eISSN 2255-0569

ORIGINAL

Association between Smart Phones Addiction and Digital Eye strain Syndrome among Private Universities Students in Riyadh

Asociación entre la adicción a los teléfonos inteligentes y el síndrome de fatiga visual digital entre los estudiantes de universidades privadas de Riad

Mansour Khater Alzahrani

1. Department of Family and Community Medicine, College of Medicine, Majmaah University, Majmaah, Saudi Arabia

Corresponding author
Mansour Khater Alzahrani
E-mail: m.alzahrani@mu.edu.sa

Received: 9 - X - 2023
Accepted: 13 - XI - 2023

doi: 10.3306/AJHS.2024.39.02.81

Abstract

Background: Nowadays, smartphones play an important role in our lives, but despite their importance, many studies have shown that using smartphones for long periods of time has negative health effects, especially on the eyes. The most prevalent ocular illnesses brought on by excessive smartphone and computer use are dry eye, diplopia and, digital eye strain syndrome. This study aims to assess the association between smart phones addiction and digital eye strain syndrome among private universities students in Riyadh.
Method: This cross-sectional study was conducted in private universities in capital city of Saudi Arabia, Riyadh. A target population was medical and non-medical females and males private universities students. The questionnaire was used as tool for collecting the data. It was consisted of Arabic version of the problematic use of mobile phones (PUMP) scale. The PUMP scale is a 20-item questionnaire that assesses mobile phone use based on the DSM-5 criteria for substance use disorder. In addition to, Digital eye strain report: convergence insufficiency symptoms questionnaire. The questionnaire was distributed to students manually and online. Time period for study was 8 months from January to August 2019.
Results: The study included 527 participants in total. Almost two-quarters of the participants were medical students, whereas one-quarter were non-medical students. Females made up the majority of the participants, accounting for 427 (81%) of the total, with males accounting for 100 (19%). This survey discovered that 45% of participants used smart gadgets for 7 hours or more, followed by n=217 (41.2%) who used them between 4-6 hours, and just 14% who used them between 1-3 hours. Participants n=485 (92% used a smartphone), followed by a laptop n=25 (4.7%), an iPad n=9 (1.7%), and less than 1% utilized a desktop computer or video games.
Conclusion: According to the study's findings, most college students use their smartphones for seven hours or longer every day. This discovery was strongly linked to the emergence of digital eye strain syndrome.

Key words: Smartphones, addiction, digital eye strain syndrome, university students.

Resumen

Antecedentes: Hoy en día, los teléfonos inteligentes desempeñan un papel importante en nuestras vidas, pero a pesar de su importancia, muchos estudios han demostrado que el uso de teléfonos inteligentes durante largos períodos de tiempo tiene efectos negativos para la salud, especialmente en los ojos. Las enfermedades oculares más prevalentes provocadas por el uso excesivo de smartphones y ordenadores son el ojo seco, la diplopía y, el síndrome de tensión ocular digital. Este estudio tiene como objetivo evaluar la asociación entre la adicción a los teléfonos inteligentes y el síndrome de tensión ocular digital entre los estudiantes de universidades privadas en Riad.
Metodología: Este estudio transversal se llevó a cabo en universidades privadas de la capital de Arabia Saudí, Riad. La población objetivo eran estudiantes de universidades privadas de ambos sexos, médicos y no médicos. Se utilizó un cuestionario como herramienta de recogida de datos. Estaba compuesto por la versión árabe de la escala de uso problemático del teléfono móvil (PUMP). La escala PUMP es un cuestionario de 20 ítems que evalúa el uso del teléfono móvil basándose en los criterios del DSM-5 para el trastorno por uso de sustancias. Además de, Informe de tensión ocular digital: cuestionario de síntomas de insuficiencia de convergencia. El cuestionario se distribuyó a los estudiantes de forma manual y en línea. El período de tiempo para el estudio fue de 8 meses de enero a agosto de 2019.
Resultados: El estudio incluyó 527 participantes en total. Casi dos cuartas partes de los participantes eran estudiantes de medicina, mientras que una cuarta parte eran estudiantes no médicos. Las mujeres constituyeron la mayoría de los participantes, representando 427 (81%) del total, mientras que los hombres representaron 100 (19%). Esta encuesta descubrió que el 45% de los participantes utilizaban los gadgets inteligentes durante 7 horas o más, seguidos de n=217 (41,2%) que los utilizaban entre 4 y 6 horas, y sólo un 14% que los utilizaban entre 1 y 3 horas. Los participantes n=485 (92% utilizaban un smartphone), seguidos de un ordenador portátil n=25 (4,7%), un iPad n=9 (1,7%), y menos del 1% utilizaba un ordenador de sobremesa o videojuegos.
Conclusiones: Según los resultados del estudio, la mayoría de los estudiantes universitarios utilizan sus smartphones durante siete horas o más cada día. Este descubrimiento está estrechamente relacionado con la aparición del síndrome de fatiga visual digital.

Palabras clave: Smartphones, adicción, síndrome de fatiga visual digital, estudiantes universitarios.

Cite as: Mansour Khater Alzahrani. Association between Smart Phones Addiction and Digital Eye strain Syndrome among Private Universities Students in Riyadh. *Academic Journal of Health Sciences 2024*; 39 (2):81-86 doi: 10.3306/AJHS.2024.39.02.81

Introduction

The term "smartphone" refers to a mobile phone that has many of the capabilities of a computer. It frequently has an operating system, a touch screen interface, and Internet access since it can run downloaded programs. Although the phrases smartphone, mobile phone, and cell phone are now commonly used synonymously, the primary functions of mobile phones and cell phones twenty years ago were calls and SMS messages[1].

Smartphones have become a big part of our lives because of all of their benefits, which include easy access to information, social networking, business applications, convenience of use, mobility, size, and so on. Additionally, cellphones are becoming essential in the medical area as both patients and medical professionals work to advance patient well-being. But in recent years, there has also been a rise in worry about the drawbacks of smartphone use[2].

Before smartphones became widely used, a Saudi Arabian study connected using a phone with a number of health risks, including headaches, sleep disruptions, tension, weariness, and dizziness[3]. Later, a Saudi Arabian study revealed that the medical student participants blamed their usage of mobile phones for their headaches, poor focus, memory loss, hearing loss, and exhaustion. Also, because users gaze at the screen for considerably longer than they do with regular mobile phones, smartphones may have negative health impacts, particularly on the eyes[4]. According to recent reports, the usage of a smartphone most adversely affects the eye. However, there is a dearth of information in the medical literature about how smartphones affect eyes. Visual problems are a widespread issue that affect people of all ages and have a significant impact on the financial and economic health of nations. The most prevalent ocular illnesses brought on by excessive smartphone and computer use, particularly in young adults who are regarded as the most frequent users of these gadgets, are dry eye, diplopia and digital eye strain syndrome[5].

Digital eye strain syndrome, also referred to as computer vision syndrome (CVS), is a transient condition caused by using smart devices for longer than two hours. Symptoms include eyestrain, tired eyes, irritation, redness, blurred vision, and double vision. The impact of digital eye strain on visual comfort and work productivity is significant. About 90%[6] of people reported having visual symptoms such as headache, ocular discomfort, diplopia, blurred vision, and dry eyes. The study's objective is to evaluate the relationship between digital eye strain syndrome and smartphone addiction among Riyadh's private university students. Computer vision syndrome (CVS), another name for digital eye strain syndrome, is a transient symptom that includes fatigue and eyestrain.

Methodology

Study design

The researcher used a cross-sectional study design to assess the association between smart phones addiction and digital eye strain syndrome among private universities students in Riyadh.

Participants

The study was conducted in private universities in capital city of Saudi Arabia, Riyadh. A target population was medical and non-medical females and males private universities students. Participants from universities, collages who were above 18 years and above, using smart phones regularly with no history of blindness or vision loss, mental and physical disabilities were included in the study.

Sampling procedure

The sample type was simple random technique. The sample size were 500 universities students including both females and males, a minimum sample size was 384 according to the formula $n= (z^2 (p) (1-p))/c^2$ where

z = standard normal deviation set at 95% confidence level (1.96)
p = percentage picking a choice or response (p = 0.50, 1 – p = 0.50)
c = confidence interval (0.05)
For more precise results we increased the sample size to 500

Instruments

This study used a validated questionnaire as tool for collecting the data. The data were collected from study subjects by trained students using online and direct methods. A questionnaire was deployed to respondents who agreed to participate in the research and signed the consent form.

The questionnaire consists of three parts:

First part: It is a cover letter to greet the participants in the study, and to clarify the purpose and objective of the study, and that the information collected from the study has its privacy and is dealt with in strict confidence, and they have the right to participate in the study or refuse to participate.

Second part: These are demographic data to know the age, gender, marital status and other information about educational characteristics and smart devise usage.

Third part: This part contains Arabic version of the problematic use of mobile phones (PUMP) scale. The PUMP scale is a 20-item questionnaire that assesses mobile phone use based on the DSM-5 criteria for substance use disorder. In addition to, Digital eye strain report: convergence insufficiency symptoms questionnaire.

Ethical consideration

Consent was taken from the participants; all the information were used for statistical analysis only for more confidently.

Data collection

The questionnaire was distributed to students manually and online. Time period for study was 8 months from January to August 2019. The researcher eliminated all invalid, incomplete responses, or any responses that did not match the inclusion criteria. The number of valid questionnaires for statistical analysis was 527.

Statistical treatment

The statistical program SPSS-20 was used to analyze the data of the study. The data was entered and analyzed using IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp. Normality of PUMP score was checked through one-sample Kolmogorov – Smirnov test. As the data was normally distributed, therefore, mean + SD has been reported. Two-Independent Sample t test was used to compare the PUMP score and computer vision syndrome. One-Way Analysis of Variance (ANOVA) was also applied to compare PUMP score with variables having three categories and more. Post-HOC Tukey Test was applied to see which group means differ significantly. A p-value of <0.05 was considered as statistically significant.

Results

Table I: Socio-demographic characteristics of participants (n=527).

	n (%)
Age (years)	
18-25	465 (88.2)
26-33	43 (8.2)
34-41	13 (2.5)
42-49	3 (0.6)
50-55	3 (0.6)
Gender	
Male	100 (19.0)
Female	427 (81.0)
Marital Status	
Single	449 (85.2)
Married	73 (13.9)
Divorced	3 (0.6)
Widow / widowed	2 (0.4)

The age group of 18 to 25 years old comprised the majority of participants (n = 465, 88.2%), followed by the age group of 26 to 33 years old (n = 43, 8.2%). A small percentage of respondents (n=19, or 3.7% of the total) were in the 34-55 age range. Women made up the majority of participants, n=427 (81%) versus men, n=100 (19%). Of the participants, n=449 (85.2%) were single, 14% were married, and a smaller proportion were widowed and divorced.

The majority of the participants 240 (45.5%) were studying at Dar Al Uloom University (DAU), followed by 101 (19.2%) at Al Maarefa University (AMU), 60 (11.4%) at Prince Sultan University (PSU), and nearly 6% at Riyadh Elm University (REU), King Faisal University (KFU), and Inaya Medical College (IMC). Participants came from Al Farabi College (FC), Al Yamamah University (YU), Al Ghad Colleges (GC), Arab Open University (AOU), and other institutions. Academic performance of the majority of participants was very good (n=261 (49.5%), with approximately 28% achieving excellent performance, one-fifth achieving good academic performance, and only n=15 (2.8%) achieving poor academic performance. According to hours spent, 45% of participants used smart devices for 7 hours or more, followed by 217 (41.2%) who used them between 4-6 hours, and only 14% used them between 1-3 hours. The distribution of participants studying in grades 1st-2nd and 3rd-4th was nearly equal (18%). Around 15% were in their 13th-14th year, followed by the 7th-8th (13.3%), 9th-10th (12.5%), 9% in their 11th-12th year, 2% in their master's, and a small number in their Ph.D. Participants 485 (92% used a smartphone), followed by a laptop 25 (4.7%), an iPad 9 (1.7%), and less than 1% used a desktop computer or video games.

Table II: Educational characteristics and smart devise usage of participants (n=527).

	n (%)		n (%)
University		Academic Level	
DAU	240 (45.5)	1st – 2nd	97 (18.4)
AMU	101 (19.2)	3rd – 4th	96 (18.2)
PSU	60 (11.4)	5th – 6th	62 (11.8)
IMC	34 (6.5)	7th – 8th	70 (13.3)
KFU	33 (6.3)	9th – 10th	66 (12.5)
REU	31 (5.9)	11th – 12th	47 (8.9)
FC	12 (2.3)	13th – 14th	76 (14.4)
Others	5 (0.9)	Master	10 (1.9)
YU	4 (0.8)	Ph.D.	3 (0.6)
GC	4 (0.8)		
AOU	3 (0.6)		
Academic Performance		Smart Device	
Excellent	146 (27.7)	Mobile phone	485 (92.0)
Very Good	261 (49.5)	Laptop	25 (4.7)
Good	105 (19.9)	iPad	9 (1.7)
Poor	15 (2.8)	Video game	5 (0.9)
		Desktop computer	3 (0.6)
Hours Spending (hours)		Specialty	
1-mar	73 (13.9)	Non-medical	189 (35.9)
4-jun	217 (41.2)	Medical	338 (64.1)
7 and above	237 (45.0)		

When computer vision syndrome was studied, n=316 (60%) of the participants reported headaches, complain of eye strain was stated by n=56 (10.6%), nearly one-fifth of the participants had blurred near and distant vision after using the smart devices. Around 15% of the participants reported glare, watery eyes n=27 (5.1%), itching n=95 (18%), red eyes n=413 (78.4%), back pain n=155 (29.4%), neck shoulder pain n=306 (58.1%), double vision n=47 (8.9%), dry eyes n=198 (37.6%) and burning was reported by n=193 (36.6%) of the participants. Almost 60% of the participants were using screens at lower level, more than one-quarter were using screens at the same level and around 6% were using the screens above the recommended level.

Table III: Computer Vision Syndrome (n=527).

Variables	n (%)		n (%)
Headaches		Red Eyes	
Yes	316 (60.0)	Yes	413 (78.4)
No	211 (40.0)	No	114 (21.6)
Eye Strain		Back Pain	
Yes	56 (10.6)	Yes	155 (29.4)
No	471 (89.4)	No	372 (70.6)
Blurred Near Vision		Neck Shoulder Pain	
Yes	104 (19.7)	Yes	306 (58.1)
No	423 (80.3)	No	221 (41.9)
Blurred Distant Vision		Double Vision	
Yes	88 (16.7)	Yes	47 (8.9)
No	439 (83.3)	No	480 (91.1)
Glare		Dry	
Yes	74 (14.0)	Yes	198 (37.6)
No	453 (86.0)	No	329 (62.4)
Watery Eyes		Burning	
Yes	27 (5.1)	Yes	193 (36.6)
No	500 (94.9)	No	334 (64.4)
Itching		Center Screen	
Yes	95 (18.0)	Lower	310 (58.8)
No	423 (82.0)	Same Level	185 (35.1)
		Above	32 (6.1)

A significant difference was observed between the problematic use of mobile phones (PUMP) Score and computer vision syndrome. Results presented in **table I** showed that the PUMP score was significantly raised in participants who had headaches (p<0.001), eye strain (p=0.047), blurred near and distant vision (p<0.001) respectively, dry eyes (p=0.012), watery eyes (p=0.016), burning (p<0.001), itching (p<0.001), red eyes (p<0.001), back pain (p<0.001), neck & shoulder pain (p<0.001) and having double vision (p<0.001). However, PUMP score and glare was not statistically significant (p=0.078).

Results presented in **table II** showed that PUMP score was not significantly different when compared with age (p=0.072) and marital status (p=0.086). However, it was significant when compared between males and females (p<0.001). PUMP score of males was significantly higher as compared to females.

Table IV: Comparison of PUMP score with Computer Vision Syndrome.

	PUMP SCORE		
	No Mean + SD	Yes Mean + SD	p-value
Headache	55.42 + 15.89	60.50 + 14.80	< 0.001*
Eye Strain	58.02 + 15.43	62.21 + 15.12	0.047*
Blurred Near Vision	57.27 + 15.26	63.36 + 15.23	< 0.001*
Blurred Distant Vision	56.96 + 15.08	66.01 + 15.05	< 0.001*
Glare	57.99 + 15.25	61.41 + 16.28	0.078
Dry Eyes	57.16 + 15.51	60.64 + 15.10	0.012
Watery Eyes	58.09 + 15.21	65.41 + 18.08	0.016
Burning	56.68 + 15.50	61.57 + 14.86	< 0.001*
Itching	57.06 + 15.02	64.87 + 15.76	< 0.001*
Red Eyes	57.14 + 15.30	63.27 + 15.03	< 0.001*
Back Pain	56.81 + 15.16	62.45 + 15.41	< 0.001*
Neck & Shoulder Pain	54.61 + 15.57	61.25 + 14.75	< 0.001*
Double Vision	57.46 + 14.95	68.77 + 16.70	< 0.001*

*statistically significant at 5% level of significance

Table V: Comparison of PUMP score with socio-demographic data.

	n	Mean + S.D	p-value
Age			
18-25	465	58.65 + 14.77	0.772
26-33	43	57.74 + 19.10	
34-41	13	54.15 + 22.03	
42-49	3	53.67 + 21.07	
50-55	3	63.67 + 28.02	
Marital Status			
Single	449	58.79 + 14.82	0.086
Married	73	55.88 + 18.75	
Divorced	3	76.67 + 5.85	
Widow / Widowed	2	54.00 + 2.82	
Gender			
Male	100	64.95 + 14.64	< 0.001*
Female	427	56.95 + 15.24	

Table VI: Comparison of PUMP score with academic data and computer usage.

	n	Mean + S.D	p-value		n	Mean + S.D	p-value
University				**Academic Performance**			
DAU	240	56.21 + 15.39		Excellent			
AMU	101	60.57 + 13.42		Very Good	146	54.35 + 14.24**	
REU	31	57.45 + 16.33		Good	261	58.97 + 15.26	< 0.001*
PSU	60	61.40 + 13.74		Poor	105	62.70 + 15.54**	
KFU	33	59.42 + 18.50			15	60.33 + 20.33**	
IMC	34	56.35 + 12.82	0.563				
YU	4	62.00 + 10.98		**Specialty**			
GC	4	72.25 + 33.51		Medical	338	59.41 + 15.17	0.680
AOU	3	58.67 + 35.92		Non-Medical	189	56.79 + 15.80	
FC	12	70.25 + 14.07					
Others	5	61.40 + 21.19					
Year				**Center Screen**			
1st - 2nd	97	58.28 + 15.42		Lower	310	59.74 + 15.27**	
3rd - 4th	96	56.09 + 16.00		Same Level	185	55.90 + 15.72**	0.017*
5th - 6th	62	61.37 + 16.41**		Above	32	61.06 + 13.73	
7th - 8th	70	59.44 + 13.32**					
9th - 10th	66	57.86 + 15.61	0.031*	**Hours Spending**			
11th - 12th	47	57.02 + 13.13		1-mar	73	52.99 + 16.61	
13th - 14th	76	60.62 + 15.56		4-jun	217	55.38 + 13.84	< 0.001*
Master	10	61.10 + 19.88		7 and above	237	62.92 + 15.28**	
Ph.D.	3	30.67 + 2.309**					

*statistically significant at 5% level of significance.
**Tukey's test significant multiple comparisons.

A significant difference was observed in PUMP score when compared with year of study (p=0.031). Post-Hoc analysis showed that those having Ph.D. had a significant lower PUMP score as compared to those studying in 5th-6th grade (p=0.021) and 7th-8th grade (p=0.040). PUMP score was significantly different in academic performance (p<0.001). Post-Hoc analysis showed that participants having excellent academic performance had a significantly lower PUMP score as compared to participants having good (p<0.001) and very good (0.018) academic performance. PUMP score was also significantly different among participants who were using the computer screen at different levels (p=0.017). Post-Hoc analysis revealed that participants who were using same level had a significantly lower PUMP score when compared with lower level (p=0.020). Hours spending and PUMP score were also statistically significantly different (p<0.001). Post-Hoc analysis showed that participants who were spending 7 hours and above had a significantly higher PUMP score as compared to those who were spending 4-6 hours (0.021) and 1-3 hours (0.032).

Discussion

Smartphone use can have a negative impact on eye health. This study looked at the prevalence and pattern of smart phone addiction and digital eye strain syndrome among Riyadh students attending private universities. The survey was completed by 527 medical and non-medical students who participated in the study. Almost two-quarters of the participants were medical students, while one-quarter were non-medical students. Females made up the majority of the participants, accounting for 427 (81%) of the total, with males accounting for 100 (19%). This study discovered that 45% of participants used smart devices for 7 hours or more, followed by n=217 (41.2%) who used them between 4-6 hours, and only 14% who used them between 1-3 hours.

According to these findings, smartphone addiction affects between 9.3% and 48% of the global population[7]. In contrast to our findings, a study of 2367 respondents in the Kingdom of Saudi Arabia discovered that the majority (61%) of study participants reported using their smartphones for at least 5 hours per day, with 27.2% using them for more than 8 hours per day[7]. Another cross-sectional study with 2435 participants was conducted in Saudi Arabia using an online Google survey form. A cross-sectional survey of 203 sixth-year medical students at King Abdul-Aziz University's School of Medicine in Jeddah discovered that 66 (36.5%) of them were addicted to smartphones[8]. According to a mixed-method study that used a systematic review and meta-analysis, India has a 39-44% smartphone addiction rate[9]. A second investigation was carried out on a sample of 587 pupils from the discredited school. The smartphone addiction scale (SAS), which was used to assess student behavior, revealed that 53.62 percent of students were low smartphone users and 33.33 percent were heavy users[10].

Regarding to visual disturbances accompanying smartphone use, it was found that eye strain, glare, watery eyes, itching, red eyes, double vision, dry eyes, burning were more prevalent in smartphone users especially on spending long duration using the devices. In addition, other common health problems among smartphone users include headache, back pain, and neck shoulder pain.

Similarly, some research looked into the effects of electronic gadgets generally on Saudi Arabian female nursing college students in terms of their reliance, sociability, and health. This cross-sectional study found that headache and visual disturbance were the most common complaint among the students who were using visual materials[11]. Other Studies have looked at several health issues related to smartphone use in Indian college students. Student participants in the study ranged in age from 17 to 23. Headache, difficulty concentrating, impatience, anxiety, loss of sleep, tiredness, eye strain, and fatigue were the main symptoms that were assessed. The most prevalent symptom, experienced by 50% of the respondents surveyed, was a headache; visual symptoms were ranked sixth[12]. In a study with 576 teenagers conducted in India, there was a significant relationship between lying down while using a screen-enabled device and symptoms of digital eye strain. The majority of students had eye fatigue by the end of the day, which was caused by using digital screens[13]. In a survey of 409 medical college students in Jamaica, eye strain (67%), dry eyes (26.2%), double vision (28.9%), and blurred vision (51.6%) were identified as prevalent symptoms[14]. Research conducted in South Korea revealed that exposure to content on any digital screen, particularly a smartphone, increases the chance of developing DES in teenagers[15]. In general, smartphone addiction could cause significant digital eye strain Syndrome and other eye problems as a result of looking and exposure to electronic screen lighting for long hours.

Conclusion

In conclusion, the use of smartphone has expanded among college students. This can be related to the striking changes in student lifestyles in Saudi Arabia. The current study found that smartphones are a significant part of university students' daily lives. There was a direct correlation between smartphone use and the digital eye strain syndrome. This study made clear the necessity to raise awareness of the harmful effects that prolonged smartphone use has on our health.

Conflict of interests

The authors declare that there is no conflict of interests.

References

1. Bali J, Neeraj N, Bali RT. Computer vision syndrome: A review. Journal of clinical ophthalmology and research. 2014;2(1):61-8. https://doi.org/10.4103/2320-3897.122661.

2. Rosenfield M, Portello JK. Computer vision syndrome and blink rate. Current Eye Research. 2016;41(4):577-8. https://doi.org/10.3109/02713683.2015.1031352.

3. Al-Khlaiwi T, Meo SA. Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population. Saudi medical journal. 2004;25(6):732-6.

4. Sadagopan AP, Manivel R, Marimuthu A, Nagaraj H, Ratnam K, Kumar T. Prevalence of smart phone users at risk for developing cell phone vision syndrome among college students. Journal of Psychology & Psychotherapy. 2017;7(299):487–2161. https://doi.org/10.4172/2161-0487.1000299.

5 Bert F, Giacometti M, Gualano MR, Siliquini R. Smartphones and health promotion: a review of the evidence. Journal of medical systems. 2014;38:1-1. https://doi.org/10.1007/s10916-013-9995-7.

6. Sheppard AL, Wolffsohn JS. Digital eye strain: prevalence, measurement and amelioration. BMJ open ophthalmology. 2018;3(1):e000146. https://doi.org/10.1136/bmjophth-2018-000146.

7. Yahyazadeh S, Fallahi-Khoshknab M, Norouzi K, Dalvandi A. The prevalence of smart phone addiction among students in medical sciences universities in Tehran 2016. Advances in Nursing & Midwifery. 2017;26(94):1-10.

8. Alhazmi AA, Alzahrani SH, Baig M, Salawati EM. Prevalence and factors associated with smartphone addiction among medical students at King Abdulaziz University, Jeddah. Pakistan journal of medical sciences. 2018;34(4):984. https://doi.org/10.12669/pjms.344.15294.

9. Davey S, Davey A. Assessment of smartphone addiction in Indian adolescents: A mixed method study by systematic-review and meta-analysis approach. International journal of preventive medicine. 2014;5(12):1500.

10. Soni R, Upadhyay R, Jain M. Prevalence of smart phone addiction, sleep quality and associated behaviour problems in adolescents. International Journal of Research in Medical Sciences. 2017;5(2):515-9. http://dx.doi.org/10.18203/2320-6012.ijrms20170142.

11. El Kiweri IA, Al Ghamdi NA. Electronic devices: Content use and health effects in Saudi female nursing students. International Journal of Nursing and Health Science. 2015;2(3):21-7.

12. Acharya JP. Common health effects of cell phones among college students. Journal of Community Medicine and Health Education. 2013;3(1):1-4.

13. Ichhpujani P, Singh RB, Foulsham W, Thakur S, Lamba AS. Visual implications of digital device usage in school children: a cross-sectional study. BMC ophthalmology. 2019;19:1-8. https://doi.org/10.1186/s12886-019-1082-5.

14. Mowatt L, Gordon C, Santosh AB, Jones T. Computer vision syndrome and ergonomic practices among undergraduate university students. International journal of clinical practice. 2018;72(1):e13035. https://doi.org/10.1111/ijcp.13035.

15. Kim J, Hwang Y, Kang S, Kim M, Kim TS, Kim J, et al. Association between exposure to smartphones and ocular health in adolescents. Ophthalmic epidemiology. 2016;23(4):269-76. https://doi.org/10.3109/09286586.2015.1136652.