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Sleep hygiene and sleep quality in Iranian adolescents during the COVID-19 pandemic

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Abstract

Objectives Sleep is one of the issues that attracted the attention of researchers during the COVID-19 pandemic. Researchers focused their studies on the prevalence of sleep disorders, sleep quality, and sleep duration. Sleep hygiene is a set of guidelines that play an important role in the sleep quality, the present study sought to evaluate the amount of sleep hygiene and sleep quality in Iranian adolescents and their relationship during the COVID-19 pandemic.

Methods The present study was conducted using a cross-sectional design. The research population consisted of all adolescents living in Kermanshah (western Iran) in 2021. The participants were a sample of 610 adolescents. They completed the Pittsburgh Sleep Quality Inventory and Adolescent Sleep Hygiene Scale.

Results The mean sleep quality score for the participants was 7.14 ± 2.47 , indicating the high frequency of sleep problems affecting the participants. There were significant correlations between all components of sleep hygiene and sleep quality. There was also a significant correlation ($r = -0.46$ between sleep hygiene and sleep quality ($p < 0.001$). No significant difference was observed in sleep hygiene and sleep quality between the male and female adolescents. The results showed that sleep hygiene subscales can predict sleep quality ($R = 0.53$, $F = 39.20$, $p < .01$).

Conclusions The data in this study confirmed the poor observance of sleep hygiene in adolescents during the COVID-19 pandemic and reported frequent sleep problems among the participants. The results also indicated a moderate relationship between sleep hygiene and sleep quality in adolescents. Thus, sleep hygiene components can be related to sleep quality.

Keywords Sleep hygiene, Sleep quality, Adolescents, COVID-19

Introduction

The Covid-19 pandemic affected all people around the whole world and a large number of people lost their life due to the disease. The spread of this disease has forced

people to stay at home and retreat into isolation. This social isolation and worries about the COVID-19 outbreak and its psychological consequences had adverse effects on people's life [1]. Studies conducted in this field confirmed the prevalence of disorders such as anxiety, depression, and sleep problems [2]. These problems had many negative effects on adolescents. Disorders such as anxiety, depression, and stress were frequently reported in adolescents around the world [3]. Stressful life events, long-term confinement at home, sadness, domestic violence, and excessive use of the Internet and social media are factors that can affect the mental health of adolescents during this period [4]. Moreover, the closure of

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schools during the pandemic was also a problem that aggravated these consequences [5].

One of the issues that attracted the attention of researchers during the COVID-19 outbreak was the issue of sleep. Thus, researchers focused their studies on the prevalence of sleep disorders, sleep quality, and sleep duration [6–8]. Changes in educational programs and lifestyle changes were frequently reported during the pandemic, affecting the observance of sleep hygiene and, as a result, decreased sleep quality [8]. The importance of healthy sleep, especially at a young age, warrants further research in this field because healthy sleep is an essential part of normal growth and is especially important for health and developing learning abilities in school [9]. Besides, adequate sleep is vital for mental and physical health and plays an important role, especially in emotion regulation, cognition, psycho-social development, and physical development [10]. Healthy sleep also plays a vital role in public health [11]. On the other hand, inappropriate sleep patterns and sleep disorders cause a decrease in well-being, physical pain, a decrease in quality of life, and psychological disorders [12]. Sleep problems are associated with deliberate self-harm behaviors [10]. Furthermore, variables such as sleep quality and the severity of insomnia play a role in the occurrence of intentional non-suicidal self-injury (NSSI). Indeed, sleep problems can be considered a risk factor for NSSI [13]. In addition, decreased sleep quality can be associated with suicidal behaviors [14]. Accordingly, there is a need for further research on sleep quality, especially in critical situations [15].

Some have highlighted the significance of promoting and observing sleep hygiene as a protective factor contributing to preventing and managing infectious diseases [16]. The results of a study showed that the quality of sleep and sleep hygiene decreased during the COVID-19 pandemic, and emphasized that sleep hygiene is an issue that has been neglected during this period [17].

The role of gender in sleep-related research should be considered, the results of a study has shown that gender differences play a role in sleep quality and sleep hygiene, so that sleep quality is worse in girls, and the level of adherence to Sleep hygiene principles is less in girls [18]. Therefore, in the present study, the role of this difference was also investigated.

Adolescents have an undeniable role in the future and progress of the community. Thus, paying attention to their issues and problems, especially sleep problems and sleep hygiene is a serious and important matter. Furthermore, exploring sleep quality in adolescents can contribute to the development of human knowledge in this field. Identifying the factors affecting sleep problems can help us find solutions to improve the quality of sleep. On the

other hand, the COVID-19 pandemic and similar crises create stressful conditions for adolescents, which may adversely affect their sleep quality. Accordingly, the present study aimed to evaluate sleep problems and sleep hygiene in adolescents. In fact, this research sought to answer the following questions:

1. What was the state of sleep hygiene of Iranian adolescents during the corona pandemic period?
2. What was the state of sleep quality of Iranian adolescents during the corona pandemic period?
3. Is there a significant relationship between sleep hygiene and sleep quality in adolescents?
4. Can sleep hygiene predict sleep quality in adolescent?

Methods

Study design and participants

This study was conducted using a cross-sectional design. The research population consisted of all adolescents living in Kermanshah in 2021. According to the statistics released by the General Registry Office of Kermanshah Province, 421,266 adolescents were living in the province. The participants were selected from 11 to 18-year-old adolescents living in urban areas. In Morgan's table, the maximum sample size for a population with more than 100,000 members is reported to be 384 persons. However, to ensure the credibility of the findings, 610 adolescents living in urban areas were selected as the participants in this study. The questionnaires were distributed online and in electronic form in cooperation with 7 psychological experts in schools from all areas of the city and among available adolescents. The questionnaires were completed after explaining the objectives of the study and assuring the participants about the confidentiality of their personal information. Additionally, they were assured that their information would remain confidential, and their informed consent was taken. The criteria for enrolling the adolescents in the study were being 11–18 years old, the willingness to participate in the study, and accuracy in answering the items in the questionnaires. The exclusion criteria were not having specified psychiatric diseases affecting sleep, substance abuse, and taking drugs affecting sleep. Since this study was conducted during the COVID-19 pandemic and given restricted access to the participants, the questionnaires were completed by the participants online through social media and networks. The protocol for this study was registered in the Sleep Disorders Research Center of Kermanshah University of Medical Sciences in Iran and was approved by the ethics committee of the university with the code IR.KUMS.REC.1401.009.

Study instrument and variables assessment

The demographic questionnaire

The questionnaire assessed the participants' demographic characteristics including age, education, gender, history of smoking and drug use, history of medical diseases, family status, and the number of hours of playing with electronic devices in 24 h (such as Xbox, PS4, computers, mobile phones, etc.)

Adolescent sleep hygiene scale (ASHS)

Adolescent Sleep Hygiene Scale is a 28-item self-report scale. The items are scored on a six-point Likert scale: Never (1), rarely (2), usually (3), sometimes (4), most of the time (5), and always (6). ASHS was developed by LeBourgeois et al. [19]. The Cronbach's alpha for the whole scale was satisfactory, and its multidomain internal consistency, with Cronbach's alpha ranging from 0.37 to 0.74, was lower than the recommended levels [19]. The scale has been validated in Iran by Chehri et al. They reported Cronbach's alpha value of 0.71 to 0.75 for the scale and its reliability ranged from 0.82 to 0.87. A significant correlation was found between most of the revised Persian versions of the Adolescent Sleep Hygiene Scale (ASHS) and the Pittsburgh Sleep Quality Inventory. The results of this study indicated that the Persian version of the ASHS can be used as a reliable and valid tool to evaluate sleep hygiene practices among Persian-speaking adolescents [20]. A higher score on this scale indicates a higher level of sleep hygiene.

Pittsburgh sleep quality inventory (PSQI)

This 19-item instrument was developed by Buysse et al. [21] to measure sleep quality and help identify people who sleep well or badly. Cronbach's alpha was 0.83 for the internal consistency of the inventory. The items in this self-report instrument are completed within 5 min. The psychometric properties of the inventory were assessed by Farahi et al. [21] and its Cronbach's alpha was 0.77. The authors concluded that the psychometric properties of the Persian version of the PSQI are acceptable. Chehri et al. also validated the inventory by administering it to a sample of adolescents. Cronbach's alpha was 0.72, showing that the Persian version of the inventory has acceptable psychometric properties [21]. A higher score on this inventory means more sleep problems. This questionnaire has 19 statements, and the answers to these items are on a four-point Likert scale from 0 to 3. A score of zero is given for the option of never, a score of one for the option of less than once a week, a score of two for the option of once or twice a week, and a score of 3 for the option of three or more times a week. And to evaluate the sleep quality, a score of zero is given for a very good

option, a score of one for a relatively good option, a score of two for a relatively bad option, and a score of 3 for a very bad option.

Data analysis

The collected data were analyzed using SPSS-22 software. Mean and standard deviation indices were used to describe the data. Pearson's correlation test was performed to investigate the relationship between sleep hygiene and sleep quality. To interpret the correlation coefficients, we considered values below 0.40 as weak correlation, between 0.40 and 0.70 as moderate correlation, and above 0.70 as strong correlation [22]. Moreover, multivariate regression analysis was run to predict sleep quality based on sleep hygiene. The one-way analysis of variance (ANOVA) was also used to compare the mean scores among the groups. To check normality of the data, the Kolmogorov Smirnov test was used and the results showed a normal distribution. It should be mentioned that the significance level was considered $p < 0.05$ for all statistical tests.

Results

The participants in this study were 610 adolescents including 336 females (55.1%) and 274 males (44.9%). The participants' mean age was 15.01 ± 2.13 years. The results also showed that participants used electronic devices for 6.37 ± 5.01 h per day. Table 1 shows the descriptive statistics or various aspects of sleep problems by gender:

As can be seen in the table above, the mean score for sleep problems reported by the participants through the Pittsburgh Sleep Quality Inventory was 7.14 ± 2.47 . Besides, there was no statistically significant difference between the male and female participants. However, this value shows poor sleep quality among the adolescents in this study. A comparison of the sleep quality subscales indicated that, except for the sleep latency component, there was no significant difference between the male and female participants.

Table 2 shows the descriptive statistics for various subscales of sleep hygiene by gender:

As shown in Table 2, the mean score of sleep hygiene for the participants is 101.90 ± 17.04 , indicating no significant difference between the male and female participants. However, a comparison of subscales of sleep hygiene suggested some differences between the male and female participants in terms of behavioral arousal, daytime sleep, and sleep stability, and the females obtained higher scores on these sleep hygiene subscales. By converting the scores of each participant to the mean, the ASHS mean score for all participants was 4.25 ± 0.71 , indicating poor sleep hygiene among the participants.

Table 1 Comparison of sleep problems in each domain among male and female groups

Domains	Total (M ± SD)	Male (M ± SD)	Female (M ± SD)	F	df	p-value	Effect size
Sleep latency	1.70 ± 1.01	1.57 ± 0.96	1.86 ± 1.05	11.94	1	0.001	0.019
Sleep disturbances	0.96 ± 0.50	0.96 ± 0.52	0.97 ± 0.45	0.061	1	0.803	0.001
Sleeping medication	0.22 ± 0.59	0.21 ± 0.79	0.24 ± 0.58	0.280	1	0.608	0.001
Daytime dysfunction	0.67 ± 0.79	0.69 ± 0.79	0.63 ± 0.80	1.06	1	0.303	0.002
Subjective sleep quality	1.03 ± 0.95	0.97 ± 0.92	1.10 ± 1	2.532	1	0.094	0.004
Sleep efficiency	2.55 ± 0.79	2.57 ± 0.78	2.54 ± 0.80	0.059	1	0.741	0.001
Sleep duration	5.44 ± 1.12	5.46 ± 1.13	5.42 ± 1.12	0.176	1	0.633	0.001
Sleep quality (total)	7.14 ± 2.47	6.98 ± 2.51	7.34 ± 2.40	3.125	1	0.078	0.005

M Mean, SD Standard deviation, F Fisher's F index value, df Degrees of freedom

Table 2 Comparison of sleep hygiene in each domain among male and female

Domains	Total (M ± SD)	Female (M ± SD)	Male (M ± SD)	F	df	p-value	Effect size
Physiological	22.06 ± 4.24	22.09 ± 4.24	22.03 ± 4.26	0.015	1	0.854	0.001
Behavioral arousal	12.27 ± 4.10	12.58 ± 4.08	11.89 ± 4.09	18.411	1	0.041	0.030
Cognitive/emotional	23.39 ± 6.34	23.39 ± 6.27	23.41 ± 6.43	0.002	1	0.971	0.001
Daytime sleep	9.09 ± 2.61	9.28 ± 2.56	8.86 ± 2.63	2.896	1	0.044	0.005
Sleep environment	24.36 ± 4.71	24.56 ± 4.77	24.10 ± 4.64	1.858	1	0.227	0.003
Sleep stability	10.72 ± 4.007	10.41 ± 3.83	11.10 ± 4.18	1.953	1	0.036	0.003
Sleep hygiene (total)	101.90 ± 17.04	102.32 ± 17.44	101.39 ± 16.54	0.452	1	0.502	0.001

Table 3 An assessment of sleep hygiene and sleep quality in the participants

	Variable	Frequency	Percent	Explain
Sleep quality	0–5	155	25.4	Good sleeper
	5–21	455	74.6	Poor sleeper
Sleep hygiene	< 3.8	160	26.2	Poor sleep hygiene
	3.8–4.9	325	53.3	Mediocre sleep hygiene
	> 4.9	125	20.5	Good sleep hygiene

Table 3 shows an assessment of sleep hygiene in the participants.

According to the results in Table 3, 160 participants (26.2%) had poor sleep hygiene and 125 participants (20.5%) had good sleep hygiene. Data analysis also revealed that sleep quality was poor in 74.6% of the participants.

Table 4 presents the results of the Pearson's correlation test for the relationship between sleep hygiene and sleep quality, and their subscales:

As can be seen, there were significant correlations between all subscales of sleep hygiene and sleep quality, most of these correlations are less than 0.40, which

Table 4 correlation between sleep hygiene and sleep quality

Domains	r	P
Physiological	−0.29	0.001
Behavioral arousal	−0.31	0.001
Cognitive/emotional	−0.38	0.001
Daytime sleep	−0.42	0.001
Sleep environment	−0.29	0.001
Sleep stability	−0.13	0.001
Sleep hygiene (total)	−0.46	0.001

r Pearson correlation

are weak correlations. Moreover, there was a significant correlation ($r = -0.46$) between sleep hygiene and sleep quality ($p < 0.001$), It can be said that this correlation is moderate. In addition, there was a significant correlation ($r = 0.12$) between the hours of using electronic devices and sleep quality ($p < 0.05$), This is a weak correlation.

Multivariate regression analysis was run to predict sleep quality based on sleep hygiene subscales (Table 5). The results showed that sleep hygiene subscales can predict sleep quality ($R = 0.53$, $R^2 = 0.27$, $F = 39.20$, $p = 0.001$). Accordingly, sleep hygiene subscales can explain 28% of sleep quality changes.

Table 5 Multivariate regression analysis for predicting sleep quality

Domains	Regression ($R = 0.52$, $R^2 = 0.27$, $F = 36.59$)			
	B	β	t	p
Physiological	-0.09	-0.17	4.32	0.001
Behavioral arousal	-0.09	-0.16	4.008	0.001
Cognitive/emotional	-0.09	-0.22	5.34	0.001
Daytime sleep	-0.20	-0.28	4.89	0.001
Sleep environment	0.02	0.04	0.79	0.366
Sleep stability	0.009	0.05	0.43	0.201

B Unstandardized regression coefficient, β Standardized regression coefficient

Discussion

The current study investigated sleep problems and sleep hygiene in Iranian adolescents during the COVID-19 pandemic. The results showed that the adolescents had poor sleep quality and hygiene during the COVID-19 pandemic. There was also a significant relationship between sleep hygiene and sleep quality, indicating that the greater the compliance with sleep hygiene, the fewer sleep problems and the higher the quality of sleep.

The results of a study showed an increase in sleep time and sleep latency, a change in waking time, poor sleep quality, and more frequent insomnia symptoms during the COVID-19 outbreak [23]. A meta-analysis study also showed that sleep disturbances were more frequent during the COVID-19 pandemic [24]. Other studies also reported similar results [25–28]. A systematic meta-analysis review of 250 studies on about half a million participants indicated that the estimated prevalence of sleep disorders (including poor sleep quality and insomnia), independent of any other variable, was 40% across all ages during the COVID-19 pandemic. The data also presented the same overall estimate of sleep disturbance, ensuring that this is likely a reasonable estimate of sleep disturbance associated with COVID-19, and reported that children and adolescents were the second most affected group with the overall prevalence rate of sleep disorders of about 46% [29]. The results of another study reported the prevalence of sleep disorders in children and adolescents during the COVID-19 pandemic to be 54% [30]. Thus, the findings of the present study confirming the high prevalence of sleep problems were in line with other studies in the literature.

The results of a study in Iran before the COVID-19 pandemic showed that a significant percentage of school-age children have sleep problems, including resistance to falling asleep and waking up during the night, difficulty waking up in the morning, insufficient sleep, and breathing problems in sleep. Moreover, these problems

were more frequent in boys than in girls. The results also showed a significant relationship between sleep hygiene and sleep problems [9], as confirmed in the present study.

Sleep is a behavior that can be controlled by an individual during an epidemic outbreak. However, this is not a simple task because psychological worries and fear aggravate sleep problems [30]. New psychological concerns were reported by adolescents during the COVID-19 pandemic that may be related to sleep abnormalities [30]. Furthermore, anxiety, depression, irritability, impatience, inattention, and fear of COVID-19 were the predominant psychological problems during the COVID-19 pandemic [31] that could account for sleep problems.

The data in the present study showed that there is a relationship between non-observance of sleep hygiene and sleep problems, as reported in previous studies [32–34]. A review study showed that the components of sleep hygiene are associated with sleep quality [35]. An experimental study also showed a relationship between sleep hygiene and sleep quality in adolescents [36]. Sleep hygiene refers to routine practices that can facilitate and maintain quality sleep at night [37]. These practices include instructions for having a regular sleep and wake schedule, prohibiting activities that disrupt sleep, and managing thoughts and emotions before sleep. Hence, a person who adheres to these instructions can have a good sleep.

The findings of the present study also showed a relationship between the number of hours of using electronic devices and sleep quality among adolescents, indicating that the use of electronic devices such as mobile phones and tablets can be associated with sleep problems, as reported in previous studies [38–40].

Adolescence is a sensitive period and this period is associated with special psychological problems. On the other hand, cultural conditions have a great impact on psychological issues, considering that our study was conducted in Iran and this country has different cultural conditions from Western countries. We must keep these conditions in mind when explaining the results. Among these conditions is the issue of individual independence, which is not much considered by families in Iranian culture.

Limitation of the study

The sampling method in our research was not random and this is one of the limitations of the study. Also, the sample included urban adolescents and people living in rural areas were not included in the study. In fact, this study was conducted on a sample of Iranian adolescents living in urban areas. Thus, caution should be taken to generalize the results to other societies. Furthermore, this study employed a correlational design, so it was not

possible to infer cause-effect relationships between the variables. This study was also conducted using cross-sectional data, while sleep hygiene and sleep quality and its consequences need longitudinal studies to confirm the cause-and-effect relationship during the COVID-19 pandemic.

This research project was conducted on a large sample during the COVID-19 pandemic, which created stressful conditions for people in the community. Thus, the findings of this study can be of interest to therapists and planners.

Conclusion

The findings of the present study confirmed poor sleep hygiene and frequent sleep problems among adolescents during the COVID-19 pandemic. The results also showed a significant relationship between the observance of sleep hygiene and sleep quality in adolescents, and sleep hygiene components can predict sleep quality.

The findings of this study can have some implications for families and parents. Poor sleep quality and poor sleep hygiene in adolescents contribute to countless problems. Thus, parents need to receive adequate training on adolescent sleep hygiene. Moreover, counseling and psychotherapy centers can organize workshops and seminars on sleep hygiene and sleep quality and provide some instructions for adolescents to improve their sleep quality and hygiene.

Future researches should evaluate other components related to sleep quality in adolescents, it is also necessary to conduct all-round investigations (including psychological and sociological) in the field of sleep quality in adolescents.

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Author contributions

AC: designed the study. MS: collected the data. HK: statistical analysis and revised the manuscript. AZ: wrote the main manuscript text. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The protocol for this study was registered in the Sleep Disorders Research Center of Kermanshah University of Medical Sciences in Iran and was approved by the ethics committee of the university with the code IR.KUMS.

REC.1401.009, which was performed under the ethical principles laid down in the seventh and current edition (2013) of the Declaration of Helsinki. Written informed consent was obtained from all subjects and/or their legal guardian(s).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

- Schou TM, Joca S, Wegener G, Bay-Richter C. Psychiatric and neuropsychiatric sequelae of COVID-19—a systematic review. *Brain Behav Immun*. 2021;97:328–48.
- Rogers JP, Chesney E, Oliver D, Pollak TA, McGuire P, Fusar-Poli P, et al. Psychiatric and neuropsychiatric presentations associated with severe coronavirus infections: a systematic review and meta-analysis with comparison to the COVID-19 pandemic. *Lancet Psychiatry*. 2020;7(7):611–27.
- Jones EA, Mitra AK, Bhuiyan AR. Impact of COVID-19 on mental health in adolescents: a systematic review. *Int J Environ Res Public Health*. 2021;18(5):2470.
- Guessoum SB, Lachal J, Radjack R, Carretier E, Minassian S, Benoit L, et al. Adolescent psychiatric disorders during the COVID-19 pandemic and lockdown. *Psychiatry Res*. 2020;291:113264.
- Tang S, Xiang M, Cheung T, Xiang Y-T. Mental health and its correlates among children and adolescents during COVID-19 school closure: the importance of parent-child discussion. *J Affect Disord*. 2021;279:353–60.
- Luciano F, Cenacchi V, Vegro V, Pavei G. COVID-19 lockdown: physical activity, sedentary behaviour and sleep in Italian medicine students. *Eur J Sport Sci*. 2021;21(10):1459–68.
- Xiao H, Zhang Y, Kong D, Li S, Yang N. The effects of social support on sleep quality of medical staff treating patients with coronavirus disease 2019 (COVID-19) in January and February 2020 in China. *Med Sci Monit Int Med J Exp Clin Res*. 2020;26:e923549–51.
- Eleftheriou A, Rokou A, Arvaniti A, Nena E, Steiropoulos P. Sleep quality and mental health of medical students in Greece during the COVID-19 pandemic. *Front Public Health*. 2021. <https://doi.org/10.3389/fpubh.2021.775374>.
- Khazaie H, Zakiei A, Rezaei M, Komasi S, Brand S. Sleep pattern, common bedtime problems, and related factors among first-grade students: epidemiology and predictors. *Clin Epidemiol Glob Health*. 2019;7(4):546–51.
- Khazaie H, Zakiei A, McCall WV, Noori K, Rostampour M, SadeghiBahmani D, et al. Relationship between sleep problems and self-injury: a systematic review. *Behav Sleep Med*. 2021;19(5):689–704.
- Khazaie H, Zakiei A, Rezaei M, Hoseini SM, Alikhani M. Emotional dysregulation leads to reduced sleep quality when the level of repetitive negative thoughts is high: findings of a structural equation model. *Iran J Psychiatry Behav Sci*. 2019;13(1):1–9.
- Fortier-Brochu É, Beaulieu-Bonneau S, Ivers H, Morin CM. Relations between sleep, fatigue, and health-related quality of life in individuals with insomnia. *J Psychosom Res*. 2010;69(5):475–83.
- Zakiei A, Khazaie H, Moradi F, Komasi S. Effects of combined profiles derived from sleep quality and disorders on non-suicidal self-injury (NSSI) Behaviors/Uyku Kalitesi ve Bozukluklarından Elde Edilen Kombine Profililerin Intihar Disi Kendine Zarar Verme (NSSI) Davranislarini Uzerindeki Etkileri. *J Turk Sleep Med*. 2020;7(3):169–75.
- Khazaie H, Khazaie S, Zakiei A, Dürsteler KM, Brühl AB, Brand S, et al. When non-suicidal self-injury predicts non-suicidal self-injury and poor sleep—results from a larger cross-sectional and quasi-longitudinal study. *Int J Environ Res Public Health*. 2021;18(24):13011.
- Khazaie H, Zakiei A, Komasi S. A simultaneous cluster analysis of cognitive, emotional, and personality factors and insomnia and sleep quality among earthquake victims. *Disaster Med Public Health Prep*. 2019;13(4):745–52.

16. Garbarino S, Scoditti E. On the role of sleep hygiene in health management during COVID-19 pandemic. *Sleep Med.* 2021;77:74.
17. Mahadule AA, Mittal S, Khapre M, Goel A, Patil PM, Mohan L. Sleep quality and sleep hygiene in preclinical medical students of tertiary care center amidst COVID-19 pandemic: a cross-sectional observational study. *J Rural Med.* 2022;17(3):137–42.
18. Galland BC, Gray AR, Penno J, Smith C, Lobb C, Taylor RW. Gender differences in sleep hygiene practices and sleep quality in New Zealand adolescents aged 15 to 17 years. *Sleep Health.* 2017;3(2):77–83.
19. LeBourgeois MK, Giannotti F, Cortesi F, Wolfson AR, Harsh J. The relationship between reported sleep quality and sleep hygiene in Italian and American adolescents. *Pediatrics.* 2005;115:257–65.
20. Chehri A, Khazaie H, Eskandari S, Khazaie S, Holsboer-Trachsler E, Brand S, et al. Validation of the Farsi version of the revised Adolescent sleep hygiene scale (ASHSr): a cross-sectional study. *BMC Psychiatry.* 2017;17(1):1–11.
21. Chehri A, Nourozi M, Eskandari S, Khazaie H, Hemati N, Jalali A. Validation of the persian version of the pittsburgh sleep quality index in elderly population. *Sleep Sci.* 2020;13(2):119.
22. Schober P, Boer C, Schwarte LA. Correlation coefficients: appropriate use and interpretation. *Anesth Analg.* 2018;126(5):1763–8.
23. Marelli S, Castelnuovo A, Somma A, Castronovo V, Mombelli S, Bottoni D, et al. Impact of COVID-19 lockdown on sleep quality in university students and administration staff. *J Neurol.* 2021;268(1):8–15.
24. Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, et al. The prevalence of depressive symptoms, anxiety symptoms and sleep disturbance in higher education students during the COVID-19 pandemic: a systematic review and meta-analysis. *Psychiatry Res.* 2021;301:113863.
25. Peixoto KO, Resende CMBMD, Almeida EOD, Almeida-Leite CM, Conti PCR, Barbosa GAS, et al. Association of sleep quality and psychological aspects with reports of bruxism and TMD in Brazilian dentists during the COVID-19 pandemic. *J Appl Oral Sci.* 2021. <https://doi.org/10.1590/1678-7757-2020-1089>.
26. Korkmaz S, Kazgan A, Çekiç S, Tartar AS, Balcı HN, Atmaca M. The anxiety levels, quality of sleep and life and problem-solving skills in healthcare workers employed in COVID-19 services. *J Clin Neurosci.* 2020;80:131–6.
27. Wang S, Xie L, Xu Y, Yu S, Yao B, Xiang D. Sleep disturbances among medical workers during the outbreak of COVID-2019. *Occup Med.* 2020;70(5):364–9.
28. Tosun A, Tosun H, ÖdülÖzkaya B, Erdoğan Z, Gül A. Sleep quality and depression level in nurses in COVID-19 pandemic. *OMEGA-J Death Dying.* 2022. <https://doi.org/10.1177/00302228221123159>.
29. Jahrami HA, Alhaj OA, Humood AM, Alenezi AF, Fekih-Romdhane F, AlRasheed MM, et al. Sleep disturbances during the COVID-19 pandemic: a systematic review, meta-analysis, and meta-regression. *Sleep Med Rev.* 2022. <https://doi.org/10.1016/j.smrv.2022.101591>.
30. Sharma M, Aggarwal S, Madaan P, Saini L, Bhutani M. Impact of COVID-19 pandemic on sleep in children and adolescents: a systematic review and meta-analysis. *Sleep Med.* 2021;84:259–67.
31. Panda PK, Gupta J, Chowdhury SR, Kumar R, Meena AK, Madaan P, et al. Psychological and behavioral impact of lockdown and quarantine measures for COVID-19 pandemic on children, adolescents and caregivers: a systematic review and meta-analysis. *J Trop Pediatr.* 2021;67(1):fmaa122.
32. Van der Heijden K, Stoffelsen R, Popma A, Swaab H. Sleep, chronotype, and sleep hygiene in children with attention-deficit/hyperactivity disorder, autism spectrum disorder, and controls. *Eur Child Adolesc Psychiatry.* 2018;27(1):99–111.
33. Knufinke M, Nieuwenhuys A, Geurts SA, Coenen AM, Kompier MA. Self-reported sleep quantity, quality and sleep hygiene in elite athletes. *J Sleep Res.* 2018;27(1):78–85.
34. Rebello LJ, Roberts AW, Fenuta AM, Cote AT, Bodner ME. Sleep quality and sleep behaviors in varsity athletes: a pilot study. *Front Sports Act Living.* 2022;4:1–7.
35. Hall WA, Nethery E. What does sleep hygiene have to offer children's sleep problems? *Paediatr Respir Rev.* 2019;31:64–74.
36. Lawless C, Turner EM, LeFave E, Koinis-Mitchell D, Fedele DA. Sleep hygiene in adolescents with asthma. *J Asthma.* 2020;57(1):62–70.
37. Grady A, Dodds P, Jones J, Wolfenden L, Yoong S. Prevalence of night sleep duration, sleep quality and sleep hygiene practices among children attending childcare services in New South Wales, Australia. *J Paediatr Child Health.* 2019;55(1):59–65.
38. Exelmans L, Van den Bulck J. Bedtime mobile phone use and sleep in adults. *Soc Sci Med.* 2016;148:93–101.
39. Mohammadbeigi A, Absari R, Valizadeh F, Saadati M, Sharifimoghdam S, Ahmadi A, et al. Sleep quality in medical students; the impact of over-use of mobile cellphone and social networks. *J Res Health Sci.* 2016;16(1):46.
40. Hale L, Guan S. Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep Med Rev.* 2015;21:50–8.

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