soft drink consumption** | | | |
| Not Consuming                         | 205 (46.8)      | 233 (53.2)      | 0.002  |
| 1-5 cups or cans/week                 | 420 (53.0)      | 372 (47.0)      |        |
| > 5 glasses or box/week>              | 143 (59.1)      | 99 (40.9)       |        |
| **Energy drink consumption in the last month** | | | |
| Never consumed in the last one month  | 684 (51.8)      | 636 (48.2)      | 0.047  |
| Consumed 1-5 days in the last one month| 96 (56.8)       | 73 (43.2)       |        |
| Consumed more than 5 days in the past month | 22 (66.7)   | 11 (33.3)       |        |
| **Hours of Caffeinated beverage consumption** | | | |
| During daytime                        | 128 (43.2)      | 168 (56.8)      | 0.001  |
| In the evening (after 18 o'clock)     | 210 (54.8)      | 173 (45.2)      |        |
| Both during the day and in the evening| 467 (55.1)      | 381 (44.9)      |        |
| **Smartphone or tablet screen usage in the last One hour before bedtime** | | | |
| Yes                                   | 651 (53.9)      | 557 (46.1)      | 0.042  |
| No                                    | 149 (47.5)      | 165 (52.5)      |        |
| **Using smartphone in bed not using** | | | |
| ≤30 minutes/24 hours                  | 247 (45.5)      | 296 (54.5)      | <0.001 |
| > 30 minutes/24 hours                 | 443 (60.0)      | 295 (40.0)      |        |
| **Disease diagnosed by a physician**  |                 |                 |        |
| Yes                                   | 125 (59.0)      | 87 (41.0)       | 0.037  |
| No                                    | 677 (51.2)      | 644 (48.8)      |        |
| **Regular medication use**            |                 |                 |        |
| Yes                                   | 93 (60.0)       | 62 (40.0)       | 0.042  |
| No                                    | 711 (51.4)      | 672 (48.6)      |        |
| **First-degree relative with sleep problems** | | | |
| Yes                                   | 181 (65.8)      | 94 (34.2)       | <0.001 |
| No                                    | 625 (49.4)      | 641 (50.6)      |        |
| **Median**                            |                 |                 |        |
| Daily internet usage time (Hours/day) | 4 (4.97 ± 2.96) | 4 (4.61 ± 2.85) | 0.011  |
| Daily smartphone usage time (hours/day)| 5                | 4                | <0.001 |
There was a positive correlation was found between the students PSQI total scores and SAS-SF scores (rho 0.242 p<0.001). A statistically significant linear relationship was found between students’ perceived financial status and their sleep quality (Table-III). Additionally, there were statistically significant relationships between students’ frequency of poor sleep quality and their smoking and alcohol use habits. Those who did not exercise had a higher rate of poor sleep quality than those who did at least 150 minutes of moderate-intensity physical activity or at least 75 minutes of vigorous-intensity physical activity per week or an equivalent combination of these, as recommended by WHO for the 18-64 age group (Table-IV). There was a significant linear relationship between the weekly consumption of coffee, caffeinated soft drinks, and energy drinks in the last month and sleep quality. Also there was a significant difference between the time of consuming caffeinated beverages and the students sleep quality (Table-III).

Daily internet usage differed according to students’ sleep quality: those with poor sleep quality had a significantly higher frequency of daily internet usage than others. The frequency of poor sleep quality was significantly higher in students using a smartphone or tablet within an hour before going to bed. The students with poor sleep quality had a significantly higher mean value of daily smartphone usage than others. The frequency of poor sleep quality increased in line with the frequency of smartphone usage, and there was a significant difference. The frequency of poor sleep quality significantly increased in the students who were diagnosed with a disease compared to those who were not in those who took regular medicines compared to those who did not, and in those who had a first-degree relative with sleep problems compared to those who did not (Table-IV).

In the multivariate analysis of factors related to the sleep quality of students, the variables which were significant in binary comparisons were evaluated using the binary logistic regression model. The risk of poor sleep quality was 1.937 times more significant in those with smartphone addiction than those without (Table-IV).

### DISCUSSION

Of the participants 52.4% had a poor sleep quality and one of the independent risk factors was smartphone addiction. Although smartphone addiction is a social problem, it should be considered in clinical practice. Studies

| Variable (Reference)                                                                 | (B)    | 95% CI         | p     |
|--------------------------------------------------------------------------------------|--------|----------------|-------|
| **Smartphone addiction (No)**                                                       |        |                |       |
| Yes                                                                                  | 1.937  | 1.486-2.524    | <0.001|
| **Perception of financial situation (Income is more than expenses)**                |        |                |       |
| Income is equal to expenditure                                                      | 1.278  | 0.935-1.747    | 0.124 |
| Income less than expenditures                                                       | 1.769  | 1.212-2.581    | 0.003 |
| **Smoking status (Never smoked)**                                                   |        |                |       |
| Quit Smoking                                                                         | 1.173  | 0.695-1.981    | 0.551 |
| Occasionally smokes                                                                | 1.489  | 0.994-2.231    | 0.054 |
| Regular smoker                                                                      | 1.510  | 1.064-2.142    | 0.021 |
| **In the past one month, alcohol use (No)**                                         |        |                |       |
| Less than one day a week                                                            | 1.087  | 0.769-1.536    | 0.638 |
| Consumes one day or more per week                                                   | 1.798  | 1.095-2.951    | 0.020 |
| **Physical activity for at least 150 minutes of moderate or 75 minutes of intense or an equivalent combination of both in the last week (Yes)** |        |                |       |
| No                                                                                   | 1.696  | 1.319-2.180    | <0.001|
| **Having first-degree relatives with sleep problems (No)**                         |        |                |       |
| Yes                                                                                  | 2.228  | 1.576-3.149    | <0.001|
| **Using a smartphone in bed (No)**                                                  |        |                |       |
| ≤30 minutes/24 hours                                                                | 1.062  | 0.687-1.644    | 0.786 |
| > 30 minutes/24 hours                                                               | 1.800  | 1.172-2.764    | 0.007 |
conducted up to date with university students across the world have also reported a prevalence of poor sleep quality, which is consistent with our findings. This frequency was 59.4% in Lithuania, 52.7% in Lebanon, 55.8% in Ethiopia, 33.8% in Taiwan, 55% in the United States, and in Brazil 61.5%. A meta-analysis in Brazil found that children with low income levels had poorer sleep quality, and these findings were in line findings of our study. Low perception of income level was an independent risk factor for poor sleep quality and this may be related to easy access to technological devices. Less poor sleep quality in students with high income perception may be related to the more conscious lifestyle created by financial opportunities in individuals.

Moreover, international scientific studies demonstrate the positive effects of exercise on sleep. In this study, the students’ levels of engagement in moderate-intensity and vigorous-intensity physical activities over the last week were investigated and according to the binary logistic regression analysis, not doing physical activity at the level recommended by WHO was found to be an independent risk factor for poor sleep quality. This relationship was understandable considering the mental and physical positive effects of physical activity. In our study, the daily internet usage hours of students with poor sleep quality were significantly higher than others, and similarly, in studies conducted with university students in Taiwan, the sleep quality of students with internet addiction was found to be significantly worse.

Daily smartphone usage hours of students with poor sleep quality were also significantly higher than others. So, the increase in daily smartphone usage time may lead to smartphone addiction and cause poor sleep quality. A study on students in Japan reported that playing computer games before going to sleep delays sleep. We did not find a significant relationship between digital gaming and students sleep quality, which may be due to the use of smartphones for other purposes than digital gaming. We found that having first-degree relatives with sleep problems was a risk factor for poor sleep quality, which is also in line with the literature. In our study, the frequency of smartphone addiction was found to be 34.6%, and similarly to the findings of previous studies, we found that smartphone addiction to poses risks for poor sleep quality.

**Limitation of the study:** Our strength was that we used valid and reliable scales for the study and investigated many variables related to sleep quality. Our limitation was that the study data were based on the participants statements.

**CONCLUSION**

Smartphone addiction was found to be one of the risk factors for poor sleep quality. Students should be informed about sleep quality and smartphone addiction. During their university education and smartphone addiction should be questioned in clinical applications with poor sleep quality problems.

**Acknowledgments:** This paper was produced from the first author’s dissertation study. The dissertation was supported as a Pamukkale University BAP project. The paper was presented at the second National Denizli Family Medicine Congress (7-10 March 2019) as a podium presentation. Ethical committee approval was obtained from Pamukkale University for the study.

**Funding:** This study was supported by the decision of Pamukkale University Scientific Research Projects (BAP) Coordination Unit, 2018TIPF039.

**Conflict of Interest:** The authors declare no conflict of interest.

**REFERENCES**

1. World Health Organization Regional Office for Europe. WHO technical meeting on sleep and health; 2004 January 22-24; Bonn, Germany. Copenhagen: Denmark; WHO Regional Office for Europe. 2004;P.2-24.
2. Buboltz WC Jr, Brown F, Soper B. Sleep habits and patterns of college students: A preliminary study. J Am Coll Health. 2001;50(3):131-135. doi: 10.1080/07448401089596117
3. Fukuda K, Ishihara K. Age related changes of sleeping pattern during adolescence. Psychiatry Clin Neurosci. 2001;55(3):231-232. doi: 10.1046/j.1440-1819.2001.00837.x
4. Soni R, Upadhyay R, Jain M. Prevalence of smartphone addiction, sleep quality and associated behaviour problems in adolescents. Int J Res Med Sci. 2017;5(2):515-519.
5. Kim H. Exercise rehabilitation for smartphone addiction. J Exerc Rehabil. 2013;9(6):500-555. doi: 10.12965/jer.130080
6. Lemola S, Perkins-Glooor 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(2):405-418. doi: 10.1007/s10964-014-0176-x
7. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213. doi: 10.1016/0165-1781(89)90047-4
8. Aaargun MY, Kara H, Anlar O. Pittsburgh Uyku Kalitesi
Indeksi’nin Gecerliği ve Guvenilirligi. Turk Psikiyatri Derg.
1996;7(2):107-115.
9. Kwon M, Kim DJ, Cho H, Yang S. The smartphone
addiction scale: development and validation of a short
version for adolescents. PLoS One 2013;8(12):e835-858.
doi: 10.1371/journal.pone.0083558
10. Noyan CO, Darcin AE, Nurmedov S, Yilmaz O, Dilbaz
N. Akilli telefon bagimligi olceginin kısa formunun
universite ogrencilerinde Turkece gecerlik ve guvenilirlik
calismasi. Anadolu Psikiyatri Derg. 2015;16(1):73-81.
11. Lai PP, Say YH. Associated factors of sleep quality and
behavior among students of two tertiary institutions in
Northern Malaysia. Med J Malaysia. 2013;68(3):196-203.
12. Rique GLN, Fernandes Filho GMC, Ferreira ADC, de
Sousa-Munoz RL. Relationship between chronotype
and quality of sleep in medical students at the Federal
University of Paraiba, Brazil. Sleep Sci 2014;7(2):96-102.
doi: 10.1016/j.slsci.2014.09.004
13. Preisegolaviciute E, Leskauskas D, Adomaitiene V.
Associations of quality of sleep with lifestyle factors and
profile of studies among Lithuanian students. Medicina
(Kaunas). 2010;46(7):482-9.
14. Assaad S, Costanian C, Haddad C, Tannous F. Sleep
patterns and disorders among university students in
Lebanon. J Res Health Sci 2014;14(3):198-204.
15. Lemma S, Gelaye B, Berhane Y, Worku A, Williams MA.
Sleep quality and its psychological correlates among
university students in Ethiopia: a cross-sectional study.
BMC Psychiatry. 2012;12(237):1-7. doi: 10.1186/1471-
244X-12-237
16. Kang JH, Chen SC. Effects of an irregular bedtime
schedule on sleep quality, daytime sleepiness, and fatigue
among university students in Taiwan. BMC Public Health
2009;9(248):1-6. doi: 10.1186/1471-2458-9-248
17. Cates ME, Clark A, Woolley TW, Saunders A. Sleep
quality among pharmacy students. Am J Pharm Educ
2015;79(1):1-6. doi: 10.5688/ajpe79109
18. Rique GLN, Fernandes Filho GMC, Ferreira ADC, de
Sousa-Munoz RL. Relationship between chronotype
and quality of sleep in medical students at the Federal
University of Paraiba, Brazil. Sleep Sci. 2014;7(2):96-102.
doi: 10.1016/j.slsci.2014.09.004
19. Felden EPG, Leite CR, Rebelatto CF, Andrade RD, Beltrame
TS. Sleep in adolescents of different socioeconomic status:
a systematic review. Rev Paul Pediatr. 2015;33(4):467-73.
doi: 10.1016/j.rpped.2015.01.011
20. Vuori I, Urponen H, Hasan J, Partinen M. Epidemiology
of exercise effects on sleep. Acta Physiol Scand Suppl.
1988;574:3-7.
21. Singh NA, Clements KM, Fiatarone MA. A randomized
controlled trial of the effect of exercise on sleep. Sleep
1997;20(2):95-101. doi: 10.1093/sleep/20.2.95
22. Higuchi S, Motohashi Y, Liu Y, Maeda A. Effects of
playing a computer game using a bright display on
pre-sleep physiological variables, sleep latency, slow
wave sleep and REM sleep. J Sleep Res. 2005;14(3):267-
273. doi: 10.1111/j.1365-2869.2005.00463.x

**Author Contribution:**

BO: Did data collection, statistical analysis and
manuscript writing.

BO: Is Responsible for the accuracy and integrity of
the research.

NMA: Conceived, designed and editing of
manuscript.