

Electronic Devices' Impact on Ocular Health

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Abstract

Globally, electronic devices are becoming more and more common; they are becoming a necessary tool for daily living and a portable technology that everybody can use. **Aims** to assess the effects of using electronic devices on the health condition of college students in particular eyes health on the other hands to evaluate internal and external symptoms that arise from prolonged use of electronic devices. A cross-sectional study was performed between November 2022 to April 2023, a sample of 99 student was selected conveniently from students of college of health and medical techniques. All students accept to full the questionnaire and undergo the examination were include in the study. those refused to answer the questionnaire or undergo the examination were excluded. In the existing study 99 students were involved, more than half of them 69.7% was 20-24 years old, the majority of them were males 57.6%, around 62% were not wearing glasses. The range of using electronic devices between 1-14 hours per day. The most commonly reported symptoms were eye strain 65.7% and headache 53.5% whereas watery/dry eye and difficulty in focusing were (44.4% & 42.4%) respectively. More than half of those with tilted position while using electronic devices associated significantly with headache symptoms p-value at 0.025 and watery/ dry eye p-value at 0.029. The significant relationship found between hours consumed on devices and symptoms as headache and watery/ dry eye with p-value 0.035 & 0.019 consequently. Highly association of head posture while using electronic devices with convergence p- value 0.000. Headache and wet/dry eyes are strongly associated with the amount of time spent in the ED. Major symptoms among students was eye strain followed by headache, watery/ dry eye then difficulty in focusing. Perform 20-20-20 rule, every 20 minutes look away at 20 feet for 20 second, also blinking more to refresh eyes. Pay attention to head posture to be in straight position. Avoid using these devices for more than one hour continuously.

Keywords: *Electronic devices, Ocular health, Eye strain, Watery eye, Head position.*

آثار الأجهزة الإلكترونية على العيون

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الخلاصة

أصبحت الأجهزة الإلكترونية شائعة على مستوى العالم؛ لقد أصبحت أداة ضرورية للحياة اليومية وتقنية محمولة يمكن للجميع استخدامها. يهدف إلى تقييم آثار استخدام الأجهزة الإلكترونية على الحالة الصحية لطلبة الكلية وخاصة صحة العيون من ناحية أخرى لتقييم الأعراض الداخلية والخارجية التي تنشأ من الاستخدام المطول للأجهزة الإلكترونية. تم إجراء دراسة مقطعية في الفترة ما بين نوفمبر 2022 وأبريل 2023، وتم اختيار عينة مكونة من 99 طالبًا بشكل ملائم من طلاب كلية التقنيات الصحية والطبية. يقبل جميع الطلاب إكمال الاستبيان ويخضعون للامتحان ويتم تضمينهم في الدراسة. تم استبعاد أولئك الذين رفضوا الإجابة على الاستبيان أو الخضوع للفحص. في الدراسة الحالية شارك 99 طالبًا، أكثر من نصفهم 69.7% تتراوح أعمارهم بين 20-24 عامًا، وكان معظمهم من الذكور 57.6%، وحوالي 62% لم يكونوا يرتدون النظارات. يتراوح استخدام الأجهزة الإلكترونية بين 1-14 ساعة يوميًا. وكانت الأعراض الأكثر شيوعاً هي إجهاد العين بنسبة 65.7% والصداع بنسبة 53.5%، بينما كانت العين الدامعة/جفاف العين وصعوبة التركيز 44.4% و 42.4% على التوالي. أكثر من نصف أولئك الذين لديهم وضعية مائلة أثناء استخدام الأجهزة الإلكترونية ارتبطوا بشكل كبير بأعراض الصداع، القيمة الاحتمالية عند 0.025 والقيمة الاحتمالية للعين الدامعة/جفاف العين عند 0.029. وجدت علاقة معنوية بين ساعات استخدام الأجهزة وأعراض الصداع والعين الدامعة/جفافها بقيمة $p = 0.035$ و $p = 0.019$ على التوالي. الارتباط العالي بوضعية الرأس أثناء استخدام الأجهزة الإلكترونية مع تقارب القيمة $p = 0.000$. يرتبط الصداع والعيون الرطبة/الجافة بقوة مع مقدار الوقت الذي يقضيه في قسم الطوارئ. وكانت الأعراض الرئيسية بين الطلاب هي إجهاد العين يليه الصداع والعين الدامعة/جفافها ثم صعوبة التركيز. قم بتنفيذ قاعدة 20-20-20، كل 20 دقيقة انظر بعيداً إلى مسافة 20 قدمًا لمدة 20 ثانية، وامض أيضاً أكثر لإنعاش العينين. انتبه إلى وضعية الرأس لتكون في وضع مستقيم. تجنب استخدام هذه الأجهزة لأكثر من ساعة متواصلة.

الكلمات المفتاحية: الأجهزة الإلكترونية، صحة العين، إجهاد العين، العين الدامعة، وضعية الرأس.

Introduction

Electronic devices are rapidly spreading throughout the world in existing years; it has become indispensable object in everyday life and mobile tool that everyone can easily used. There is a sharp increase in the availability and use of personal electronic devices as laptops, smartphones, tablets, and other related devices as well as computers at institutions. Individual's social life is greatly influenced by the uses of these devices [1-3]. When World Health Organization-declared novel coronavirus disease-19 (COVID-19) outbreak, a number of nations implemented nationwide lockdowns to reduce activities requiring human assembly and interaction, including educational institutions, in an effort to stop the virus's spread. The anticipated consequences of this global pandemic forced a most people turned to the internet and internet-based services during the lockdown in order to connect, communicate, and carry out their work from home. During the pandemic, online learning programs provided a solution. Compared to pre-lockdown levels, internet service usage increased from 40% to 100% [4, 5]. The long-term effects of using a smartphone or other portable digital device on the eyes remain unknown. However, using smartphones and tablets has been linked

to a variety of short-term ocular surface pain, visual discomfort, and asthenopia symptoms [6, 7]. Eye strain can be caused by a variety of activities, including prolonged phone use, computer use, and TV viewing.

This condition is frequently referred to as computer vision syndrome or digital eye strain [8]. The American Optometric Association states that daily computer or digital screen users who spend two or more hours on their devices are most at risk of acquiring digital eye strain (DES) [9]. A computer, tablet, e-reader, or smart phone is used for extended periods of time, which might cause digital eye strain (DES), which is defined as the combination of one or more vision-related symptoms [10]. There are two classes into which these asthenopia symptoms fall. Internal symptoms include the first group and include headaches, diplopia, blurred vision, and eye strain. The second category of symptoms consists of what are known as outward signs, such as burning, itching, tearing, and dryness [11]. Digital eye strain (DES) is very common in many demographics, with prevalence rates ranging from 50% to 90% and one million new cases annually [12-14]. Nearly 14% of patients seek an optical checkup due to computer vision syndrome, and many of those afflicted are unaware that they have the illness, according to an American Optometric Association report [15]. The strain on the human eye is often increased when reading information on a computer screen. In an attempt to adjust to this screen-heavy viewing environment, people often blink less than usual. Dry eyes are the result of prolonged periods without blinking, during which tears covering the eyes evaporate more quickly. The display will cause more eye strain the smaller and lower its resolution. The high visual demands of screens and the mental focus required for computer work cause a significant reduction in spontaneous eye blink rate while one is staring at a computer screen, smartphone, or tablet. People with uncorrected or under corrected refractive defects are particularly vulnerable due to the eye focusing and ocular motions necessary for improved vision of digital screens, which places additional demands on a complex balance between accommodation and convergence mechanisms [16- 18].

THE AIM: To assess the effects of using electronic devices on the health condition of college students in particular eyes health as well as to evaluate internal & external symptoms that arise from prolonged use of electronic devices.

Patients and Methods

A cross-sectional study was performed between November 2022 to April 2023, a sample of 99 students were selected conveniently from students of college of health and medical technology.

All students accept to full the questionnaire and undergo the examination were include in the study. Some were rejected to answer the inquiries the questionnaire, others refused to undergo the examination, those students were excluded from the study. Snellen chart [19] used to examine the visual acuity of both patient's eyes. Cover-uncover test is useful to identify tropia and differentiate it from phoria. The test is done by using an opaque occluder and target. Alternate cover test is used to detect total deviation [20]. Convergence test is a test that the optometrist does in order to test the ability of your eyes to come together effectively as you focus close to, it's done by pen. All these exams were done in the college's optics workshop.

These tests were achieved by professional investigator. A structured questionnaire was administered following the test that filled by the participant himself. The questionnaire consisted of demographic characteristics (age, gender, job, if he/she is wearing glasses), questions in concern with symptoms associated with the using electronic device as (has headache, eye strain, watery/dry eye, difficulty in focusing, electronic device usage period and type, head posture and place illumination), the final part was about eye exam information. Data were analyzed using the Statistical Package of Social Science software (SPSS) version 26; numerical values and percentages were used for categorical variables, while mean and standard deviation were utilized for quantitative variables. Chi-square test was used to detect association between variables that expressed as <0.05 p- value.

Results

A total of ninety-nine college students were involved in the present study, more than half of them 69.7% was 20-24 years, 57.6% were male and around 62% were not wearing glasses. The mean oh hours spent on electronic devices per day was 7 ± 2.89 hours.

Table (1): Demographic characteristics of study participants.

Demographic variables		N	%
Age group	<20 years	8	8.1%
	20- 40 years	69	69.7%
	25-29 years	16	16.2%
	≥ 30 years	6	6.1%
Gender	Male	57	57.6%
	Female	42	42.4%
Wearing glasses	Yes	37	37.4%
	No	62	62.6%
Use ED* hr./day	Mean \pm SD	7 \pm 2.89 hours	

* ED: electronic devices

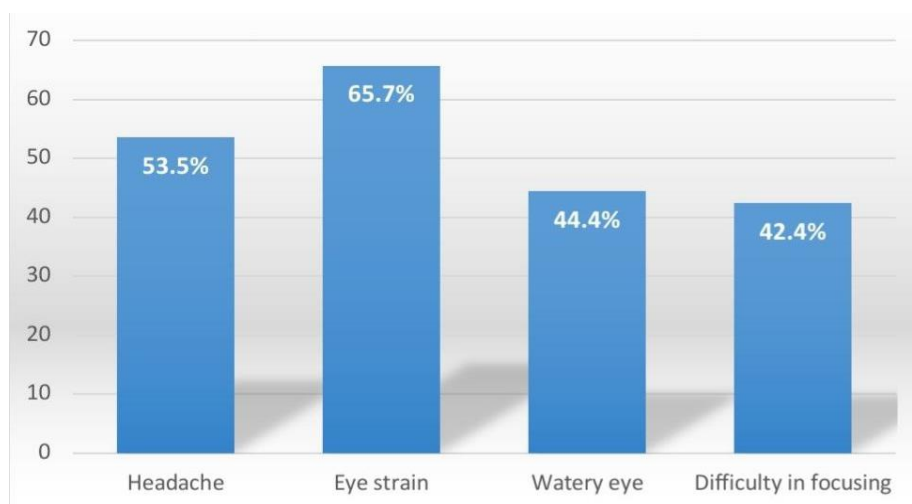


Fig. (1): Frequency (as percentage) of symptoms from using electronic devices.

Figure (1) shows the percentage of symptoms from using electronic devices. The most commonly reported symptoms were eye strain 65.7% and headache 53.5% whereas watery/dry eye and difficulty in focusing was (44.4% & 42.4%) respectively.

Head posture while used phones and other electronic devices may be straight or tilted, more than half of those with tilted position associated significantly with headache symptoms p-value 0.025 and watery/ dry eye p-value 0.029. Squint observed in thirty-eight percent with those have tilted situation while using electronic devices that were statistically associated significantly p-value <0.006, table (2).

Table (2): The relation between symptoms and head posture.

		Head posture				P- value
		Tilted		Straight		
		N	%	N	%	
Headache	Yes	28	66.7	25	43.9	0.025*
	No	14	33.3	32	56.1	
Eye strain	Yes	29	69.0	36	63.2	0.542
	No	13	31.1	21	36.8	
Watery/ dry eye	Yes	24	57.1	20	35.1	0.029*
	No	18	42.9	37	64.9	
Squint	Yes	16	38.1	8	14.0	0.006*
	No	26	61.9	49	86.0	

As regard with time spent on electronic devices, the significant association found between hours consumed on devices and symptoms as headache and watery/ dry eye with p-value 0.035 & 0.019 consequently. There is no association between hours expended on phones or other electronic

devices with symptoms as eyestrain and difficulty in focusing p-value > 0.05. The majority of students spend more than 10 hours per day on electronic devices wear glasses 52.4% table (3).

Table (3): The relation between symptoms & electronic devices spending time.

Symptoms		Period						P- value
		< 5 hours		5-10 hours		≥ 10 hours		
		N	%	N	%	N	%	
Wearing glasses	Yes	7	46.7	19	30.2	11	52.4	0.137
	No	8	53.3	44	69.8	10	47.6	
Headache	Yes	9	60.0	28	44.4	16	76.2	0.035*
	No	6	40.0	35	55.6	5	23.8	
Eye strain	Yes	10	66.7	39	61.9	16	76.2	0.488
	No	5	33.3	24	38.1	5	23.8	
Watery/ dry eye	Yes	6	40.0	23	36.5	15	71.4	0.019*
	No	9	60.0	40	63.5	6	28.6	
Difficulty in focusing	Yes	8	53.3	25	39.7	9	42.9	0.629
	No	7	46.7	38	60.3	12	57.1	

Discussion

Recently, electronic devices have become increasingly significant in people's social lives. With the increasing popularity of mobile phones as a communication tool, telephone functions have expanded and evolved into smartphones in recent years. Smartphones have replaced computers because of numerous applications and non-telephone services they offer, like access to social media. In addition to the advantages of smart phones in daily life, excessive use has been linked to health risks, including a decline in real-world social interaction and academic performance, headaches, neck discomfort, exhaustion, sleep disruptions, memory loss, hearing loss, and concentration problems.

According to the World Health Organization (WHO), exposure to radiofrequency electromagnetic field radiation (RF-EMFR) from mobile phones raises body core temperature and may impair cognition. Another research indicates that using these electronic devices can have adverse effects on one's health [21-23]. Although there is no significant association between period spent on electronic devices and eyestrain in present study, the highest percentage of eyestrain was found among those still 10 hours on devices or more, that may be related to the role of orbicularis oculi muscle that is required during demanding computer work [24]. Another reference shows that Visual stress increases with factors such as refractive disorders, convergence insufficiency, and screen & surface glare [25]. Headache and dry eye associated significantly with period that individuals be on

electronic devices in present study, another study done by Thorud [24] in 2012 also reveals significant association of dry eye with time spent on devices whereas no association detected with the headache in particular those spent 2 hours on these devices, this is due to limited time spent on them. Unconsciously smartphones users putting their necks into an overstressed forward curve that was known as text neck syndrome [26]. This causes several problems significantly as headache, watery and dry eye, squint, that was approved in current study p-value <0.05 . Other study done in AL-Emirate in [27] 2021 shows the same findings. The interpretation is that eye strain, which is caused by improper focusing and can increase with excessive phone use and holding the device too close to your face, can also cause headaches, according to the American Migraine Foundation [28].

Conclusions

Headache and wet/dry eyes are strongly associated with the amount of time spent in the ED. Major symptoms among students was eye strain followed by headache, watery/dry eye then difficulty in focusing.

Recommendation

Perform 20-20-20 rule, every 20 minutes look away at 20 feet for 20 seconds, also blinking more to refresh eyes. Pay attention to head posture to be in straight position. Avoid using these devices for more than one hour continuously.

References

1. Noori, T. A., Hassan, K. S., & Hassan, T. A. Social, Psychological and Behavioral Implications of Smart Phone Use among Children less than 10 Years in Iraq.
2. Statista. Number of smartphone users worldwide from 2014 to 2020 (in billions). 2019. Available from: <https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/> (cited: 18 March 2020).
3. Chesley, N. (2014). Information and communication technology use, work intensification and employee strain and distress. *Work, employment and society*, 28(4), 589-610.
4. Kasulaitis, B., Babbitt, C. W., & Tyler, A. C. (2021). The role of consumer preferences in reducing material intensity of electronic products. *Journal of Industrial Ecology*, 25(2), 435-447.
5. Pandey, N., & Pal, A. (2020). Impact of digital surge during Covid-19 pandemic: A viewpoint on research and practice. *International journal of information management*, 55, 102171.
6. Moon, J. H., Kim, K. W., & Moon, N. J. (2016). Smartphone use is a risk factor for pediatric dry eye disease according to region and age: a case control study. *BMC ophthalmology*, 16(1), 1-7.
7. Kim, D. J., Lim, C. Y., Gu, N., & Park, C. Y. (2017). Visual fatigue induced by viewing a tablet computer with a high-resolution display. *Korean Journal of Ophthalmology*, 31(5), 388-393.
8. Klamm, J., & Tarnow, K. G. (2015). Computer vision syndrome: a review of literature. *Medsurg Nursing*, 24(2), 89.
9. Computer vision syndrome (Digital Eye Strain). AOA.org. (n.d.). Retrieved January 6, 2023, from <https://www.aoa.org/healthy-eyes/eye-and-vision-conditions/computer-vision-syndrome?ss0=y&sso=y>.
10. American optometric association. Computer vision syndrome. In: American optometric association. [cited 2020 May 11]. Available from: <https://www.aoa.org/patients-and-public/caring-for-your-vision/protecting-your-vision/com>.
11. Rosenfield, M. (2016). Computer vision syndrome (aka digital eye strain). *Optometry in practice*, 17(1), 1-10.
12. Portello, J. K., Rosenfield, M., Bababekova, Y., Estrada, J. M., & Leon, A. (2012). Computer-related visual symptoms in office workers. *Ophthalmic and Physiological Optics*, 32(5), 375-382.
13. Coles-Brennan, C., Sulley, A., & Young, G. (2019). Management of digital eye strain. *Clinical and experimental Optometry*, 102(1), 18-29.
14. Sen, A., & Richardson, S. (2007). A study of computer-related upper limb discomfort and computer vision syndrome. *Journal of human ergology*, 36(2), 45-50.

15. Noreen, K., Batool, Z., Fatima, T., & Zamir, T. (2016). Prevalence of computer vision syndrome and its associated risk factors among under graduate medical students of urban karachi. *Pakistan Journal of Ophthalmology*, 32(3).
16. Otero Molins, C. (2018). Lens-based technologies to study accommodation and refraction.
17. Yan, Z., Hu, L., Chen, H., & Lu, F. (2008). Computer Vision Syndrome: A widely spreading but largely unknown epidemic among computer users. *Computers in human behavior*, 24(5), 2026-2042.
18. Németh, J., Tapasztó, B., Aclimandos, W. A., Kestelyn, P., Jonas, J. B., De Faber, J. T. H., ... & Resnikoff, S. (2021). Update and guidance on management of myopia. *European Society of Ophthalmology in cooperation with International Myopia Institute. European Journal of Ophthalmology*, 31(3), 853-883.
19. McGraw, P., Winn, B., & Whitaker, D. (1995). Reliability of the Snellen chart. *Bmj*, 310(6993), 1481-1482.
20. Du, K. (2017). Econometric convergence test and club clustering using Stata. *The Stata Journal*, 17(4), 882-900.
21. Kim JH, Lee JK, Kim HG, Kim KB, Kim HR. Possible Effects of Radiofrequency Electromagnetic Field Exposure on Central Nerve System. *Biomol Ther (Seoul)*. 2019;27(3):265- 275. doi:10.4062/biomolther.2018.152.
22. Meo S , Arif M, Rashied S, Khan MM, Vohra MS, Usmani A, Muhammad Babar Imran, Al-Drees AM. Hypospermatogenesis and spermatozoa maturation arrest in rats induced by mobile phone radiation. *J Coll Physicians Surg Pak*. 2011; 5:262-265.
23. Beaglehole R, Bonita R. Kjellstrom, T. Basic Epidemiology. World Health Organization (WHO). WHO report: chapter 7, Switzerland, Geneva, 1993. Pp-23-34.
24. Thorud, H. M. S., Helland, M., Aarås, A., Kvikstad, T. M., Lindberg, L. G., & Horgen, G. (2012). Eye-related pain induced by visually demanding computer work. *Optometry and vision science*, 89(4), E452-E464.
25. Aaras A, Horgen G, Bjorset HH, Ro O, Walsoe H. *Musculoskeletal, visual and psychosocial stress in VDU operators before and after multidisciplinary ergonomic interventions. A 6 years prospective study—part II. Appl Ergon* 2001; 32:559–71.
26. <https://claritypt.com/blog/text-neck-signs-symptoms-and-what-you-can-do/>.
27. Sarraf, F., & Varmazyar, S. (2022). Comparing the effect of the posture of using smartphones on head and neck angles among college students. *Ergonomics*, 65(12), 1631-1638.
28. <https://americanmigrainefoundation.org/resource-library/do-i-need-to-have-my-eyes-checked-if-my-head-hurts/>