SMARTPHONE USAGE TIME, POSTURE OF THE CERVICAL REGION, AND ASSOCIATED FACTORS IN TEENAGE UNIVERSITY STUDENTS

TEMPO DE USO DO SMARTPHONE, POSTURA DA REGIÃO CERVICAL E FATORES ASSOCIADOS EM ADOLESCENTES UNIVERSITÁRIOS

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ABSTRACT

Objective: this study aimed to assess the relationship between smartphone usage time and postural alignment in teenage university students and the associated factors. **Methods:** we carried out a cross-sectional study with 133 teenage university students (18-19 years old) between April and November 2018 in Fortaleza, Ceará, Brazil. Questionnaires were used to collect information on socioeconomic status, health conditions, smartphone usage time and level of physical activity. The alignment of the cervical region was assessed using photogrammetry in anatomical position and while texting on the smartphone. Horizontal Alignment of the Head (HAH), Horizontal Alignment of the Acromion (HAA), and Vertical Alignment of the Head (VAH) were measured. Bivariate and multivariate analyses were performed to check for factors associated with smartphone usage time (>6 hours a day). **Results:** there were higher rates of girls (66.9%; n=89), people in the lower social class (71.4%; n=95), frequent drinkers (66.9%; n=89), people who complained of headache (83.5%; n=111) and people who used smartphones for more than 6 hours a day (72.9%; n=97). The multivariate analysis showed an association of smartphone usage time (>6 hours a day) with cervical anteriorization, estimated by measuring the VAH (OR=1.053; p=0.007 – left side), female gender (OR=2.729; p=0.046), frequent drinking (OR=2.636; p=0.038) and complaint of headache (OR=5.617; p=0.002). **Conclusions:** there was a high percentage of adolescents who excessively used smartphones for more than 6 hours a day. Prolonged smartphone use was associated with female gender, alcohol consumption, headache and changes in cervical alignment.

Keywords: Smartphone; Adolescent; Posture; Pain.

RESUMO

Objetivo: avaliar a relação entre o tempo de uso do smartphone e o alinhamento postural em adolescentes universitários, bem como fatores associados. **Métodos:** estudo transversal com 133 adolescentes universitários (18-19 anos), desenvolvido entre abril e novembro de 2018 em Fortaleza, Ceará, Brasil. Aplicaram-se questionários para coleta das variáveis: socioeconômicas, condições de saúde, tempo de uso do smartphone e nível de atividade física. Avaliou-se o alinhamento da região cervical por fotogrametria, na posição anatômica e ao digitar no smartphone, mensurado pelo Alinhamento Horizontal da Cabeça (AHC), Alinhamento Horizontal do Acrômio (AHA) e Alinhamento Vertical da Cabeça (AVC). Análises bivariada e multivariada foram realizadas para verificar os fatores associados ao tempo de uso do smartphone (> 6 horas/dia). **Resultados**: houve maior proporção do sexo feminino (66,9%; n=89), classe social baixa (71,4%; n=95), consumo de bebida alcoólica frequentemente (66,9%; n=89), queixa de dor de cabeça (83,5%; n=111) e tempo de uso do smartphone > 6 horas/dia (72,9%; n=97). Na análise multivariada, tempo de uso (>6 horas/dia) apresentou associação com anteriorização cervical, medido pelo AVC (OR=1,053; p=0,007 – lado esquerdo), sexo feminino (OR=2,729; p=0,046), consumo frequente de bebida alcoólica (OR=2,636; p=0,038) e queixa de dor de cabeça (OR=5,617; p=0,002). **Conclusões:** há elevado percentual de adolescentes que usam o smartphone por tempo excessivo, superior a 6 horas/diárias, relacionando-se com sexo feminino, consumo de bebida alcoólica, dor de cabeça e alteração no alinhamento cervical.

Palavras-chave: Smartphone; Adolescente; Postura; Dor.

INTRODUÇÃO

The majority of smartphone users are adolescents. This is due to the various functionalities of this device, such as access to virtual content, applications, games, among other things. European and Asian countries have high rates of adolescents who own smartphones with gender differences in use behavior[1,2].

In Brazil, smartphones are present in the daily lives of adolescents due to the convenience and pleasure in using them. A population survey found that 93% of Brazilian adolescents use the smartphone as the main device to access the internet and spend about 6 hours/day online[3].

Spending too much time on smartphones has a negative impact on adolescents' physical and mental health. Studies warn that excessive smartphone use can resemble an addiction when it is used for longer than intended or perceived by the user[4]. It can also be associated with poor sleep quality and loss of productivity at work or school[4].

Another negative effect of excessive smartphone use is postural changes, such as the text neck. This incorrect posture consists in moving the neck forward and downward with protrusion and internal rotation of the shoulders while using the smartphone. This can cause injuries to the musculoskeletal structure of the cervical spine and upper limbs and, consequently, pain in the region[5].

Despite such evidence, there is still a shortage of effective information systems in the country to monitor technology addictions, such as addiction to smartphones, online games, and social media, which can affect adolescents' physical and mental health. Without quality information, strategies to improve health systems are unlikely to be based on scientific evidence. In addition, the use of data from countries with political, socioeconomic, and cultural differences could not be useful in addressing the country's real problems[6].

In view of the considerations outlined above, this study aimed to assess the relationship between smartphone usage time and postural alignment in teenage university students and the associated factors.

METHODS

Study type and period

This analytical cross-sectional study is part of a research project entitled "Study of the relationship between musculoskeletal dysfunction in the cervical region and use of mobile devices at different ages" carried out between April and November 2018 in the city of Fortaleza, Ceará, Brazil.

Study setting

Fortaleza is the capital of the state of Ceará. It is located on the Atlantic coast of Northeastern Brazil, and it has 2,669,342 inhabitants. It is the fifth most populous capital city in the country and 224,117 of its inhabitants are university students. It has a Municipal Human Development Index (MHDI) of 0.754 and 81.6% of the population has a mobile phone for personal use.

Data were collected at a private higher education institution and philanthropic organization. In 2018, there were 2,827 teenage university students – students aged up to 19 years, as defined by the World Health Organization.

Study population

The study included 133 teenage university students (18-19 years old) who routinely used mobile phones regardless of their demographic characteristics. This quantity of students was obtained from

the database used in the research project, which included 510 university students and employees of the institution.

Adolescents diagnosed with disc pathologies, fractures or degenerative lesions in the cervical spine, fibromyalgia, and self-reported head/neck surgery were excluded from the study due to the influence of these dysfunctions on the functionality of the cervical region. Pregnant women and physically and cognitively disabled people were also excluded due to the non-adaptability of the data collection instruments.

The participants were recruited through posters affixed in the institution and direct invitations during the breaks between classes of undergraduate courses.

This study was approved by the Research Ethics Committee (Approval No 2.144.930). All the participants gave their written informed consent.

Data collection procedures and variables

Data collection started after the participants gave their written consent. Data were collected in two stages at the institution's research laboratory. In the first stage, the participants answered 2 data collection instruments: 1) a questionnaire addressing socioeconomic conditions, health conditions, and smartphone usage time and 2) the short version of the International Physical Activity Questionnaire (IPAQ).

The first questionnaire was developed by the researchers and contained 12 questions addressing socioeconomic variables (gender, skin color, paid job, and social class), health conditions (smoking, drinking, sleep disorders, general health, use of glasses/contact lenses, complaint of cervical pain, and headache) and time (hours) spent on the smartphone.

The short version of the IPAQ was validated in Brazil for adults, older people and adolescents. It assesses the level of physical activity of populations in different countries through 8 open-ended questions that allow to estimate the time

spent weekly on different physical activity practices. It was categorized into "active" – when vigorous or moderate activities or walking are performed ≥ 5 days/week for ≥ 150 minutes – and "inactive" – people who did not meet the criteria for frequency and duration[7].

In the second stage, the postural alignment of the cervical region was assessed using photogrammetry in two positions: 1) anatomical position, which was considered baseline and 2) position simulating the cervical region when reading/texting on the smartphone.

Photogrammetry was performed using a digital camera (Canon Powershot SX530HS) on a tripod (for Canon, Nikon and Sony cameras) at a distance of 3 meters from the participants and height adjusted according to each participant (half the participant's height). Markers were placed on the participants at 9 standardized anatomical points: glabella, manubrium, right (R) and left (L) tragus, chin, acromion (R and L), and the spinous processes of C7 and T1. The participants were told to remain standing in the anatomical position and with eyes open. Photos of the anterior and lateral views (R and L) of the participants were taken in the positions previously described[8].

Postural alignment was analyzed using the Postural Assessment Software (PAS) to measure the angles: 1) in the anterior view: Horizontal Alignment of the Head (HAH), which identifies a head tilt to the right (when the value is positive) or left (when the value is negative) and the Horizontal Alignment of the Acromion (HAA), which identifies the elevation of the right shoulder (when the value is negative) and left shoulder (when the value is positive); and 2) lateral view: Vertical Alignment of the Head (VAH), which identifies the cervical anteriorization when the angle value is high8. Data were collected by previously trained researchers who used a "manual" to minimize interferences.

Statistical analysis

Univariate analysis of categorical variables was performed to calculate the

absolute and relative frequencies. We also performed univariate analysis of numerical variables to calculate the mean and Standard Deviation (SD). Some variables were categorized: 1) upper social class (for social classes A and B), and lower social class (for social classes C, D and E); and the smartphone usage time was categorized into ≤6 and >6 hours/day, a cutoff value estimated according to a study on the time young Brazilians spend online[9].

A bivariate analysis was performed using the chi-squared test to check for associations between the smartphone usage time and the socioeconomic variables, health conditions and physical activity. Odds ratios (OR) and their respective confidence intervals (95%CI) were calculated. The t-test was used to check for differences in postural alignments (HAH, HAA and VAH) in relation to the smartphone usage time after checking for normality using the Kolmogorov-Smirnov (KS) test.

Finally, multivariate logistic regression was performed using the backward method. Associations with a significance level of 20% were included in the model. Only the associations with a significance level of 5% remained in the adjusted model and their OR and respective confidence intervals (95%CI) were

also adjusted. The statistical analyses were performed using the IBM SPSS® Statistic (US) software, version 23.0.

RESULTS

In the present study, there was a greater proportion of women (66.9%; n=89), white skin color (45.9%; n=61), people without paid jobs (85.7%; n=114), and people in the lower social class (71.4%; n=95). With regard to health conditions, 85% (n=113) of the participants were non-smokers, 66.9% (n=89) often consumed alcohol, 75.9% (n=101) did not report sleep disorders, 58.6 % (n=78) reported good general health, 63.9% (n=85) complained of cervical pain and 83.5% (n=111) complained of headache (Table 1). A total of 72.9% (n=97) of the participants used the smartphone for more than 6 hours/day and 48.9% (n=65) were physically inactive.

Table 1. Distribution of socioeconomic variables and health conditions of teenage university students who use smartphones. Fortaleza, Ceará, 2018

Variables	n	%
Socioeconomic variables		
Gender		
Boys	44	33.1
Girls	89	66.9
Self-reported skin color		
White	61	45.9
Black	5	3.8
Pardo (mixed-race Brazilians)	61	45.9
Indigenous	2	1.5
Yellow	4	3.0
Paid job		
No	114	85.7
Yes	19	14.3
Social Class		
Lower	95	71.4
Upper	38	28.6
Health conditions		
Smoking		
Never smoked	113	85.0
Former smoker	20	15.0
Smoker	0	0.0
Drinking		
No	44	33.1
Frequently	89	66.9
Sleep disorder		
No	101	75.9
Yes	32	24.1
Self-rated general health		
Poor	55	41.4
Good	78	58.6
Use of glasses/contact lenses		
No	53	39.8
Yes	80	60.2
Cervical pain		
No	48	36.1
Yes	85	63.9
Headache		
No	22	16.5
Yes	111	83.5
Smartphone usage time (hours a day)		
≤ 6	36	27.1
> 6	97	72.9
Level of physical activity		
Inactive	65	48.9
Active	68	51.1

The analysis of the association of postural alignments in the lateral view with the smartphone usage time showed that the left VAH indicated greater cervical anteriorization when texting on the smartphone compared with the anatomical position (baseline) in the group of people who used smartphones for more than 6 hours/day (p=0.024). The anterior view analysis showed no significant differences in HAH (p=0.626) and HAA (p=0.734) in relation to the smartphone usage time (Table 2).

Table 2. Relationship between smartphone usage time and differences in postural alignment of the cervical region in teenage university students. Fortaleza, Ceará, 2018

Difference in postural alignment of the cervical region[a]	Smartphone usage time		p-value
	≤ 6 hours	> 6 hours	
Anterior view			
Horizontal alignment of the head (HAH)	-0.80 ± 2.70	-0.52 ± 3.01	0.626
Horizontal alignment of the acromion (HAA)	0.21 ± 1.47	0.09 ± 2.03	0.734
Lateral view			
Right side vertical alignment of the head (VAH)	19.12 ±11.67	23.90 ± 13.13	0.058#
Left side vertical alignment of the head (VAH)	13.40 ± 11.80	23.86 ± 12.30	0.024*

[a]Difference in degrees between the values of postural alignments while texting on the smartphone and anatomical position (baseline). In the anterior view, the negative sign (-) in the HAH and the positive sign (+) in the HAA represent head tilt and shoulder elevation on the left side, respectively. *p<0.05; #, variable added in the multivariate analysis.

Smartphone usage time (>6 hours/day) was associated with frequently drinking (OR=3.219; p=0.003), sleep disorders (OR=3.246; p=0.033) and headache (OR=5.527; p=0.000) (Table 3). The multivariate analysis showed that smartphone usage time (>6 hours/day) was associated with cervical anteriorization, estimated by measuring the VAH (OR=1.053; p=0.007 – left side), female gender (OR=2.729; p=0.046), frequently drinking (OR=2.636; p=0.038) and headache (OR=5.617; p=0.002) (Table 4).

Table 3. Bivariate analysis of the relationship between smartphone usage time and socioeconomic variables and health conditions in teenage university students. Fortaleza, Ceará, 2018

Variable	Smartphone usage time		Crude OR (95%CI)	p-value
	≤ 6 hours	> 6 hours		
	n (%)			
Gender				0.200#
Boys	15 (41.7)	29 (29.9)	1	
Girls	21 (58.3)	68 (70.1)	1.675 (0.758-3.699)	
Paid job				0.524
No	32 (88.9)	82 (84.5)	1	
Yes	4 (11.1)	15 (15.5)	1.463 (0.451-4.744)	
Smoking				0.188#
Never smoked	33 (91.7)	80 (82.5)	1	
Former smoker	3 (8.3)	17 (17.5)	2.338 (0.642-8.514)	
Drinking				0.003*
No	19 (52.8)	25 (25.8)	1	
Yes	17 (47.2)	72 (74.2)	3.219(1.451-7.142)	
Sleep disorder				0.033*
No	32 (88.9)	69 (71.1)	1	
Yes	4 (11.1)	28 (28.9)	3.246 (1.050-10.034)	
Self-rated general health				0.455
Good	23 (63.9)	55 (56.7)	1	
Poor	13 (36.1)	42 (43.3)	1.351(0.613-2.976)	
Eyeglasses/contact lenses				0.145#
No	18 (50.0)	35 (36.1)	1	
Yes	18 (50.0)	62 (63.9)	1.771 (0.817-3.840)	
Cervical pain				0.998
No	13 (36.1)	35 (36.1)	1	
Yes	23 (63.9)	62 (63.9)	1.001 (0.452-2.220)	
Headache				0.000*
No	13 (36.1)	9 (9.3)	1	
Yes	23 (63.9)	88 (90.7)	5.527(2.104-14.519)	
Physical activity				0.874
Inactive	18 (50.0)	47 (48.5)	1	
Active	18 (50.0)	50 (51.5)	1.064 (0.495-2.286)	

OR: odds ratio; 95%CI: 95% Confidence Interval. Chi-squared test, *p<0.05; #, variable included in the multivariate analysis.

Table 4. Multivariate analysis of the relationship between smartphone usage time and postural alignment, socioeconomic variables and health conditions in teenage university students. Fortaleza, Ceará, 2018

Variable	Adjusted OR (95%CI)	p-value
Right side VAH	1.018 (0.957-1.083)	0.569
Left side VAH	1.053 (1.014-1.094)	0.007*
Gender	2.729 (1.017-7.328)	0.046*
Smoking	1.755 (0.361-8.529)	0.486
Drinking	2.636 (1.054-6.592)	0.038*
Sleep disorder	2.429 (0.714-8.258)	0.155
Eyeglasses/contact lenses	1.566 (0.643-3.813)	0.323
Headache	5.617 (1.900-16.606)	0.002*

OR: odds ratio; 95%CI: 95% confidence interval; VAH: vertical alignment of the head. Final model parameters: 0.212 (Cox & Snell); 0.306 (Nagelkerke); χ^2 of the model=31.189. *p<0.05

DISCUSSION

Monitoring the time adolescents spend on smartphones has been a subject of study because it is a predictor of smartphone addiction. In addition, other health problems such as sleep disorders and depression are associated it[10]. A Brazilian population-based study showed that more than 2 hours a day of screen time is associated with factors such as being in an upper social class, having educated parents, and living in urban areas. Furthermore, sedentary behavior, unhealthy lifestyle, and overweight are associated with extended screen time[11].

With regard to the smartphone usage time, the present study found that 73% of teenage university students used their smartphone excessively for more than 6 hours a day. Similar results were found in young populations in England[12] and Thailand[13], with an average of 5 hours a day. Another study conducted in Lebanon found that about 49% of the adolescents analyzed excessively used smartphones for more than 5 hours a day[14]. On the other hand, a study of Japanese adolescents found a shorter time – an average of 3 hours a day[15].

About postural alignment, the teenage university students analyzed in our study presented cervical anteriorization when reading/texting on the smartphone and it was associated with more than 6 hours a day of smartphone use. Other two studies carried out in China also showed that university students engaged in a flexed posture and displayed head anteriorization and increased neck flexion angle compared with the anatomical position16,2. A Korean study conducted with 50 university students (mean age of 21 years) measured the craniovertebral angle and found that the extended use of smartphones for more than 4 hours a day was associated with the anteriorization of the head[5].

Previous studies suggest that prolonged and/or frequent use of smartphones with the head flexed and tilted forward may be one of the main factors that contribute to the prevalence of neck pain in smartphone users[17]. This posture generates overload of musculoskeletal structures such as muscles, ligaments, and intervertebral discs in the cervical region, thereby causing inflammatory and degenerative processes[18].

In the present study, the smartphone usage time (>6 hours a day) was also associated with female gender, headache and frequently drinking. In regard to gender, there are also differences in duration and patterns of smartphone use. A study of Japanese adolescents found that girls spent more time a day on smartphones compared with boys[15]. In contrast, a study conducted with teenage university students in Korea found a higher rate of smartphone addiction among boys[19].

Many studies have addressed the association of prolonged smartphone use with neck pain. However, just a few studies have assessed its association with headache. A French study carried out with 4,927 participants (mean age of 20 years) showed that high levels of screen time exposure was associated with headache[1]. A similar finding was reported in a study carried out with Swedish adolescents (15-19 years old) which demonstrated that headache was associated with continuous use of smartphones[20].

As for alcohol consumption, a study carried out in South Korea with 448 university students showed that female gender, internet use, drinking, and anxiety were risk factors for smartphone addiction. The study also suggested that the consumption of alcoholic beverages may be associated with smartphone addiction because both favor interpersonal relationships[21]. Contrary to these findings, a study of 1,519 students in Switzerland did not find a relationship between smartphone addiction and alcohol and tobacco consumption[22].

The Brazilian Society of Pediatrics is concerned about the health of adolescents in the Digital Age and has recommended, among other things, to set a time limit for smartphone use, talk to adolescents in order to improve their understanding of conscious use, and avoid screen exposure during meals and 1-2 hours before bed[23].

Despite these recommendations, there is still a shortage of evaluations and treatments to tackle the problem in Brazil.

Also, there are no specific programs for the prevention or treatment of this condition and its associated health problems in primary health care centers[6]. Currently, there is no public policy in the country aimed at reducing risks and damages caused by prolonged screen time. The Brazilian Civil Rights Framework for the Internet addresses only the rights and responsibilities of those who use the Internet; it does not address the health consequences of prolonged screen time[24].

The present study also warns of the importance of adopting an adequate posture by keeping the device at eye level with support from upper limbs to prevent muscle and postural dysfunction in the general population and, in particular, in adolescents[18].

One limitation of the present study was the absence of specific questionnaires to collect data related to the smartphone usage time, alcohol consumption, and complaints of headache and sleep disorders, which can generate bias in the information provided by the participants. Another limitation was the participation of adolescents from one single university, which makes it difficult to generalize the findings to the general population. Furthermore, the age of the participants was limited to 18-19 years as they are the most common ages on admission to university in the country.

CONCLUSIONS

There was a high percentage of adolescents who excessively used smartphones for more than 6 hours a day. Prolonged smartphone use was associated with female gender, alcohol consumption, headache, and postural changes such as head anteriorization. Our findings warn of the importance of educational campaigns to guide adolescents, parents, educators, and health professionals on the impact of prolonged smartphone use on the health of adolescents and the factors associated with such behavior.

REFERENCES:

1. Montagni I, Guichard E, Carpenet C, Tzourio C, Kurth T. Screen time exposure and reporting of headaches in young adults: A cross-sectional study. Cephalalgia. 2016;36(11):1020–7.

2. Guan X, Fan G, Wu X, Zeng Y, Su H, Gu G, et al. Photographic measurement of head and cervical posture when viewing mobile phone: a pilot study. Eur Spine J. 2015;24(12):2892-8.

3. Brazilian Internet Steering Committee. Pesquisa sobre o uso da internet por crianças e adolescentes no Brasil [Internet]. São Paulo; CGI.BR; 2019 [accessed 2021 Feb 14]. Available from: www.cgi.br

4. Montag C, Błaszkiewicz K, Sariyska R, Lachmann B, Andone I, Trendafilov B, et al. Smartphone usage in the 21st century: Who is active on WhatsApp? BMC Res Notes. 2015;8(331):1-6.

5. Jung SI, Lee NK, Kang KW, Kim K, Lee DY. The effect of smartphone usage time on posture and respiratory function. J Phys Ther Sci. 2016;28(1):186-9.

6. Spritzer DT, Kessler FHP. Playing the wrong game again? Policy responses to problematic video gaming in Brazil. J Behav Addict. 2018;7(3):518-21.

7. Silva J, Andrade A, Capistrano R, Lisboa T, Andrade RD, Felden ÉPG, et al. Níveis insuficientes de atividade física de adolescentes associados a fatores sociodemográficos, ambientais e escolares. Cien Saude Colet. 2018;23(12):4277-88.

8. Ferreira EAG, Duarte M, Maldonado EP, Burke TN, Marques AP. Postural assessment software (PAS/SAPO): Validation and reliabiliy. Clinics. 2010;65(7):675-81.

9. Mundo do Marketing. Radar Jovem 2016. Smartphone: Herói ou vilão [Internet]. 2017 [accessed 2021 Feb 14]. Available from: https://www.mundodomarketing. com.br/inteligencia/pesquisas/511/smartphone-heroi-ou-vilao-.html

10. Dewi RK, Efendi F, Has EMM, Gunawan J. Adolescents' smartphone use at night, sleep disturbance and depressive

symptoms. Int J Adolesc Med Health. 2018;2018:1-8.

11. Guedes DP, Desiderá RA, Gonçalves HR. Prevalence of excessive screen time and correlates factors in Brazilian schoolchildren. Rev Bras Atividade Física Saúde. 2018;23:1-10.

12. Andrews S, Ellis DA, Shaw H, Piwek L. Beyond self-report: Tools to compare estimated and real-world smartphone use. PLoS One. 2015;10(10):1-9.

13. Namwongsa S, Puntumetakul R, Neubert MS, Boucaut R. Factors associated with neck disorders among university student smartphone users. Work. 2018;61(3):367-78.

14. Boumosleh JM, Jaalouk D. Depression, anxiety and smartphone addiction. PLoS One. 2017;12(8):1-14.

15. Nishida T, Tamura H, Sakakibara H. The association of smartphone use and depression in Japanese adolescents. Psychiatry Res. 2019;273:523-7.

16. Guan X, Fan G, Chen Z, Zeng Y, Zhang H, Hu A, et al. Gender difference in mobile phone use and the impact of digital device exposure on neck posture. Ergonomics. 2016;59(11):1453-61.

17. Lee S, Kang H, Shin G. Head flexion angle while using a smartphone. Ergonomics. 2015;58(2):220-6.

18. Hansraj KK. Assessment of stresses in the cervical spine caused by posture and position of the head. Surg Technol Int. 2014;25:277-9.

19. Kim EY, Joo SW, Han SJ, Kim MJ, Choi SY. Depression, impulse control disorder, and life style according to smartphone addiction. Stud Health Technol Inform. 2017;245:1272.

20. Söderqvist F, Carlberg M, Hardell L. Use of wireless telephones and self-reported health symptoms: A population-based study among Swedish adolescents aged 15-19 years. Environ Health. 2008 May 21;7:18.

21. Choi S-W, Kim D-J, Choi J-S, Ahn H, Choi E-J, Song W-Y, et al. Comparison of risk and protective factors associated with smartphone addiction and Internet addiction. J Behav Addict. 2015;4(4):308-14.

22. Haug S, Paz Castro R, Kwon M, Filler A, Kowatsch T, Schaub MP. Smartphone use and smartphone addiction among young people in Switzerland. J Behav Addict. 2015;4(4):299-307.

23. Sociedade Brasileira de Pediatria. Saúde de Crianças e Adolescentes na Era Digital [Internet]. Rio de Janeiro: SBP; 2016 [accessed 2021 Feb 14]. Available from: https://www.sbp.com.br/fileadmin/user_upload/2016/11/19166d-MOrient--Saude-Crian-e-Adolesc.pdf

24. Brasil. Lei nº 12.965, de 23 de abril de 2014. Estabelece princípios, garantias, direitos e deveres para o uso da Internet no Brasil. Diário Oficial da União [Internet]. 2014 [accessed 2021 Feb 14]; 24 Apr. Available from: https://www.in.gov.br/materia/-/asset_publisher/Kujrw0TZC2Mb/content/id/30054611/do1-2014-04-24-lei-n-12-965-de-23-de-abril--de-2014-30054600