International Journal of Community Medicine and Public Health
Chahine K et al. Int J Community Med Public Health. 2023 Apr;10(4):1342-1349
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20230909

Original Research Article

Effect of screen time use and digital technology on sleep pattern in Lebanese college students

Krystel Chahine[1], Annick Pelletier[2], Nathalie Chahine[2,3]*

[1]Faculty of Medical Sciences, Lebanese University, Lebanon and Nimes University Hospital, Nimes, France.
[2]Centre d'Essais Précoces en Cancérologie de Marseille (CLIPP CEPCM), La Timone University Hospital, Marseille, France.
[3]Faculty of Public Health, Lebanese University, Lebanon

Received: 15 February 2023
Accepted: 15 March 2023

***Correspondence:**
Dr. Nathalie Chahine,
E-mail: nathaliechahine@hotmail.com

ABSTRACT

Background: Communication technologies are tremendously expanding and disturbing our lifestyles, especially those of adolescents. Their misuse has been associated with negative consequences for sleep quality and school performance. The objective of this study was to investigate the relationship between times spent using a device with a screen, the quality of sleep, and the associated factors.
Methods: 657 students were enrolled from 22 secondary colleges in greater Beirut (Lebanon) to participate in a cross-sectional descriptive observational study. The questionnaire was focused on the time spent on digital screens, lifestyle habits, sleep schedule, biometrics, and family data. SPSS 24 was used to analyse descriptive statistics, correlation and variance analysis.
Results: 90% of students possess at least one screen in their bedroom. Mostly during weekdays, spending more than 4 hours daily in front of screens decreased duration and quality of sleep as well as the daytime fatigue, delayed bed time and increased low grades ($p<0.05$). This was significantly associated with having a screen device in the bedroom, using a screen before falling asleep, living in rich neighborhoods with a high family income, a divorced couple, and no extra-scholar sport. The average sleep duration of students was 6 hours 58 minutes during the week and 8 hours 55 minutes during the weekend trying to recover from sleep deprivation.
Conclusions: The quality of sleep worsens with increasing levels of screen use. It is becoming imperative to develop prevention campaigns within colleges, and to foster rational use of screens that honors sleep hygiene.

Keywords: Adolescents, Sleep problems, Screen use

INTRODUCTION

Nowadays, the overuse of new technologies (smartphones, videogames, computers, etc.) is disrupting human behavior and favoring a sedentary lifestyle. In this context, the digital tools used for learning or entertainment are multiplying and invading daily life, primarily targeting youth. In fact, adolescence is a key developmental age characterized, among others, by numerous hormonal, psychological, and, more importantly, cognitive changes.

Many studies concerning new technologies showed that the percentage of adolescents possessing smartphones has raised drastically, 41% in 2012 versus 89% in 2017, changing the way they communicate with each other. Six years ago, in-person conversation was more popular than texting, however adolescents today prefer texting on their cell phone rather than face-to-face conversations with friends.[1] Therefore, in advanced and emerging economies, younger people are much more digitally connected than older generations. In most countries surveyed, those under 35 are more likely to own

smartphones and use the internet (mainly for social media purposes) than those aged 50 and older. In fact, in Brazil, 85% of those aged 18 to 34 own a smartphone compared with just 32% of those older than 50. Even in countries like Germany and Australia, where smartphone ownership rates far outpace those in Brazil, younger adults are more likely to own smartphones than older age groups.[2]

Without underestimating the positive aspects of these new technologies, many studies underline their harmful impacts on the overall development of the child, the rhythm of sleep, eating habits, sedentary lifestyle, and body size.[3] In the field of healthy family-school relationships, the fight against poor performance at school and bad lifestyles is a real challenge, both for parents and health educators. These factors determine socio-educational success and overall health, particularly in popular areas. As such, they constitute important targets of public health policies.

Most of all, sleep disorders possess a severe impact on health. Current sleep recommendations are 8 to 9 hours of sleep for teenagers every 24 hours.[4] Sleeping less than 7 hours is particularly deleterious for their health.[5] Insufficient and disturbed sleep together with difficulty getting up in the morning is a common problem faced by children and adolescents around the world.[6] Sleep disorders can appear in adolescence and risk becoming chronic with overuse of new technologies. The most common sleep disorders are insomnia, sleep deprivation syndrome, and delayed phase syndrome.[7] Apparently, adolescents who watched more than 3 hours of television per day experienced similar trouble sleeping as adults.[8]

Studies agree on the negative impact of sleep deprivation on memory and, more recently, on social behavior or dietary balance. Reduced sleep have been shown to be associated with an increased risk of obesity.[9] In addition, a reduction in sleep duration leads to hormonal changes such as a decrease in the plasma level of appetite hormones, as well as metabolic changes in blood sugar and insulin, thus inducing a state of glucose intolerance.[10]

In children and adolescents, insufficient and poor-quality sleep has been associated with impairments in declarative, procedural, and working memory, as well as poor concentration skills.[11] This can negatively impacts the performance of middle school students, in particular due to excessive daytime sleepiness.[12] In this context, Reddy et al, have shown that acute sleep restriction in adolescents is associated with affective disturbances and disorders.[13]

There is a correlation between reduced sleep time and the use of electronic media, especially at night. However, the quality of sleep remains little studied. In fact, the consumption of screens, and in particular that of smartphones, through their multitasking technologies, is increasingly afflicting youth, particularly when used at bedtime.[14,15] Thus, it is imperative to disseminate prevention messages with a view to promoting health and lifestyle habits among children and adolescents. Several health actions already exist in the school environment, such as the fight against obesity, the prevention of addictive behavior, or nutritional education. However, to date, there are very few health actions on the use of screens, sleep hygiene, and their consequences.

A survey carried out in schools appeared relevant in order to collect objective data on the health and lifestyle of secondary school students in the region. The data obtained will be used to better define the basis of a future intervention program for prevention and modification of lifestyle habits. The main objective of this study was to investigate a relationship between the use of video screens and the three parameters: sleep duration, sleep quality, and bedtime. The secondary objective was to highlight the main factors related to lifestyle habits influencing these sleep parameters.

METHODS

This was a cross-sectional descriptive observational study including 657 individuals conducted online in 2018 by students in secondary classes at 22 private and public schools in Greater Beirut. The aim of the study was explained to the parents of the students of each college by mail to obtain their consent. A computed questionnaire was developed, based on various validated questionnaires.

The first part of the questionnaire included data such as weight, height, and age, as well as academic results expressed by the overall trimestral averages of the student and the class. The second part concerned family data such as the composition of the family, the level of education, and the professional status of the parents. The third part concerned the student's lifestyle habits, such as the possession and consumption of video screens in the family home, eating behavior, and extra-curricular activities. The fourth part concerned students' sleep. They were asked to record the daily falling asleep schedule, the duration of sleep, and the quality of sleep. It was based on a validated questionnaire from Becker et al.[6]

The questionnaire was distributed on a compact disk in secondary classes to students whose parents consented to participate. According to the colleges, the teaching or paramedical teams were responsible for the distribution and explanation of the instructions.

The first part of the "lifestyle" questionnaire was completed by the students during one hour of class. The second part of the "sleep compendium" questionnaire was completed daily by the student for a full week, i.e., seven consecutive days. Students filled out this information in class throughout the week. They reported the perceived quality of their sleep and their energetic form via visual analog scales (VAS). Students also wrote down when to

go to bed and when to get up. Bedtime was defined as when all light sources went out. Only the nightlight was accepted as long as it was not used as a source to read or play. The time to wake up corresponded to the time the student was awake.

The third part of the questionnaire was completed by a member of the teaching team for school data and by a health professional for biometric data. Biometric data was collected during the first trimester of the school year using an electronic scale and a measuring rod.

The fourth part of the questionnaire, entitled "family data", was distributed at the same time as the consents and had to be completed by the parents or legal representatives.

Data collection and analysis

Questionnaires were collected or sent via email by students and then analysed by assigning to each student an arbitrary number ranging from 1 to 680 (23 files were found unusable). Class assignment lists were kept by the colleges. All the data collected using the questionnaires were coded in an Excel spreadsheet for statistical analysis using SPSS 24 software. Variables were analyzed by the Student test in normally distributed values or by nonparametric test (Mann-Whitney U) when they are not normally distributed (Kolmogorov-Smirnov test was used to test normality). Qualitative values were expressed in number and percentage of all students and analyzed by the chi^2 test. Values of less than 0.05 were considered statistically significant.

RESULTS

Description of the population

Anthropometric measurements and general information about students and their screens usage are recorded in Table 1. We noticed the very high prevalence of students possessing a cellphone, the presence of screens in bedroom and their use before sleep.

Time spent using a device with a screen

There is a clear difference in the percentage of adolescents spending an average time duration (2-4 hours) in front of screens during week days (40%) and week end (23%). On the other hand, during week days, 42% of students reported spending a below average time (slightly and <2 hours) in front of a screen, versus 18% above average and excessively (>4 hours). Conversely, during weekends, only 27% of students spent less than 2 hours in front of a screen versus 48% more than 4 hours (Table 2).

Table 1: General information about students and their screens.

Information	Frequency or percentage
Number of participants colleges	22
Total number of students of secondary classes	657 (originally 680 - 23 files unusable)
Sex	
Boys	301 (45.8%)
Girls	356 (54.2%)
Age (years)	17.1±1.8 (mean±standard error)
Students with at least one monitor in their bedroom	90%
Most common screen in the room	
Mobile phone	88%
Computer	57%
Tablet	42%
Game console	30%
Television	22%
Students using one of the screens before falling asleep	85%
Students' average screens in their room	2
Family average screens at home	6

Factors associated with screen time

After adjustment, spending more than 4 hours looking at the screens was significantly associated ($p<0.05$) with having a smartphone or laptop in the bedroom, using a screen before falling asleep, living in rich neighborhoods with a high family monthly income, a divorced couple, no extra scholar sport or other activity and being in the 10th grade year (Table 3).

Sleep duration of the participants

The average sleep duration of students for seven consecutive days and 3 weekends were: during the week:

418±40.5 or 6 hours 58 minutes. During the weekend: 535±49.4 or 8 hours 55 minutes.

Table 2: Distribution of students according to the number of hours spent in front of the screens during the week and weekends.

Duration in front of screens (hours)	Week (%)	Weekend (%)
Slightly	10	9
Below average	32	18
Average	40	23
Above average	10	28
Excessively	8	22

Slightly <1 hour; below average 1-2 hours; average 2-4 hours; above average 4-6 hours; excessively >6 hours.

Table 3: Analysis table of factors associated with screen time >4 hours.

Factors influencing screen time >4 hours	P value
Sex	NS
No siblings	p<0.05
Smartphone/laptop in the room	p<0.05
Use a screen before sleep	p<0.05
Number of screens in the room	p<0.05
Home in rich neighborhoods	p<0.05
High family monthly income	p<0.05
Couple's status in the household	p<0.05
No extra scholar sport or other activity	p<0.05
10th grade year	p<0.05

Relationship between periods spent in front of screens and duration of sleep

A significant inverted correlation was found between sleep duration and time spent in front of screens for school days (p<0.05). The more time the student spent in front of the screens, the less he slept during the week. In fact, there was an average difference in sleep of 155 minutes between adolescents spending less than an hour in front of screens and those spending more than 6 hours (Figure 1). No significant correlation was found between the duration of sleep and the time spent in front of screens for week end days.

Analysis of factors associated with sleep duration

The analysis of the confounding variables on the duration of sleep shows that the couple's status (together or separated) and the neighborhood (calm or vibrant) were significantly associated with the duration of sleep. Being with separated parents and living in a popular neighborhood were both associated with a shorter sleep time. On the other hand, the percentage of students sleeping below the recommended minimum threshold of 8 hours of sleep was 32%. Sleeping less than 8 hours per night was significantly associated with having a cell phone in the bedroom, having at least one screen in his room, using a screen before falling asleep, spending a long time in front of video screens during weekends. Also, the more the adolescent is not engaged in a sporting extra-curricular activity, the more likely he was to have less than 8 hours of sleep per night (p<0.05).

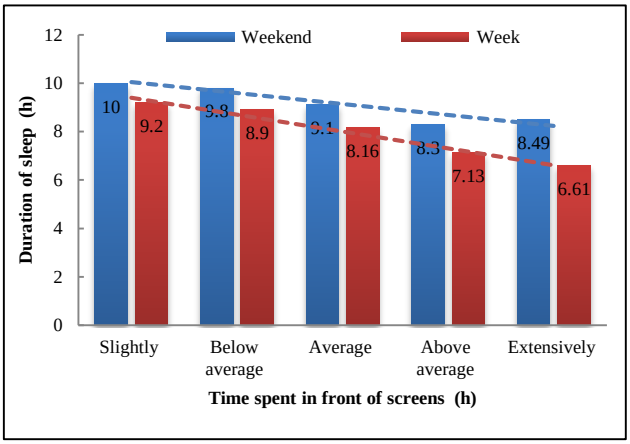

Figure 1: Duration of sleep (in hours) versus the time spent in front of screens (in hours) during school days and during weekends.

Slightly <1 hour; below average 1-2 hours; average 2-4 hours; above average 4-6 hours; excessively >6 hours.

The quality of sleep

On a scale from 0 to 99: 80-99 stand for good sleep, 50-79 for moderate and 0-49 for poor sleep. The average sleep quality was 42±21 on weekdays and 79±18 on weekends. Regarding week days, an inverted correlation was found between the quality of sleep and the time spent in front of screens. The more time the child spent in front of the screens, the poorer their quality of sleep during the week.

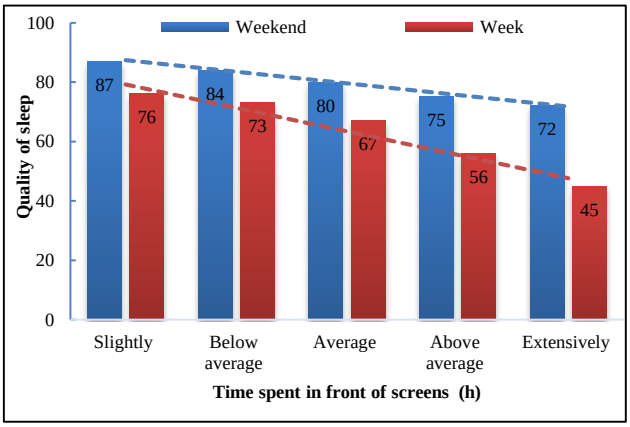

Figure 2: Value illustrating the quality of sleep in relation with time spent in front of screens (in hours) on week days and during week end.

Slightly <1 hour; below average 1-2 hours; average 2-4 hours; above average 4-6 hours; excessively >6 hours.

There was an average difference of 31 points between students spending less than an hour in front of screens

and those spending extensive time more than 6 hours. Regarding the weekends, an inverted correlation was found between the quality of sleep and the time spent in front of the screens but to a lesser extent than during weekdays. The more time the child spent in front of screens, the poorer their quality of sleep on weekends, with an average difference of 15 points between adolescents spending less than an hour in front of screens and those spending more than 6 hours. After adjustment, none of the lifestyle factors analysed were significantly associated with the quality of sleep (Figure 2).

Bedtime

The average bedtime was 22:45 on weekdays and 24:25 on weekends. A significant correlation was found between bedtime and time spent in front of screens for weekdays ($p<0.05$, after adjusting for confounding factors). The more time the adolescent spent in front of the screens, the later he went to bed at the weekend, with an average difference of 3.5 hours between the student spending less than an hour in front of the screens and the one spending more than 6 hours (Figure 3).

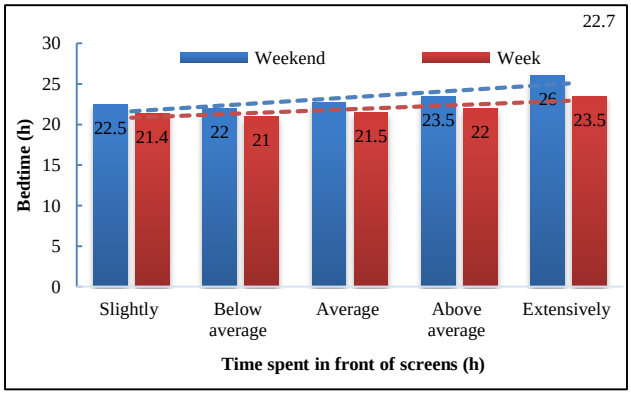

Figure 3: Bedtime (in hours) of students according to time spent in front of screens on weekdays and weekends.

Slightly <1 hour; below average 1-2 hours; average 2-4 hours; above average 4-6 hours; excessively >6 hours.

The daytime fatigue

On a scale from 0 to 99: 80-99 stand for high energy, 50-79 for moderate energy and 0-49 for poor energy. The average energy feeling was 61±18 points during the week, and 75.4±16 points on weekends. After adjustment, a significant correlation was found between a decrease in diurnal energy feeling and time spent in front of screens for week days (Figure 4).

Screen time and grades

Students spending less than 1 hour in front of screens have 10% of their grades under the class average. Between 4 and 6 hours it increased low grades to about 22%. More than 6 hours in front of screens raised significantly to 40 % the low grades ($p<0.05$) (Figure 5).

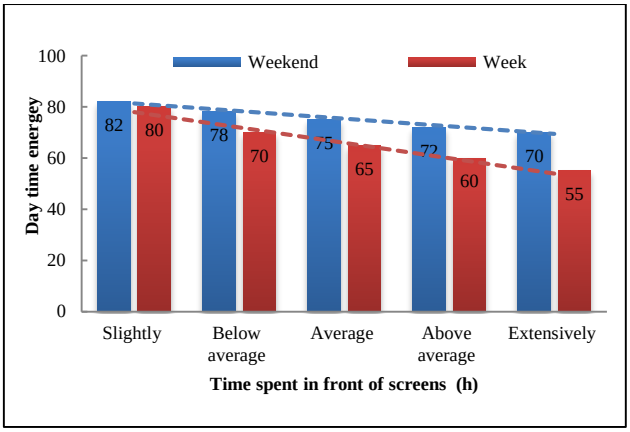

Figure 4: Diurnal energetic sensation versus time spent in front of the screens (in hours) on week days and weekends.

Slightly <1 hour; below average 1-2 hours; average 2-4 hours; above average 4-6 hours; excessively >6 hours.

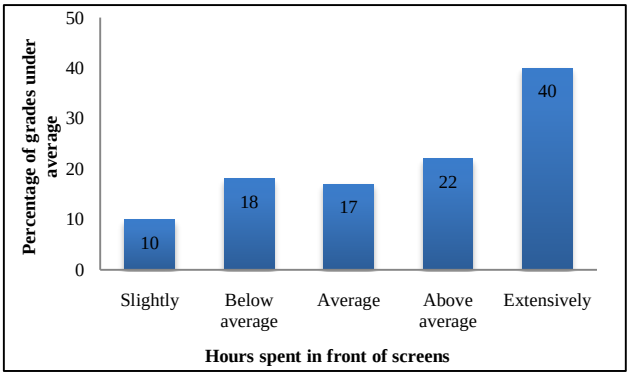

Figure 5: Distribution (in percentage) of grades under average according to the time spent in front of screens.

DISCUSSION

The study showed that screen use on weekdays was significantly associated with a reduction in the adolescent sleep time in relation with additional hours spent in front of screens. These results are in agreement with many studies published in this field. Researchers have tried to explain the mechanisms that are almost intertwined.[16] The first one would be an unstructured free time of screens usage, with no established start or end time of use, thus detrimentally expanding on sleep time. A second mechanism assumes that using electronic media before sleep increases mental, emotional and physical arousal through the release of stress hormones. A third mechanism suggests that light emission from the screens of electronic media devices could interfere with the circadian rhythm by suppressing physiological nocturnal secretion of the sleep-promoting hormone melatonin.[17] Furthermore, our study, did not show a significant relationship between the use of screens and the duration of sleep on weekends. It is possible that on weekends, the use of screens has more influence on bedtime which can be compensated for by waking up later.

On weekdays, there was an average difference in sleep duration of 155 min between the group using screens less than an hour and the group using screens more than 6 hours, which is alarming during week days. In addition, there was a 48 minutes difference between the group using screens less than 1 hour and the group using screens more than 2 hours. These observations are consistent with previously published data. Yet another study found that a difference of only 25 minutes per night in sleep duration was associated with changes in the academic performance of middle school students.[18]

The widespread trend of using a screen for a long time before falling asleep is associated with a smaller duration of students sleep. This is consistent with a recent study of Haartley et al showing that both duration of screen use and timing are associated with adverse effects on sleep and daytime functioning in adolescents.[19] In 2013, Arora et al found in a population of teenagers aged between 11 to 13 in the UK, that cell phone use before bed reduced the average sleep time by 45 minutes.[20] The lack of significance in the results could be explained by the small sample size, or certain biased information. Likewise, other factors that were not shown in the study to be associated with sleep duration have been significant in previous studies many times. Thus, the presence of a television in a child's bedroom was significantly associated with shorter sleep time. Although methodological flaws may have been at the origin of these results, it is also possible that, 15 years after the first studies in this field, a new generation of adolescents is using new electronic media that are equally responsible for a lack of sleep.[21]

Our study showed that screen use, on either weekdays or weekends, was significantly associated with a reduction in teenagers sleep quality for additional hours spent in front of screens. The relationship was independent of other socio-educational characteristics noted in the study. There are thus new data in the field of the quality of sleep of adolescents that is little studied, with complex conclusions in the literature. The few studies that showed a negative association of screen usage with quality of sleep did not use the same scale. On weekdays, there was a difference of 31points in sleep quality between the group using screens for less than an hour and the group using screens for more than 6 hours.[22]

After adjustment, none of the lifestyle factors analysed were significantly associated with students' quality of sleep. A trend was nonetheless observed for the use of a screen before falling asleep. Although far fewer studies have looked at the quality of sleep, Ivarsson et al have shown that the use of violent or non-violent video games before bedtime is associated with poorer quality of sleep. They used different quality scales such as the Karolinska sleep scale.[23] The tendency to use screens before falling asleep was therefore found in both the duration and the quality of sleep.

This study showed that screen use, during either weekdays or weekends, was significantly affected the late child's bedtime, for additional hours spent in front of screens. The relationship was independent of excess weight, the mother's professional status, the mother's educational level, the household's status as a couple or not, and the head of the household's sleep average. In summary, weekend screen usage was significantly associated with both reduced sleep quality and a later bedtime. While their use did not affect sleep duration. This could suggest that a shift in sleep/wake rhythm, even for equal sleep duration, affects sleep quality. Moreover, the distribution of pupils' bedtime hours during the week and on weekends clearly showed a difference in the waking/sleeping rhythm between school days and days without school.

Bedtime is significantly associated with the presence of a computer and a cell phone in the bedroom, the number of screens in the bedroom and at home, the use of a screen before falling asleep. A trend was observed for the presence of a television in the bedroom. This result was not significant although this association has been demonstrated many times in recent years.[24] The hypothesis put forward for explanation is that among adolescents, the computer and the cell phone supplant television as media used before sleeping. Today, internet access on computers and smartphones allows access to multiple television programs. A French study and another from Saudi Arabia have shown that the presence of a cell phone in the bedroom was a predictor of sleep disorders such as delayed bedtime and difficulty getting up. In particular, adolescents who used their mobile phones between midnight and 3 a.m. were more likely to be tired during the day than adolescents who had never used a mobile phone after the lights were turned off.[25,26]

The average sleep duration over a total week of the study population was 6 h 58 min, thus scoring below the official recommendations for adolescents which is 8 to 9 hours.[27] During the weekend, sleep duration increased to 8 hours 55 minutes which is within the recommended duration. However, teens can't recover from sleep debt over the weekend as reported by the National Health Institute.[28]

CONCLUSION

The study confirmed an association between the use of screens and the development of sleep disturbances. It is clear that the new generation of adolescents with access to the latest technologies have discovered new ways of using screens that are invading their environment more and more, even in their beds. The family and socio-economic environment seemed to play an important role in the lifestyle habits of adolescents. Although these parameters are invariable at our level, they have made it possible to target a particularly vulnerable population which justifies preventive actions. It also appeared that adolescence is a key period of intervention for research teams. Indeed, the study showed that the harmful impact

of screens does not yet have major apparent health consequences; however, a continuous monitoring of the cohort appears imperative for their future health. Finally, it will be interesting to characterize, through additional studies using the same scales, the long-term clinical impact of poor quality of sleep.

ACKNOWLEDGEMENTS

Authors would like to thank Prof. Ramez Chahine for contributions in conceiving the idea of this study and his appreciated comments.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Study: Teen ownership of smartphones grows to 89%. Available at: https://www.marketingdive.com/news/study-teen-ownership-of-smartphones-grows-to-89/532017/. Accessed on 1 May 2020.
2. Silver L. Smartphone ownership is growing rapidly around the world, but not always equally. Pew Res Center. 2019.
3. Tereshchenko S, Kasparov E. Neurobiological risk factors for development of internet addiction in adolescents. Behav Sci. 2019;9(6):62.
4. Suni E, Singh A. How Much Sleep Do We Really Need? Available at: https://sleepfoundation.org/media-center/press-release/national-sleep-foundation-recommends-new-sleep-times. Accessed on 1 May 2020.
5. Hysing M, Harvey AG, Stormark KM, Pallesen S, Sivertsen B. Precursors of delayed sleep phase in adolescence: a population-based longitudinal study. Sleep. 2018;41(11):zsy163.
6. Becker SP, Ramsey RR, Byars KC. Convergent validity of the child behavior checklist sleep items with validated sleep measures and sleep disorder diagnoses in children and adolescents. Sleep Med. 2015;16:79-86.
7. Dore-Stites D, Conroy DA. Delayed sleep wake phase disorder in adolescents: chronotherapy and best practices. Available at: https://www.psychiatrictimes.com/view/delayed-sleep-wake-phase-disorder-adolescents-chronotherapy-and-best-practices. Accessed on 2 May 2020.
8. Baiden P, Tadeo SK, Peters KE. The association between excessive screen-time behaviors and insufficient sleep among adolescents: Findings from the 2017 youth risk behavior surveillance system. Psychiatr Res. 2019;281:112586.
9. Arora T, Hussain S, Hubert Lam KB, Neil Thomas G, Taheri S. Exploring the complex pathways among specific types of technology, self-reported sleep duration and body mass index in UK adolescents. Int J Obes. 2013;37(9):1254-60.
10. Kim TW, Jeong JH, Hong SC. The impact of sleep and circadian disturbance on hormones and metabolism. Int J Endocrinol. 2015;2015:591729.
11. Jalilolghadr S, Hashemi HJ, Hashemi F, Nozari H, Yazdi Z. Sleep duration and its relationship with school performance in Iranian adolescents. J Prev Med Hyg. 2021;62(1):E54-9.
12. Dagys N, McGlinchey EL, Talbot LS, Kaplan KA, Dahl RE, Harvey AG. Double trouble? The effects of sleep deprivation and chronotype on adolescent affect. J Child Psychol Psychiatr. 2012;53(6):660-7.
13. Reddy R, Palmer CA, Jackson C, Farris SG, Alfano CA. Impact of sleep restriction versus idealized sleep on emotional experience, reactivity and regulation in healthy adolescents. J Sleep Res. 2017;26(4):516-25.
14. Hale L, Guan S. Screen time and sleep among school-aged children and adolescents: a systematic review. Sleep Med Rev. 2015;21:50-8.
15. Owens JA, Weiss MR. Insufficient sleep in adolescents: causes and consequences. Minerva Pediatr. 2017;69(4):326-36.
16. Strasburger VC, Jordan AB, Donnerstein E. Health effects of media on children and adolescents. Pediatrics. 2010;125(4):756-67.
17. Moderie C, Van der Maren S, Paquet J, Dumont M. Home versus laboratory assessments of melatonin production and melatonin onset in young adults complaining of a delayed sleep schedule. J Sleep Res. 2020;29(3):e12905.
18. Alfonsi V, Scarpelli S, D'Atri A, Stella G, De Gennaro L. Later school start time: the impact of sleep on academic performance and health in the adolescent population. Int J Environ Res Public Health. 2020;17(7):2574.
19. Hartley S, Royant-Parola S, Zayoud A, Gremy I, Matulonga B. Do both timing and duration of screen use affect sleep patterns in adolescents? Plos One. 2022;17(10):e0276226.
20. Arora T, Broglia E, Thomas GN, Shahrad T. Associations between specific technologies and adolescent sleep quantity, sleep quality, and parasomnias. Sleep Med. 2014;15(2):240-7.
21. Liu J, Ghastine L, Um P, Rovit E, Wu T. Environmental exposures and sleep outcomes: a review of evidence, potential mechanisms, and implications. Environ Res. 2021;196:110406.
22. Carter B, Rees P, Hale L, Bhattacharjee D, Paradkar MS. association between portable screen-based media device access or use and sleep outcomes: a systematic review and meta-analysis. JAMA Pediatr. 2016;170:1202-8.
23. Ivarsson M, Anderson M, Åkerstedt T, Lindblad F. The effect of violent and nonviolent video games on heart rate variability, sleep, and emotions in adolescents. Psychosom Med. 2013;75(4):390-6.
24. Touitou Y, Touitou D, Reinberg A. Disruption of adolescents' circadian clock: The vicious circle of media use, exposure to light at night, sleep loss and risk behaviors. J Physiol Paris. 2016;110(4):467-79.

25. Kubiszewski V, Fontaine R, Rusch E, Hazouard E. Association between electronic media use and sleep habits: an eight-day follow-up study. Int J Adolesc Youth. 2014;19(3):395-407.
26. Al-Anazi NS, Al-Harbi Z. association of electronic media use and sleep habits among secondary school students in Al-Madinah. Cureus. 2022;14(2):e22334.
27. Leger D, Beck F, Richard JB, Godeau E. Total sleep time severely drops during adolescence. PLoS One. 2012;7(10):e45204.
28. National Institute of Health. Weekend catch-up can't counter chronic sleep deprivation. March 2019. Available at: https://www.nih.gov/news-events/nih-research-matters/weekend-catch-cant-counter-chronic-sleep-deprivation. Accessed on 2 May 2020.

Cite this article as: Chahine K, Pelletier A, Chahine N. Effect of screen time use and digital technology on sleep pattern in Lebanese college students. Int J Community Med Public Health 2023;10:1342-9.