Original Research / Orijinal Araştırma

Evaluation of The Effect of Using Devices Emitting Blue Light On The Total Sleep Duration of 1-3-Year-Old Children

1-3 Yaşındaki Çocukların Toplam Uyku Sürelerine Mavi Işık Yayan Cihaz Kullanımının Etkisinin Değerlendirilmesi

Kübra Koçyiğit Gültepe[1], Dilek Cingil[2]

Abstract

Objective: This study was descriptively and relationally performed to determine the factors associated with blue light exposure in children aged 1 to 3 years and their total sleep duration. Methods: A total of 323 mothers with children aged 1 to 3 years were included in the study. As a data collection tool, a questionnaire was used to evaluate sociodemographic characteristics, exposure to blue light, and total sleep time, which was prepared for mothers of children aged 1-3. Results: A statistically significant difference was found ($p<0.05$) between the total duration of sleep and the child having his/her bed, presence of a tablet belonging to the child, presence of a blue-light-emitting electronic device, and a blue-light-emitting illuminator in the child's room, whether the mother allows her child to use a smartphone and whether the child uses a blue-light-emitting electronic device in the dark right before going to sleep. Based on the multiple regression analysis results, Sociodemographic variables have affected sleep duration at a rate of 6.6% in Model 1 and 16.5% in Model 2, in which characteristics related to the use of blue-light-emitting devices were also added. Conclusion: The usage of the blue-light-emitting device is becoming an increasingly significant public health problem, and effective measures should be taken and implemented to prevent this problem from worsening.

Key words: Children, Screen time, Sleep

Özet

Amaç: Bu çalışma 1-3 yaş arası çocuklarda mavi ışığa maruziyet ile ilişkili faktörleri ve toplam uyku sürelerini belirlemek amacıyla tanımlayıcı ve ilişkisel olarak yapılmıştır. Yöntemler: Çalışmaya 1-3 yaş arası çocuğu olan toplam 323 anne dahil edildi. Veri toplama aracı olarak 1-3 yaş arası çocukların annelerine yönelik hazırlanmış olan sosyodemografik özellikler, mavi ışığa maruziyet ve toplam uyku sürelerini değerlendiren anket formu kullanılmıştır. Bulgular: Çocuğun toplam uyku süresi ile kendi yatağına sahip olması, çocuğa ait tablet varlığı, mavi ışık yayan elektronik cihaz varlığı, çocuğun odasında mavi ışık yayan aydınlatıcı varlığı, annenin çocuğunun akıllı telefon kullanmasına izin verme durumu ve çocuğun yatmadan hemen önce karanlıkta mavi ışık yayan elektronik cihaz kullanma durumu arasında istatistiksel olarak anlamlı fark bulundu ($p<0.05$). Çoklu regresyon analizi sonuçlarına göre sosyodemografik değişkenler Model 1'de uyku süresini % 6,6, mavi ışık yayan cihaz kullanımına ilişkin özelliklerin de eklendiği Model 2'de uyku süresini %16.5 oranında etkilemiştir. Sonuç: Mavi ışık yayan cihaz kullanımı giderek daha önemli bir halk sağlığı sorunu haline gelmekte ve bu sorunun daha da kötüleşmemesi için etkin önlemler alınmalı ve uygulanmalıdır.

Anahtar kelimeler: Çocuklar, Ekran süresi, Uyku

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[1]Karaman Kazımkarabekir İlçe Devlet Hastanesi / Türkiye
[2]Necmettin Erbakan Üniversitesi / Türkiye

Address for Correspondence / Yazışma Adresi: Kübra Koçyiğit Gültepe, Necmettin Erbakan Üniversitesi, Türkiye
kc.0107@hotmail.com

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Introduction

The period of 1–3 years of age is known as the early childhood and play-age childhood period.[1] During this period, children express interest in moving and visual objects. Devices that emit blue light such as television (TV), smartphones, computers, and tablets, all of which have visual components, attract the attention of children in this period.[2,3] Blue light is a short wavelength of light that is emitted to increase the efficiency and brightness of devices such as computers, tablets, smartphones, TVs, and LED-based illuminators but it negatively affects sleep.[4,5] This inhibits the secretion of the hormone melatonin that helps with sleep, thereby disrupting the sleep-wake cycle which is the most well-known circadian rhythm of the human body.[6] Sleep is defined as a state of unconsciousness from which an individual can be woken up by stimuli such as sound and light.[7] In this study, the total sleep duration of the child was evaluated. Total sleep duration is the remaining time after sleep time (daytime sleep + night sleep) subtracted from night-time wakefulness.[8] Although there are few studies in the literature on blue light exposure in children aged 1–3 years in Turkey and the rest of the world, different terms have been used in these studies instead of blue-light-emitting electronic devices, screen exposure,[3] such as electronic media,[9] screen light,[10] digital technology,[11] electronic devices,[12] digital media,[13] and self-emitting devices,[14] and the relationship of these devices with sleep has been investigated. There are limited studies on the effect of blue light on sleep,[4,6] the effect of blue light on wakefulness and mood at night[15] and the effect of the use of blue-light-emitting devices during the day and in the evening.[16]

This descriptive and relational study aimed to investigate the effect of blue light exposure on total sleep duration in children aged 1–3 years. This age group was included in the study because these children are exposed to blue-light-emitting devices in the early stages of life. Unlike other studies, this study that examined the effect of blue-light-emitting devices on total sleep duration also assessed all the variables of day-time sleep duration, night-time sleep duration, total sleep duration, duration of sleep onset, number of awakenings, and wake after sleep onset.

Methods

Study Design

This is a descriptive and correlational study conducted to investigate the effect of blue light exposure on total sleep duration in children aged 1–3 years. In the regression analysis, the characteristics of the use of blue-light-emitting devices were evaluated together with the sociodemographic variables.

Study Location

The study was performed at 10 different family healthcare centers within the central district of Karaman province in Turkey between January and March 2018.

Study Sample

The sample size of the study was determined using a table recommended for 'the estimation with certain accuracy of the ratio in a population.[17] Regarding the prevalence of sleep disorder in children, the rate (20%–30%) reported by Bruni and Novelli was used.[18] The reported rate was considered to be 30%, and the sample size reported in the table at 95% confidence level and 5% relative precision was found to be 323.[17] The cluster and proportional sampling methods were used for sample selection. Each of the 10-family healthcare centers in the city center represented a single cluster. The calculated sample size was then proportioned to the total population of children aged 1–3 years in the clusters. The study was conducted with mothers who visited the family healthcare centers and provided consent to participate in the survey. The study included mothers of healthy children aged 1–3 years who did not have any medical conditions such as nasal congestion, urinary tract infection, and congenital anomaly/disability and who did not use any medication when the surveys were administered.

Data Collection Tools

The 'Blue Light Exposure and Total Sleep Duration in 1–3-Year-old Children Questionnaire' was developed based on a literature review and used for data collection.[19,20] The questionnaire consists of 37 items regarding the following: (a) sociodemographic characteristics such as age, sex, number of children, breastfeeding period, parents' age, education, employment status, and family type; (b) sleep characteristics such as sleep latency, bedtime and waking time, wake after sleep onset and place and type of sleep and (c) questions on the presence

of tablets belonging to the child, presence of blue-light-emitting electronic devices at home and in the child's room and use of blue-light-emitting devices by the child during the day, in the evening and before bedtime.

Study Variables

The dependent variable of the study was total sleep duration. In the study, total sleep duration was obtained by subtracting the wakefulness period during the night from sleep duration (day-time sleep + night-time sleep).[8] The independent variables of the study were the child's sex, breastfeeding status, presence of blue-light-emitting electronic devices, presence of blue-light-emitting electronic devices at home, usage of blue-light-emitting devices, mother's permission to use blue-light-emitting electronic devices, the age, the use of blue-light-emitting devices in a dark environment before bedtime, the use of blue-light-emitting LEDs as lighting and how the child sleeps.

Ethical Compliance

Before conducting the study, approval was obtained from the Ethics Committee for Non-Drug and Non-Medical Device Studies (Decision No.: 2017/1101) of the Necmettin Erbakan University Meram Medical Faculty, and the necessary official permissions were obtained from the Turkish Ministry of Health's Karaman Provincial Health Directorate for the institutions in which the study was conducted. Written and verbal informed consents were obtained from all participants.

Statistical Analysis

Sociodemographic and sleep characteristics and certain characteristics related to blue light exposure were compared with total sleep duration. Because total sleep duration shows a normal distribution, the Independent Samples Test was used to compare two independent groups and the One-Way ANOVA test was used to compare three or more independent groups. In the study, hierarchical multiple regression analysis was used to determine the predictive ability of sociodemographic variables and variables related to the use of blue-light-emitting devices, which were determinants of total sleep duration. A 95% confidence level and 0.05 error margin were considered in the interpretation of all analyses.

1. Presence of a tablet belonging to the child (No = 0, Yes = 1)
2. Presence of a blue-light-emitting electronic device in the child's room (No = 0, Yes = 1)
3. Presence of a blue-light-emitting electronic illuminator in the child's room (No = 0, Yes = 1)
4. Use of blue-light-emitting electronic devices by the child in darkness before bedtime (No = 0, Yes = 1)

Results

The effect of sociodemographic characteristics, sleep characteristics, and certain characteristics related to blue light exposure on total sleep duration was investigated. No significant difference was found in total sleep duration with respect to sex, the presence of the child's room, mother's employment status, first day-time sleep, how the child falls asleep for the first day-time sleep, the second day-time sleep, how the child falls asleep for the second day-time sleep, how the child falls asleep during the night-time sleep, mother allowing the child to watch TV, mother allowing the child to use a tablet, mother allowing the child to use a computer and mothers' response to the question of whether blue-light-emitting devices affect the child's sleep or not ($p>0.05$). A significant difference was found in total sleep duration with respect to the presence of the child's bed, presence of a tablet belonging to the child, presence of a blue-light-emitting device and blue-light-emitting illuminator in the child's room, mother allowing the child to use a smartphone and the child using blue-light-emitting electronic devices in the darkness just before bedtime ($p<0.05$). (Table I)
A low level of positive and statistically significant correlation was found between total sleep time and among breastfeeding time ($r = 0.137$, $p=0.029$), father's age ($r = 0.154$, $p= 0.046$) and father's education time ($r=0.117$, $p=0.008$).

Table 1. Comparison of Sociodemographic and Sleep Characteristics and Certain Characteristics Related to Blue Light Exposure with Total Sleep Duration (n = 323)

VARIABLES		X̄±SD	t	p
Gender				
	Female	8.8±1.3	0.333	0.740*
	Male	8.7±1.2		
Child's room				
	Yes	8.8±1.2	0.748	0.455*
	No	8.7±1.3		
Child bed				
	Yes	8.7±1.2	−2.224	**0.027***
	No	9.6±1.5		
Mother's employment status				
	Yes	8.6±1.2	-1.140	0.255*
	No	8.8±1.3		
Caregiver of the child				
	No caregiver	8.7±1.2	0.873	0.419**
	Relative	8.9±1.1		
	Paid caregiver	8.8±1.3		
First day-time sleep				
	Yes	8.7±1.2	−0.513	0.608*
	No	8.8±1.2		
How the child falls asleep for the first day-time sleep				
	No first day-time sleep	8.8±1.2	0.517	0.597**
	Other[&]	8.8±1.3		
	With a blue-light-emitting device	8.6±1.1		
Second Day-time Sleep				
	Yes	8.6±1.4	−0.674	0.501*
	No	8.8±1.2		
How the child falls asleep for the second day-time sleep				
	No second day-time sleep	8.8±1.2	1.146	0.319**
	Other[&]	8.2±1.3		
	With a blue-light-emitting device	8.8±1.4		
How the child falls asleep during the night				
	Other[&]	8.7±1.3	0.125	0.901*
	With a blue-light-emitting device	8.7±1.2		
Tablet belonging to the child				
	Yes	8.3±1.2	−3.399	**0.001***
	No	8.9±1.2		
Blue-light-emitting electronic device in child's room				
	Yes	8.5±1.3	−2.370	**0.018***
	No	8.9±1.2		
Blue-light-emitting illuminator in child's room				
	Yes	8.5±1.2	−3.953	**0.000***
	No	9.1±1.2		

* Independent Samples Test, **One-Way ANOVA

([&]Other: In the child's bed, by swinging in the child's bed, by swinging while standing, by singing a lullaby, in the parents' bedroom)

Table 1. Continued Comparison of Sociodemographic and Sleep Characteristics and Certain Characteristics Related to Blue Light Exposure with Total Sleep Duration (n = 323)

VARIABLES		X̄±SD	t	p
Does the mother allow the child to watch television?				
	Yes	8.7±1.2	−1.550	0.122*
	No	9.7±1.6		
Does the mother allow the child to use a tablet?				
	Yes	8.7±1.3	−0.205	0.837*
	No	8.8±1.2		
Does the mother allow the child to use a smartphone?				
	Yes	8.7±1.3	−2.576	**0.011***
	No	9.0±0.9		
Does the mother allow the child to use a computer?				
	Yes	8.8±1.5	0.035	0.972*
	No	8.7±1.2		
Exposure of child to the blue-light-emitting electronic device in the darkness just before bedtime				
	Yes	8.4±1.2	−3.379	**0.001***
	No	8.9±1.2		
Blue-light-emitting devices affecting your child's sleep				
	Yes	8.8±1.3	1.008	0.314*
	No	8.6±1.2		

* Independent Samples Test, **One-Way ANOVA

([&]Other: In the child's bed, by swinging in the child's bed, by swinging while standing, by singing a lullaby, in the parents' bedroom)

Table 2. Determinants of Total Sleep Duration (hierarchical multiple regression analysis)

	β	t	p
Model-1 Sociodemographic variables			
Constant		13.269	**<0.001**
Breastfeeding time	0.116	2.097	**0.037**
Presence of the child's bed (0 = No. 1 = Yes)	−0.135	−2.476	**0.014**
Father's age	0.123	2.213	**0.028**
Father's education level (in years)	0.122	2.242	**0.026**
Model 1	**R = 0.257**	**R^2 = 0.066**	**F = 5.641, p<0.001**
Model-2 Sociodemographic variables and variables related to blue-light-emitting devices			
Constant		10.141	**<0.001**
Breastfeeding time	0.137	2.564	**0.011**
Presence of the child's bed (0 = No, 1 = Yes)	−0.118	−2.248	**0.025**
Father's age	0.146	2.650	**0.008**
Father's education level (in years)	0.112	2.127	**0.034**
Tablet belonging to child (0 = No, 1 = Yes)	−0.175	−2.469	**0.014**
Blue-light-emitting electronic device in child's room (0 = No,1 = Yes)	0.022	0.312	0.756
Blue-light-emitting illuminator in child's room (0 = No, 1 = Yes)	−0.158	−2.943	**0.003**
Smartphone belonging to the mother (0 = No,1 = Yes)	−0.052	−0.974	0.331
Does the mother allow the child to use a smartphone? (0 = No, 1 = Yes)	−0.042	−0.756	0.450
Child using a blue-light-emitting electronic device in darkness before bedtime (0 = No,1 = Yes)	−0.122	−2.167	**0.031**
Model 2	**R = 0.406**	**R^2 = 0.165**	**F = 6.164, p<0.001**

(Constant: Total sleep duration)

In Table II, the determinants of total sleep duration were evaluated using the hierarchical multiple regression analysis. Sociodemographic variables were investigated in Model 1, and it was found that the duration of breastfeeding (β = 0.116), age of the father (β = 0.123), and father's education level in years (β = 0.122) affected the total sleep duration. In Model 2, characteristics related to the use of blue-light-emitting devices were analyzed together with sociodemographic characteristics, and it was found that the duration of breastfeeding (β = 0.137), age of the father (β = 0.146), father's education level in years (β = 0.112), presence of a tablet belonging to the child (β = -0.175), presence of a blue-light-emitting illuminator in the child's room (β = -0.158) and the use of blue-light-emitting electronic devices by the child in darkness before bedtime (β = -0.122) affected total sleep duration.

Discussion

The effect of blue-light-emitting devices on total sleep duration was investigated in this study, and the day-time sleep duration, night-time sleep duration, total sleep duration, sleep latency, number of awakenings, and wake after sleep onset were evaluated. The most important and primary result of the study was the correlation between blue light exposure and total sleep duration. In a study conducted with toddlers, it was stated that the use of devices blue-light-emitting sleep latency affects total sleep duration.[21]

There was no significant difference in total sleep duration with respect to first-day-time sleep, second-day-time sleep, night-time sleep, and how the child fell asleep. In their study, Cheung et al. found that day-time sleep duration, night-time sleep duration, and the use of blue-light-emitting electronic devices before sleep affected total sleep duration.[2] In a study, it was determined that the time spent by the child on the screen was related to the time of falling asleep.[22] In the present study, no statistically significant difference was found in total sleep duration with respect to the mother's permission to watch TV and use tablets and computers; however, there was a statistically significant difference between the mother's permission to use a smartphone and the child's sleep is negatively affected.

In a study conducted on preschool children, it was found that parents' permission to use TV and computers changed and negatively affected their sleep patterns.[23] The difference between this study from other studies was that the child's second daytime sleep was evaluated and the use of all blue-light-emitting devices and the mother's permission status were questioned in the study.

In the present study, no correlation was found between the time spent using blue-light-emitting electronic devices after dark by children and total sleep duration. It has been found that exposure to blue light after dark and during the night shortens the duration of sleep and increases wakefulness.[6,24,25] In a study conducted on children and adolescents, it was found that the use of electronic media after dark was associated with an increase in sleep problems.[26] The use of blue-light-emitting electronic devices in the evening was found to be associated with sleep disturbances in humans owing to the suppression of the hormone melatonin.[27]

Based on the results of the hierarchical multiple regression analysis, the predictive power of sociodemographic characteristics on total sleep duration was investigated. Sociodemographic variables affected sleep duration at a rate of 6.6%. Predictive power increased from 6.6% to 16.5% in Model 2 when characteristics related to the use of blue-light-emitting devices were included. The results of the present study show that blue light exposure negatively affects total sleep duration. Studies have found that the use of devices blue-light-emitting affects total sleep duration.[28,29] Unlike other studies, sociodemographic variables were also mentioned.

Conclusion

In conclusion, it can be recommended that parents should have sufficient information regarding these devices; they should keep the child away from electronic devices that emit blue light and establish a sleeping routine for the child. The data of this study were not collected during the pandemic period. However, the COVID-19 outbreak has also caused children to spend more time at home in recent years. This situation has increased the use of electronic devices emitting blue light. Thus, it is predicted that children's sleep problems will increase. Parents should not expose their children to electronic devices that emit blue light until at least 3 years of age and allow their children to spend time with groups of peers to reduce their exposure to blue light. Parents should be informed that their children should not have blue-light-emitting electronic devices and illuminators in their room and that these devices may adversely affect the child's sleep. For children sleeping in their parent's room, it should be noted that blue-light-emitting electronic devices should not be kept on charging or plugged in during the night. Parents should not buy electronic devices such as tablets for children of this age group and should not allow the use of such devices. Parents are advised to limit the use of blue-light-emitting electronic devices themselves to set better examples for their children.

Limitations of this study
The research was carried out in 10 different family health centers affiliated with the Karaman Provincial Health Directorate in the center of Karaman province in Turkey. Therefore, the research findings can only be generalized to the family health centers participating in the research. While the mothers who participated in the study answered the questionnaire, it was observed that they tended to conceal whether they allowed their children to use devices emitting blue light because of the concern of social acceptability (in other words, they were anxious that such behavior would be perceived as negative or were guilty). Therefore, in-depth interviews can be conducted with mothers.

Contribution of the study to the literature
Children 1-3 years old use devices that emit blue light significantly. Electronic devices emitting blue light is shortened the total duration of sleep. Exposure to devices emitting blue light in a dark environment shortened the total duration of sleep. Health professionals working in primary health care centers should warn parents about protecting their children from blue light. Finally, there is a need for studies in different designs on this subject.

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Compliance With Ethical Standards
Ethical Approval
All procedures performed were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of Interest
The authors report no conflicts of interest.

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References
1. Ariani N, Intani TM, Sarli D, Poddar S. Psychosocial stimulation towards the development of toddler 1–3 years old. Mal J Med Health Sci. 2021;17(SUPP4):88-91.
2. Cheung CHM, Bedford R, Urabain IRSD, Simith AK, Smith TJ. Daily touchscreen use in infants and toddlers is associated with reduced sleep and delayed sleep onset. Sci Rep. 2017;13:1-7. https://doi.org/10.1038/srep46104
3. Duch H, Fisher EM, Ensari I, Harrington A. Screen time use in children under 3 years old: a systematic review of correlates. Int J Behav Nutr Phys Act. 2013;10:102. https://doi.org/10.7916/D8G15Z97
4. Gringras P, Middleton B, Skene DJ, Revel VL. Bigger, Brighter, Bluer-Better? Current light-emitting devices-adverse sleep properties and preventative strategies. Front Public Health. 2015;13(3):233. https://doi.org/10.3389/fpubh.2015.00233
5. Tosini G, Ferguson I, Tsubata K. Effects of blue light on the circadian system and eye physiology. Mol Vis. 2016;24(22):61-72. https://pubmed.ncbi.nlm.nih.gov/26900325/
6. Gordijn MCM, Beersma DGM, Rüger M, Daan S. The effects of blue light on sleepiness. Annual Proceedings of the Dutch Sleep-Wake Society. 2005;16:67-70.
7. Ball HL. Breastfeeding, Bed-sharing and infant sleep. Birth. 2003;30(3):181-8. https://doi.org/10.1046/j.1523-536X.2003.00243.x
8. Zhang Z, Okely AD, Pereira JR, Sousa-Sá E, Veldman SL, Santos, R. Associations of sleep characteristics with cognitive and gross motor development in toddlers. Sleep Health. 2022; 704. https://doi.org/10.1016/j.sleh.2022.04.001
9. Fossum IN, Nordnes LT, Storemark SS, Bjorvatn B, Pallesen S. The association between use of electronic media in bed before going to sleep and insomnia symptoms, daytime sleepiness, morningness, and chronotype. Behav Sleep Med. 2014;12(5):343-57. https://doi.org/10.1080/15402002.2013.819468
10. Heath M, Sutherland C, Bartel K, Gradisar M, Williamson P, Lovato N, et al. Does one hour of bright or short-wavelength filtered tablet screenlight have a meaningful effect on adolescents' pre-bedtime alertness, sleep, and daytime functioning?

Chronobiol Int. 2014;31(4):496–505. https://doi.org/10.3109/07420528.2013.872121
11. Mustafaoğlu R, Zirek E, Yasacı Z, Özdinçler AR. The negative effects of digital technology on children 's development and health. Addicta. 2018;5(2):227-47.
https://scholar.google.com/scholar?cluster=12471219321004835342&hl=tr&as_sdt=0,5
12. Nathanson AI, Beyens I. The relation between use of mobile electronic devices and bedtime resistance, sleep duration, and daytime sleepiness among pre-schoolers. Behav Sleep Med. 2018;16(2):202-19.
https://doi.org/10.1080/15402002.2016.1188389
13. Orzech KM, Grandner MA, Roane BM, Carskadon MA. Digital media use in the 2 h before bedtime is associated with sleep variables in university students. Comput Human Behav. 2016;55(A):43-50. https://doi.org/10.1016/j.chb.2015.08.049
14. Wood B, Rea MS, Plitnick B, Figueiro MG. Light level and duration of exposure determine. the impact of self-luminous tablets on melatonin suppression. Appl Ergon. 2013;44(2):237-40. https://doi.org/10.1016/j.apergo.2012.07.008
15. Nagare R, Plitnick B, Figueiro MG. Effect of exposure duration and light spectra on night time melatonin suppression in adolescents and adults. Light Res Technol. 2019;51(4):530- 43. https://doi.org/10.1177%2F1477153518763003
16. Van der Maren S, Moderie C, Duclos C, Paquet J, Daneault V, Dumont M. Daily profiles of light exposure and evening use of light-emitting devices in young adults complaining of a delayed sleep schedule. J Biol Rhythms. 2018;33(2):192-202.
https://doi.org/10.1177/0748730418757007
17. Lemeshow S, Hosmer DW, Klar J, Lwanga SK. Adequacy of sample size in health research. In: Kayaalp SO, editor. Turkey: Hacettepe Tas Publishing; 2000. p.143.
18. Bruni O, Novelli L. Sleep disorders in children. BMJ Clin Evid. 2010;27:2304.
https://pubmed.ncbi.nlm.nih.gov/21418676/
19. Owens JA, Spirito A, McGuinn M. The Children's Sleep Habits Questionnaire (CSHQ): Psychometric properties of a survey instrument for school-aged children. Sleep. 2001;23(8):1043-51. https://pubmed.ncbi.nlm.nih.gov/11145319/
20. Sneddon P, Peacock GG, Crowley SL. Assessment of sleep problems in preschool aged children: an adaptation of the children's sleep habits questionnaire. Behav Sleep Med. 2013;11(4):283-96. https://doi.org/10.1080/15402002.2012.707158
21. Chindamo S, Buja A, DeBattisti E, Terraneo A, Marini E, Gomez Perez LJ, et al. Sleep and new media usage in toddlers. Eur J Pediatr. 2019;178(4):483-490. https://doi.org/10.1007/s00431-019-03318-7
22. Waller NA, Zhang N, Cocci AH, D'Agostino C, Wesolek-Greenson S, Wheelock K, et al. Screen time use impacts low-income preschool children's sleep quality, tiredness, and ability to fall asleep. Child: Care, Health and Development. 2021;47(5):618-626. https://doi.org/10.1111/cch.12869
23. Güngör M. Pre-school children's watching television habits and parental attitudes. Mustafa Kemal University Journal of Graduate School of Social Sciences. 2014;28(11):199-216. https://dergipark.org.tr/tr/download/article-file/183381
24. Chahal H , Fung C, Kuhle S, Veugelers PJ. Availability and night-time use of electronic entertainment and communication devices are associated with short sleep duration and obesity among Canadian children. Pediatr Obes. 2013;8(1):42-51.
https://doi.org/10.1111/j.2047-6310.2012.00085.x
25. Iskra-Golec IM, Wazna A, Smith L. Effects of blue-enriched light on the daily course of mood, sleepiness and light perception: A field experiment. Light Res Technol. 2012;44(4):506–13. https://doi.org/10.1177%2F1477153512447528
26. Bruni O, Sette S, Fontanesi L, Baiocco R, Laghi F, Baumgartner E. Technology use and sleep quality in preadolescence and adolescence. J Clin Sleep Med. 2015;11(12):1433-41. https://doi.org/10.5664/jcsm.5282
27. Rangtell FH, Ekstrand E, Rapp L, Lagermalm A, Liethof L, Bucaro MO, et al. Two hours of evening reading on a self-luminous tablet vs. reading a physical book does not alter sleep after daytime bright light exposure. Sleep Med. 2016;23:111-18. https://doi.org/10.1016/j.sleep.2016.06.016
28. Olteanu-Pascal D, Lupușor N, Nadejda. The influence of light from gadgets on circadian rhythm in children. MedEspera; 2020. p.248-249.
29. Shechter A, Quispe KA, Mizhquiri Barbecho JS, Slater C, Falzon L. Interventions to reduce short-wavelength ('blue') light exposure at night and their effects on sleep: A systematic review and meta-analysis. Sleep Advances. 2020;1(1):zpaa002.
https://doi.org/10.1093/sleepadvances/zpaa002