

Computer vision syndrome among Saudi population: An evaluation of prevalence and risk factors

Alaa N. Turkistani, Arwa Al-Romaih, Majd M. Alrayes, Abdulrazaq Al Ojan, Wisam Al-Issawi

Department of Neurosurgery, King Fahad University Hospital, Imam Adulrahman bin Faisal University, Dammam, Saudi Arabia

ABSTRACT

Introduction: In the recent era of technological evolution, electronic devices have become an essential part of our lives, not merely in professional work settings, but also in daily leisure activities. Although these devices have simplified our lives, they are associated with a wide variety of health complaints. Thus, the so-called computer vision syndrome (CVS) has become a growing public health problem and has gained significant attention as it plays an important role in the quality of life of each individual, which in turn has put an increased burden on the health care system. Eye symptoms are among the most reported, yet extraocular symptoms were frequently described as adding an extra load. **Method:** An electronic survey was distributed randomly through social media platforms among the general population in Saudi Arabia, between the period from July to December 2017, irrespective of their sociodemographic factors, aiming to determine the prevalence of CVS and to verify the most common associated risk factors. **Results:** In total, 690 participants were involved in our study, with a mean age of 33.8 years. Of these, 77.6% suffer from CVS, with eye-burning being the most common ocular symptoms (71%), as well as itching (67.5%), blurred vision (65%), tearing (62.3%), and other eye symptoms being reported. Neck/shoulder pain was found to be the most prevalent extra ocular symptom (85.2%); also back pain and headache are frequently expressed (78% and 70% respectively). A significant positive correlation was observed between CVS symptoms and time spent using the devices (P -value: 0.002). **Conclusion:** As technology advances, electronic devices have become a common tool that is used for different purposes on daily basis. We found in our study that the so-called computer vision syndrome is a growing public health problem. Thus, community education about the impact of such a lifestyle for proper handling of electronic devices must be addressed to avoid such health complaints.

Keywords: Computer, electronic devices, mobile phone, neck pain, syndrome

Background

Computers and other electronic devices (ED) have become a part of everyday life in every age group, not only in professional work but also for leisure activities. EDs have expanded their existence: laptops and mobile touchscreen devices, such as tablet computers and smartphones, which can

be used anywhere at any time. Moreover, these EDs have now shifted into the pockets of millions of smartphone users.^[1] Most smartphone owners have been reported to be adults aged from 18 to 34 years. However, later studies reported that the majority of teenagers between 14 to 18 years in the USA (87%) own smartphones.^[2] With this clear expansion in technology and its prolonged and repetitive use, computer vision syndrome (CVS) has gained significant attention as it plays an important role in the quality of life of each individual, even though technology has made our lives easier in household work and also in offices.

Address for correspondence: Dr. Alaa N. Turkistani, Jubail Industrial City, Saudi Arabia. E-mail: alaanabil.t@gmail.com

Received: 15-12-2020

Revised: 28-02-2021

Accepted: 16-03-2021

Published: 02-07-2021

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_2466_20

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Turkistani AN, Al-Romaih A, Alrayes MM, Al Ojan A, Al-Issawi W. Computer vision syndrome among Saudi population: An evaluation of prevalence and risk factors. J Family Med Prim Care 2021;10:2313-8.

CVS is a collection of disorders that include ocular, musculoskeletal, dermatological, neurological plus psychological detrimental effects that are experienced in relation to the use of different types of EDs.^[3] It has been predicted that about 60 million people worldwide struggle with difficulty in vision associated with other symptoms as a result of EDs uses. Millions of new cases arise each year.^[4] CVS is a misnomer, as visual symptoms are not the only or the most prevalent harmful effects of electronic devices, as there are extraocular symptoms such as neck and shoulder pain. The cervical spine is the most mobile part of the vertebral column and the prolonged abnormal positioning of the neck, such as bending the neck forward, will eventually lead to disabling neck pain.^[5] Long, uninterrupted handling of EDs may lead to a complex of clinical symptoms. Symptoms documented by computer users are classified into ocular symptoms (strain, ache, dryness, irritation, and burning), visual symptoms (blur, double vision), and musculoskeletal symptoms (neck, shoulder, and back pain).^[6] The incidence of headaches has been noted to increase when the screen is viewed at a distance less than 50 cm, making this a major problem with the constant presence and usage of smartphones.^[7] Though the eye problems are the most frequently encountered complaint among its users, extra-ocular symptoms have their own concerns.^[1] The continuous use of EDs may induce abnormal forward bending posture of the neck and damage proximate anatomical structures. It is reported that the neck flexion angle is greater with small-sized devices, thus increasing the stress on neck muscles.^[8] Shoulder-arm-neck syndrome is mainly found in people who do repetitive work for more than six months. These extraocular preventable symptoms present an extra load and a burden on the practice of certain subspecialties, such as orthopedics and neurosurgery.

The discomfort associated with the use of computers and other EDs has not yet been known to cause permanent damage. However, it may result in a reduction of work accuracy and quality, which can reduce productivity. The broad use of different types of ED for various reasons requires consideration into the extent of the disorder effect on the population. Therefore, the aim of the study is to assess the prevalence of symptoms related to ED use and the risk factors of developing the symptoms of using these devices.^[9,10]

Material and Methods

A cross-sectional study was conducted among Saudi general population. An online survey was distributed through social media platforms around the kingdom between the period from July to December 2017. All respondents who used computer, laptops or smartphones were included in the study. The sample size of our cross-sectional study was estimated by applying the formula of qualitative variables. The study had been submitted and was approved by the Research and Ethical Committee at the College of Medicine, Imam Abdulrahman bin Faisal University (IRB-2017-01-108). Ethical approval obtained on

17 May 2017. Participants aged 15 years and above gave their consent after reading an explanation of the purpose and the aims of our study. The participants were surveyed using a pre-tested structured questionnaire, which included the basic demographic profile, hours of computer, laptops, and mobile phones usage per day. The study subjects were asked to report any eye or extraocular symptoms experienced while on the continuous use of computer and smartphones either at work or home. They were asked to mark whether they had experienced: none, mild (transient symptoms persist for few minutes to hours), moderate (persist for few hours and subsides after rest or sleep) or severe (needs medical consultation) visual problems during or after electronic device use.

Statistical data analysis was conducted using Statistical Package for Social Sciences (SPSS). Descriptive data were presented as percentages and unadjusted odds ratios (OR) to measure the strength of association and 95% confidence intervals (CI). The Chi-square test was applied to identify differences between the studied variables (such as the increase in hours of computer use), as well as simple frequency tables to establish the frequency distribution of the responses. The threshold for statistical significance was set at a *P* value less than 0.05.

Results

Sociodemographic characteristics

A sample size of 691 participants came from different regions in the country and had a mean age of 33.8 years (ranging from 14 to 65 years). The majority of the participants were females (68.7%). The respondents had different work statuses. Characteristics of the study population are summarized in Table 1.

Table 1: Characteristics of the study population

	Frequency	Percent
Gender		
Male	216	31.3
Female	475	68.7
Age		
<25 years	225	
25-45	319	
>45	144	
Work		
Unemployed	124	18
Students	179	25.9
Teacher/Lecturer	78	11.3
Healthcare worker	65	9.4
Engineering	28	4.1
Retired	30	4.3
Others	186	27
Province		
Eastern	495	71.6
Central	76	11
Western	92	13.3
Northern	20	2.9
Southern	8	1.2

Workstation characteristics

We sought to analyze the data regarding the workstation and computers that the participants used both at work and at home. In total, 313 (45%) are using desktops at work, while 220 (31.8%) participants are using laptops. In comparison, at home, the number of laptops usage is greater than desktops with 79.2% and 8.8%, respectively. Regarding the light source used in the workplace, most of the participants (43.7%) have a fluorescent lightening type. Data regarding the computers of the respondents is summarized in Table 2 and 3.

Symptoms associated with electronic devices syndrome

Symptoms that arise from EDs are classified as ocular and musculoskeletal symptoms. The prevalence of symptoms related to the use of visual display units was found to be 77.1%. No

difference in the incidence of symptoms was noted among the different regions of the respondents, and there was an insignificant association with the level of education. A significant correlation was found between increased hours of ED use and symptoms ($P = 0.002$). Graph 1 shows the frequency of all the symptoms associated with EDS.

Ocular symptoms

In regard to ocular and visual symptoms, participants were asked about the frequency and intensity of these symptoms. Ocular and visual symptoms include strain, ache, dryness, irritation, burning, and blurred and double vision. From the data collected, most reported that they experienced moderate intensity visual and ocular symptoms occasionally. However, in regard to double vision, difficulty focusing for near vision, colored halos around objects, and sensitivity to light, most respondents reported not to have experienced these symptoms, while the rest reported that they experienced the symptoms less often. Headaches were reported by 69.9% of them, with 75.8% being of moderate intensity. Eye burning, itching, blurred vision, and tearing were the most common ocular symptoms. Each had a frequency of 71%, 67.5%, 65%, and 62.3%, respectively. Table 4 summarizes the most frequent ocular symptoms reported.

Musculoskeletal symptoms

Participants were also asked to indicate how often they experienced musculoskeletal symptoms and headaches after using electronic devices. The most frequent musculoskeletal risk factors associated with the electronic devices syndrome are neck, shoulder, and back pain. Occasional shoulder and neck pain were found to be the most prevalent musculoskeletal symptoms that most participants experienced (50.2%). In addition, 44.9% reported having experienced occasional back pain.

A positive P value of 0.002 indicated significant correlation between increased hours of electronic devices usage and associated symptoms. Based on the P value of 0.01, it was clear that neck and shoulder pain severity have a positive relationship with age.

Carpal tunnel syndrome

A questionnaire is based on the work of Levine *et al.* and has been validated in secondary care for the diagnosis of CTS by Kamath and Stothard. The results gave a sensitivity of 85% for

Table 2: Computer Characteristics

	Frequency Percentage	
	Frequency	Percentage
Type of Computer at Work		
Desktop	313	55.8
Laptop	220	39.2
Both	28	5
Type of Computer at Home		
Desktop	61	9.7
Laptop	547	87
Both	21	3.3
Lighting Type		
Fluorescent	302	44.7
Incandescent	199	29.4
Natural sunlight	64	9.5
Fluorescent and Incandescent	21	3.1
Fluorescent and Natural sunlight	51	7.5
Incandescent and Natural sunlight	29	4.3
Fluorescent, Incandescent and Natural sunlight	10	1.5

Table 3: Number of working hours on electronic devices per day

Number of working hours/day	Frequency (%)		
	Computer at work	Computer at home	Handheld devices
1-3 h	255	395	240
			30+
4-6 h	169	120	245
>6	76	23	198

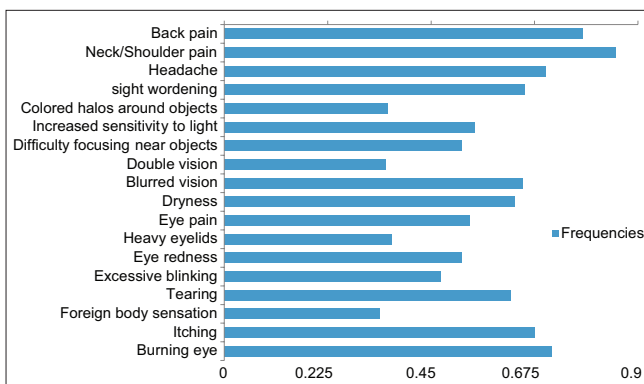
Table 4: Frequency and intensity of ocular symptoms

Ocular symptom	Frequency (%)			Intensity (%)		
	Never	Occasional	Always	Mild	Moderate	Intense
Eye burning	28.7	57.7	13.6		94.5	5.5
Itching	32.4	55.4	12.2		91.9	8.1
Foreign body sensation	66.1	29.2	4.6		93.6	6.4
Tearing	37.6	52.2	10.1		93.3	6.7
Excessive blinking	53	40.2	6.8		92.9	7.1
Eye redness	48.3	44.3	7.4		92.4	7.6

Discussion

the scored questionnaire compared to 92% for nerve conduction studies. Importantly, the positive predictive value was 90% for the questionnaire and 92% for the nerve conduction studies. Symptom relief was taken as the “gold standard” for true carpal tunnel syndrome. This scored questionnaire can replace nerve conduction studies in the initial assessment of patients presenting with CTS [Table 5]. Since people are using handheld devices more often nowadays, the question “Do tingling and numbness present while holding your mobile phone?” was added to the questionnaire to assess the correlation between CTS and the use of mobile phones.

By using this questionnaire, a total of 142 (20.7%) reported having symptoms of CTS. In addition, 90 and 163 participants (13% and 23%, respectively) reported having been woken up at night by wrist pain or numbness. 25.8% of participants reported that these symptoms were often pronounced first thing in the morning, and 43.1% reported to perform trick movements to make the tingling/numbness leave their hands. In addition, 277 (40.1%) indicated that they experience tingling and numbness after using their cellphones, especially for prolonged periods.



Graph 1: Frequency of symptoms associated with CVS

Table 5: Cumulative percent of “Yes” answers

Questions asked	Percent of "yes" answers
Has pain in the wrist woken you at night?	13%
Has tingling and numbness in your hand woken you during the night?	23.6%
Has tingling and numbness in your hand been more pronounced first thing in the morning?	25.8%
Do you have/perform any trick movements to make the tingling, numbness go from your hands?	43.1%
Do you have tingling and numbness in your little finger at any time?	20.8%
Has tingling and numbness presented when you were reading a newspaper, steering a car or knitting?	22%
Do you have any neck pain?	14.9%
Has the tingling and numbness in your hand been severe during pregnancy?	12.9%
Has wearing a splint on your wrist helped the tingling and numbness?	17.5%
Do tingling and numbness present when you hold your mobile phone?	40.1%

Effects of CVS can manifest themselves in many varied forms.^[9] These symptoms are linked to fatigue on the ocular, extraocular, and nervous systems of an individual as a result of excessive use of electronic devices, especially for very long hours.^[6] According to Shantakumari *et al.*,^[7] the most prevalent visual problems associated with prolonged use of computers include eye burning sensation (54.8%), headaches (53.3%), and eye tiredness. Both longitudinal and cross-sectional data collected from the study corresponded largely with the prevalence of symptoms related to VDU usage and the risk factors of using these devices. As Bali *et al.*^[11] state, the risk factors and symptoms related to the use of electronic devices increase with excessive use of electronics. The findings of this study supported their statement since data collected indicated a positive correlation between the two variables: electronic devices usage and prevalence of symptoms related to EDs use. Also, Prodanovska *et al.*^[12] reported an increase in musculoskeletal symptoms, which are some of the symptoms associated with electronic devices syndrome in their quantitative analysis of the same issue.

Light and waves emitted by the electronic devices result in retinal damage or eye discomfort, hence the prevalence of these symptoms.^[13] This confirms the research done by Ranasinghe *et al.*,^[3] who state that light from the VDUs create a glaring effect on eyes, and this effect often results in symptoms such as nearsightedness, eye fatigue, blurred vision, and dry eye, among other symptoms. The results of this study also confirm previous findings of Shantakumari and his colleagues^[7] that indicate that the lighting type of electronic devices results in a condition referred to as digital eye strain, which could be temporary or permanent depending on the intensity of the light and the hours that one spends using these devices. Prolonged use of electronic devices seemed to have a positive relationship with extraocular symptoms. Building on the results of this study, shoulder and neck pain was the most prevalent extraocular symptoms. Neck pain has been proven the most common symptom resulting from the use of smartphones, since the user tends to lean forward, thus stretching the neck muscles.^[14] Neck and shoulder pain result from muscle fatigue due to long hours of using electronic devices.^[15] Maintaining a static posture while using digital devices weakens and destabilizes the neck and shoulder muscles, resulting in intense pain.^[16]

Individuals who worked for very long hours at home and at the office, especially those using desktops, reported frequent and intense shoulder and neck pain. These findings confirm that a static posture weakens the shoulder and neck muscles, hence causing pain.^[17] In addition to these findings, a previous study by Toh *et al.*^[2] indicated that the use of portable electronic devices results in the same effects as using static devices. This is because leaning forward stretches the disks and facet joints of the neck causing neck pain and headaches.^[18] Building on the results of this study, using electronic devices at close range results in frequent and intense neck and shoulder pain and headaches. It

is reported that headaches have also been attributed to excessive use of smartphones.^[19] According to Shantakumari *et al.*,^[7] the ideal distance of viewing screens is 50–70 cm when the vergence and accommodation are at a resting state physiologically.

Increased digitalization and presence of smartphones have posed a major problem because smartphones are used at very close ranges of less than 50 cm.^[20] Levels of muscle activation and efficiency are affected by excessive use of portable digital devices.^[8] Ning *et al.*^[21] also support this statement that prolonged cell phone use affects neck kinematics.

The cervical angle that people place their heads especially when using smartphones is the contributing factor to neck muscle pain.^[22] Based on our the results, frequent and intense back pain is another musculoskeletal symptom associated with prolonged use of EDs. The results are in line with the discussions of Jin and Jong^[23] and Lee *et al.*^[8] who state that both abnormal and static postures cause pressure and discomfort on the spine, hence causing back pain. Work furniture and placement of keyboards or screens are also among the factors that contribute to back pain.^[24] When the screen is placed too high or too low, it may result to back strain and abnormal postures respectively, hence causing the pain.^[25] Uncomfortable and unstable furniture may also lead to back strain, which results in causing pain on both upper and lower back.^[26]

Wrists, arms, and hands are other parts that are affected by excessive use of EDs.^[27] Findings of this study confirmed that prolonged hours of using electronic devices cause pressure on the tendons of the wrists, causing wrist and hand pain. Carpal tunnel syndrome is a condition that causes numbness, pain, and tingling in the arm and hands.^[28] It occurs when a median nerve is squeezed as it travels through the carpal tunnel in the wrist.^[28] Based on the results of this study, it is clear that excessive use of electronic devices can result in the development of carpal tunnel syndrome. The results of the study in regard to CTS confirm the findings of a longitudinal study conducted by Toosi *et al.*^[28] who revealed that prolonged use of electronic devices, such as computers and smartphones, cause pressure on the median nerve.

Generally, the findings of this study confirm the findings of a longitudinal study conducted by Ranasinghe^[3] on Sri Lankan computer office workers who reported to have a high prevalence of CVS. Some of the factors that are associated with CVS include prolonged durations of occupation, intense daily computer use, female gender, use of contact lenses, and pre-existing eye disease, among other factors. Intensity and frequency of symptoms associated with electronic devices syndrome differ depending on gender differences.^[29] However, the prevalence of these symptoms was not addressed based on gender differences. Prevalence of these symptoms also differs with age.^[30] Children and adolescents tend to have more ocular and visual symptoms as a result of excessive use of electronic devices than adults.^[31] Kim *et al.*^[32] and Vacheva *et al.*^[33] also confirm this building on

the findings of their research conducted among adolescents and children, respectively. In addition, a study conducted in Saudi Arabia by Altalhi^[33] on health sciences students also support that adolescents tend to have more ocular and visual symptoms; they observed a lack of applying ergonomic practices among their participants which could be a contributing factor that explains the higher prevalence among such age group.

Our study did not address all the symptoms that result from prolonged use of digital devices. To clarify, regarding the discrepancies and gaps not addressed in the present study, future research in this field should be conducted for accounting the specific contextual and individual factors that influence the prevalence of the symptoms associated with EDs use.

We found that CVS is a growing public health problem which is significantly associated with increased health related complaints and unpleasing symptoms that can dramatically compromise the quality of life of the affected individuals, causing an increased load on primary care centers. Primary care physicians are the first to deal with such complaints having a crucial role in risk assessment and disease prevention. Community education about the impact of such a lifestyle and its consequences on the health necessitates more efforts to increase the awareness for proper handling of electronic devices.

Conclusion

As technology advances, electronic devices have become a common tool that is used for different purposes on daily basis. We found in our study that the so-called computer vision syndrome (CVS) is a growing public health problem, resulting in variety of complaints and symptoms. Thus, preventive measures and community education about the burden of such lifestyle, and the proper handling of devices must be addressed.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Parihar JK, Jain VK, Chaturvedi P, Kaushik J, Jain G, Parihar AK. Computer and visual display terminals (VDT) vision syndrome (CVDTS). *Med J Armed Forces India* 2016;72:270-6.

2. Toh SH, Coenen P, Howie EK, Straker LM. The associations of mobile touch screen device use with musculoskeletal symptoms and exposures: A systematic review. *PLoS One* 2017;12:e0181220.
3. Ranasinghe P, Wathurapatha W, Perera Y, Lamabadusuriya D, Kulatunga S, Jayawardana N, *et al.* Computer vision syndrome among computer office workers in a developing country: An evaluation of prevalence and risk factors. *BMC Res Notes* 2016;9:150.
4. Rathore D. A cross sectional study to assess prevalence of computer vision syndrome and vision related problems in computer users. *J Med Sci Clin Res* 2016;4:11007-12.
5. Kim J, Lee H, Park S. Effects of the active release technique on pain and range of motion of patients with chronic neck pain. *J Phys Ther Sci* 2015;27:2461-4.
6. Gowrisankaran S, Sheedy JE. Computer vision syndrome: A review. *Work* 2015;52:303-14.
7. Shantakumari N, Eldeeb R, Sreedharan J, Gopal K. Computer use and vision. Related problems among university students in Ajman, United Arab Emirate. *Ann Med Health Sci Res* 2014;4:258-63.
8. Lee S, Lee D, Park J. Effect of the cervical flexion angle during smart phone use on muscle fatigue of the cervical erector spinae and upper trapezius. *J Phys Ther Sci* 2015;27:1847-9.
9. Klammer J, Tarnow KG. Computer vision syndrome: A review of literature. *Medsurg Nurs* 2015;24:89-93.
10. Kamath V, Stothard J. A clinical questionnaire for the diagnosis of carpal tunnel syndrome. *J Hand Surg* 2003;28:455-9.
11. Bali J, Neeraj N, Bali RT. Computer vision syndrome: A review. *J Clin Ophthalmol Res* 2014;2:61-8.
12. Prodanovska-Stojcevska V, Jovanovic J, Jovanovska T, Rajchanovska D, Filov I, and Bogdanova B. THE RELATION BETWEEN PSYCHOSOCIAL WORK FACTORS AND MUSCULOSKELETAL SYMPTOMS AMONG COMPUTER WORKERS. *CBU International Conference Proceedings* 2016; 4:669-75. doi: 10.12955/cbup.v4.830.
13. Porcar E, Pons AM, Lorente A. Visual and ocular effects from the use of flat-panel displays. *Int J Ophthalmol* 2016;9:881-5.
14. Vate-U-Lan P. Text neck epidemic: A growing problem for smart phone users in Thailand. *Int J Comput Internet Manag* 2015;23:551-6.
15. Brandt LP, Andersen JH, Lassen CF, Kryger A, Overgaard E, Vilstrup I, *et al.* Neck and shoulder symptoms and disorders among Danish computer workers. *Scand J Work Environ Health* 2004;30:399-409.
16. Douglas EC, Gallagher KM. The influence of a semi-reclined seated posture on head and neck kinematics and muscle activity while reading a tablet computer. *Appl Ergon* 2017;60:342-7.
17. Kietrys DM, Gerg MJ, Dropkin J, Gold JE. Mobile input device type, texting style and screen size influence upper extremity and trapezius muscle activity, and cervical posture while texting. *Appl Ergon* 2015;50:98-104.
18. Vasavada AN, Nevins DD, Monda SM, Hughes E, Lin DC. Gravitational demand on the neck musculature during tablet computer use. *Ergonomics* 2015;58:990-1004.
19. AlZarea BK, Patil SR. Mobile phone head and neck pain syndrome: Proposal of a new entity. *Headache* 2015;251:63-3.
20. Cuéllar JM, Lanman TH. "Text neck": An epidemic of the modern era of cell phones? *Spine J* 2017;17:901-2.
21. Ning X, Huang Y, Hu B, Nimbarte AD. Neck kinematics and muscle activity during mobile device operations. *Int J Ind Ergon* 2015;48:10-5.
22. Kim JH, Kim JG, Do KS, Yim J. The effect of applying a head-weight device on cervical angle and pain of neck muscles. *Phys Ther Rehabil Sci* 2016;5:101-5.
23. Valcheva K., Krivoshiiska-Valcheva E., Stateva D, and Statev K. COMPUTER EYE SYNDROME IN CHILDREN AGED 3 TO 6 YEARS. *Journal Of IMAB - Annual Proceeding (Scientific Papers)* 2016;22:1075-77. doi: 10.5272/jimab.2016221.1075.
24. Arumugam S, Kumar K, Subramani R, Kumar S. Prevalence of computer vision syndrome among information technology professionals working in Chennai. *World J Med Sci* 2014;11:312-4.
25. Xie Y, Szeto G, Dai J. Prevalence and risk factors associated with musculoskeletal complaints among users of mobile handheld devices: A systematic review. *Appl Ergon* 2017;59:132-42.
26. Werth A, Babski-Reeves K. Effects of portable computing devices on posture, muscle activation levels and efficiency. *Appl Ergon* 2014;45:1603-9.
27. Young JG, Trudeau MB, Odell D, Marinelli K, Dennerlein JT. Wrist and shoulder posture and muscle activity during touch-screen tablet use: Effects of usage configuration, tablet type, and interacting hand. *Work* 2013;45:59-71.
28. Toosi KK, Hogaboom NS, Oyster ML, Boninger ML. Computer keyboarding biomechanics and acute changes in median nerve indicative of carpal tunnel syndrome. *Clin Biomech (Bristol, Avon)* 2015;30:546-50.
29. 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;59:1453-61.
30. El-Seht RM, El-Sabagh H. Pattern of visual display terminals usage and eye effects among primary school children in Egypt. *Delta J Ophthalmol* 2018;19:40-5.
31. Khalaj M, Ebrahimi M, Shojai P, Bagherzadeh R, Sadeghi T, and Ghalenoei M. Computer Vision Syndrome in Eleven to Eighteen-Year-Old Students in Qazvin. *Biotechnology And Health Sciences* 2015;2. doi: 10.17795/bhs-28234.
32. 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 Epidemiol* 2016;23:269-76.
33. Altalhi A, Khayyat W, Khojah O, Alsalmi M, Almarzouki H. Computer vision syndrome among health sciences students in Saudi Arabia: Prevalence and risk factors. *Cureus* 2020;12:e7060.