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Association Between Screen Time, Vitamin A Consumption Behavior, and Computer Vision Syndrome in Preclinical Medical Students

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Abstract

Computer Visual Syndrome (CVS) refers to visual disturbances induced by electronic media such as computers, laptops, tablets, and smartphones. This research aimed to determine the association between screen time, vitamin A consumption behavior, and CVS symptoms among preclinical medical students. Ninety-five students from a single class at the Faculty of Medicine, Universitas Islam Sultan Agung, Indonesia, participated in this cross-sectional study. Data were collected using an online survey platform in February 2022. The screen time, vitamin A consumption behavior, and CVS were measured using a validated questionnaire. The average daily screen time of the respondents was more than 10 h, with the majority having a moderate vitamin A consumption patterns (66.3%) and experienced CVS (63.2%). The most prevalent CVS symptom identified among these respondents was eye fatigue (62.1%), while double vision and inflamed or watery eyes were the least reported CVS symptoms (9.5% and 8.4%, respectively). The Chi-Square test revealed that there was no correlation between screen time and CVS ($p>0.05$), but there was a significant correlation between vitamin A consumption and CVS ($p<0.05$). In conclusion, CVS is observed among preclinical medical students due to increased screen time and decreased vitamin A consumption. Therefore, there is a need to develop strategies to manage screen time and vitamin A consumption among students at risk for developing a CVS during their academic careers.

Keywords: Computer vision syndrome (CVS), consumption behavior, screen time, vitamin A

Introduction

Today, millions of medical students use computers (including desktops, laptops, and tablets) and other electronic displays (such as smartphones and electronic reading devices) daily for both educational and recreational purposes, both on campus and at home. Computer vision syndrome (CVS) has been linked to screen time, the amount of time spent on electronic devices or in front of a screen per day.[1] Prolonged screen time without regular breaks was associated with an increased risk of CVS.[2] CVS symptoms include impaired vision, visual fatigue (VF) or discomfort, diplopia, dry eye disease, redness, eye strain, irritation, headache, and shoulder, neck, and back pain.[3] Although the visual effects of computer use on adults have been studied, few studies have examined this issue in preclinical medical students.

Although the COVID-19 pandemic has not been an issue, the prevalence of CVS and the widespread use of electronic devices should heighten awareness. Screen time induces tear film instability and oxidative stress indices in tears and on the eye's surface, according to a cross-sectional study conducted at JSS Medical College in Mysuru. The average daily screen time was 5.13 h.[4] A study of 1884 adolescents in Singapore found a correlation between increased smartphone use and physical health issues, including musculoskeletal and visual symptoms.[5] Increased screen time during the pandemic compared to before the pandemic resulted in ocular health issues, such as eye strain, in 50.6% of online learning students.[6] A cross-sectional study conducted in China revealed that CVS had

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a moderately positive correlation with screen time among Bachelor of Medicine and Bachelor of Surgery (MBBS) students with the most significant frequency of digital screen time (7–9 h/week).[7]

In addition, CVS can be alleviated by changes in dietary habits, which result in unhealthy food selections.[8] Due to the tight daily schedule, university students tend to consume high-calorie food selections, fast food snacking, fried food consumption, and low intake of daily fruits and vegetables.[9]especially when transitioning into university life as they become responsible for their daily eating and lifestyles. This study estimates the prevalence of overweight/obesity and explores the eating patterns and lifestyle practices of university students. METHODS: A cross-sectional study was conducted at Universiti Brunei Darussalam (UBD The low intake of vitamin A-rich foods among university students can increase the risk of ocular health disorders, including CVS.[10] Vitamin A is a micronutrient mixture of retinol, retinal, and retinoic acid, along with other components such as β-carotene. The most common animal sources of vitamin A are cod liver oil, liver, butter, cheese, eggs, and fish. In contrast, the most common vegetable sources include sweet potato, carrot, broccoli, sweet red pepper, spinach, and lettuce.[11] Vitamin A is essential for good vision, growth, reproduction, bone metabolism, gene transcription, and immune health.[12] Vitamin A deficiency can exacerbate the symptoms of CVS.[13]pre-school children are the most at-risk population groups for vitamin A deficiency (VAD It has been discovered that carotenoid vitamin therapy increases macular pigment concentrations with concomitant improvements in visual performance; this may be clinically pertinent for treating digital eye strain.[8] This research investigates whether increased screen time and vitamin A-rich food consumption behavior are associated with CVS in preclinical medical students.

Methods

A cross-sectional, observational, web-based survey was conducted on medical students in the Faculty of Medicine at Universitas Islam Sultan Agung, Semarang, Indonesia. Participants included the third year of preclinical level from a five-year medical education program. This study was conducted in February 2022. Under the assumption of a 95% predictive prevalence, 95% confidence, a 5% margin of error, and a 75% response rate, we determined that a sample size of 95 would be representative of the entire population. The sampling method used a consecutive sampling method. All intended participants were eligible to take part. Exclusion criteria included a previous history of ocular surgery or active ocular diseases. All participants were informed of the purpose of the study, and their participation was voluntary. All respondents provided their informed consent digitally and signed online. The Institutional Review Board (or Ethics Committee) of the Faculty of Medicine at Universitas Islam Sultan Agung (Document No. 45/II/2022/ Komisi Bioetik) approved the research and conducted it following the Declaration of Helsinki.

Using an online survey platform (docs.google.com/forms/), a researcher designed and disseminated the questionnaire to students via WhatsApp groups. The survey consisted of three fundamental sections: demographic data (age and past medical history of ocular disorders), screen time, vitamin A consumption behavior, and computer vision syndrome (CVS) symptoms.

Students were asked to estimate the average amount of time they spent on all digital devices (phone, computer, tablet, television, etc.) per day during the previous week following the beginning of the semester. The screen time for all activities, including work, study, and leisure, was accounted for. The screen time was categorized as 2 h, 2-4 h, 4-6 h, and 6–10 h/day. Vitamin A consumption behavior was asked through a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) questionnaire[14]utilisation and validation of food-frequency questionnaires (FFQ with some modifications. The questionnaire consisted of four multiple-choice questions related to the type and frequency of consuming foods that contain vitamin A in the last three months. The vitamin A food sources were selected based on the vitamin A-rich food reported in the literature,[15] using multiple-choice scores of 0,1,2,3 for A, B, C, and D, respectively. The total score of vitamin A consumption attitudes was categorized as low (0-13), moderate (5-8), and good (9-12). Ten self-reported queries were used to validate CVS as a reliable instrument for assessing CVS. The answer is "Yes" and "No". Symptoms are categorized as "Yes" if one of the answers is Yes.

The data from the online survey platform were extracted into Microsoft Excel. The data were analyzed using SPSS version 25.0 (IBM, United States). The Chi-square test examined the relationship between screen time, vitamin A, and

computer vision syndrome symptoms. A *p-value* of 0.05 was considered statistically significant.

Results

The respondents ranged from 19 to 21, and 84.2% were female. Table 1 depicts respondents' time before a screen, the amount of vitamin A they consumed, and the CVS problems they encountered. In addition to having a daily screen time of over 10 h, 66.3% of respondents reported moderate vitamin A consumption behaviour.

Based on the types of vitamin A-containing foods consumed by the respondents, it can be determined that they consumed fewer vitamin A-containing foods throughout the study. 52.6% of respondents consume vitamin A supplements infrequently, whereas 41.1% consume packaged milk infrequently (Figure 1). As shown in Figure 2, 63.2% of 95 respondents were discovered to have CVS symptoms. Eye fatigue is the most common symptom of CVS among respondents who are preclinical students (62.1%). Double vision and red or watery eyes were reported by 9.5% and 8.4% of respondents, respectively, as the least common CVS symptoms among preclinical students.

The Chi-Square test revealed no association between screen time and CVS ($p>0.05$), although 61.8% of respondents with screen time >10 h/day reported CVS symptoms. Those who consumed less vitamin A, up to 80.8% of respondents, and moderate amounts, up to 58.7% of respondents, reported CVS symptoms. The Chi-Square analysis revealed a correlation ($p<0.05$) between vitamin A consumption and CVS (Table 2). Only one independent variable was associated with the dependent variable, so a multivariate analysis was not conducted.

Table 1 Screen Time, Vitamin A Consumption Behaviour, and Visual Disturbance Among Respondents

Variable	Total respondents (%)
Screen time (h/day)	
< 2	0 (0)
2–4	0 (0)
4–6	1 (1.1)
6–10	19 (18.9)
>10	76 (80.0)
Vitamin A consumption behaviour	
Less	26 (27.4)
Moderate	63 (66.3)
Good	6 (6.3)
Computer vision syndrome (CVS) symptoms	
Yes	60 (63.2)
No	35 (36.8)

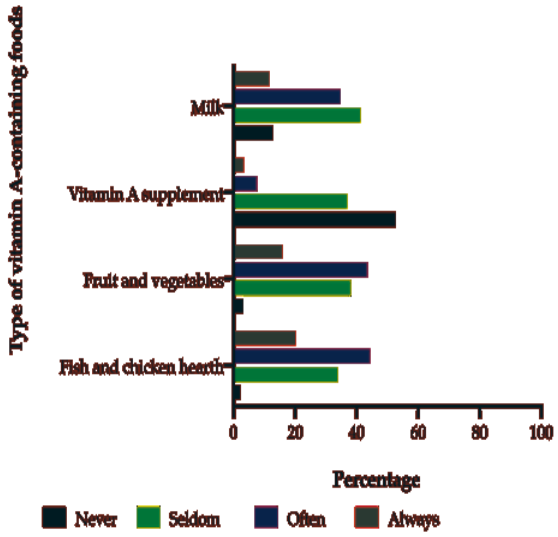

Figure 1 The Frequency of Consumption of Type of Vitamin A-Containing Foods Consumed by The Respondents

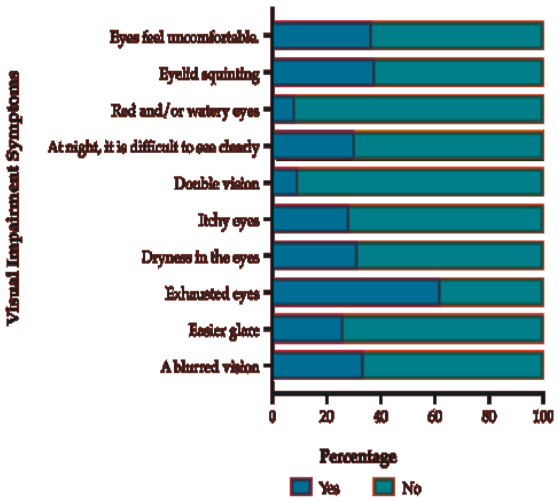

Figure 2 The Frequency of CVS Symptoms Faced by The Respondents

Table 2 Association between Screen Time, Vitamin A Consumption Behavior, and Computer Vision Syndrome (CVS) Symptoms

Variable	CVS symptoms (N=95)		*p*
	Yes	No	
Screen time (h/day)			
< 2	0	0	0.304
2–4	0	0	
4–6	1	1	
6–10	13	5	
>10	47	29	
Vitamin A consumption behaviour			
Less	21	5	0.045
Moderate	37	26	
Good	2	4	

Discussion

Computer Visual Syndrome (CVS) refers to visual disturbances resulting from using electronic media, such as computers, laptops, tablets, and smartphones. Eye and head disorders, complaints of pain or headache, dry eyes, irritation, and eye fatigue indicate CVS.[16]so that extensive daily use for both social and professional purposes is now normal. Digital eye strain (DES Excessive screen time, repetitive focusing of the eyes, continuous exposure to blue light, and an unergonomic monitor screen position (too high, too low, too close, too far) for the eyes are the causes of CVS.[17]

This study found no association between screen time and CVS among preclinical Faculty of Medicines students at Universitas Islam Sultan Agung. University students have been documented to develop CVS potentially due to the study burden and heavy use of digital devices, with a reported high prevalence.[18] Preclinical students have a prevalent leading CVS of ocular fatigue, consistent with another study in Nepal and numerous studies.[19] Computer work requires frequent saccadic eye movements (ocular motility), accommodation (continuous focusing), and vergence (alignment demands), which all entail endless relaxation and contraction of the eye muscles.[20] When students spend up to twice as much time in front of a screen, their CVS, such as headaches and itchy eyes, worsen.[6]

In recent years, the function of nutrition in promoting optimal visual performance and the potential consequences of inadequate nutrient intake have become increasingly apparent.[21] Vitamin A deficiency is related to the absence of two significant vitamin A metabolites with very different functions: the chromophore 11-cis-retinal (vitamin A aldehyde) is a crucial component of the visual pigment that mediates phototransduction, whereas the signaling molecule all-trans-retinoic acid regulates the development of various tissues and is essential for immune function. Since humans cannot synthesize vitamin A, they must consume either preformed vitamin A from animal products or carotenoid precursors from plant sources. Acute vitamin A deficiency impairs photoreceptor function and causes night blindness (deficient vision in dim light), whereas chronic vitamin A deficiency causes retinal dystrophy and photoreceptor cell death.[22] CVS in preclinical students during their education is not only caused by the prolonged and extended use of smartphones, tablets, e-readers, and computers. It can be attributed to low levels of vitamin A consumption.[23] This study shows a 6.3% out of 93 who consumed vitamin A-containing foods during their research. This study demonstrates that vitamin A consumption attitudes among university students in the Faculty of Medicine, Universitas Islam Sultan Agung, is significantly ($p<0.05$) associated with CVS, such that the higher the vitamin A intake, the lower the proportion of respondents who experience CVS. This is because of the intensity of the lectures; most students admitted during their study that they consume vitamin-A-rich vegetables and fruits infrequently, preferring to consume fast or instant food).

The rational use of screen time and adopting

ergonomics should be promoted to protect medical students from these CVS.[19] This study is relevant to the previous study reported by Rochmayani and Cahyaningsih (2021) that using the computer for more than 4 h continuously, short (<10 min) break after the computer, the distance of vision less than <50 cm and higher position the top of the monitor than the horizontal height of the eye showed an 83% greater risk of CVS.[24] This study suggests that some measures should be encouraged for students who take online courses at home, such as promoting regular breaks, setting balanced illumination of screen light and room light, and keeping a suitable distance from the screen.[10] To prevent the risk of CVS, policymakers should reduce the length of online classes for students and online work hours for professionals.[6] An adjunctive nutraceutical, especially vitamin A strategies, may impart additional ocular and systemic health benefits to students with CVS. A review on the potential function of micronutrients with nutraceutical properties in the diet reported that antioxidant and immunosuppressive properties of carotenoid-rich fruits and vegetables as a vitamin A source exhibit improved cognitive functioning and overall visual performance, thereby reducing digital eye strain.[24] A placebo-controlled trial that involved 48 healthy young adults with at least 6 h of daily near-field screen time exposure showed that supplementation of macular carotenoids lutein, zeaxanthin, and mesozeaxanthin for 6 months yielded significant improvement in macular pigment optical density (MPOD), overall sleep quality, headache frequency, eye strain, eye fatigue, and all visual performance measures, versus placebo ($p < 0.05$ for all). Increased MPOD significantly improves optical performance and, in turn, improves several undesirable physical outcomes associated with excessive screen time.[25]

An essential limitation of this study is the lack of a control group of university students from non-medical clusters with CVS without longer screen time and vitamin A deficiency. Observing the CVS symptoms among medical students with or without vitamin A deficiency could be more helpful in clarifying the pathogenesis of CVS. In addition, students' daily digital screen time consisted of both studying and non-studying activities, so the effect of education on the prevalence of CVS cannot be determined with precision. The function of vitamin A supplementation in the amelioration of CVS can be investigated in future research.

It can be concluded that screen time and vitamin A-rich food consumption behavior are associated with CVS among preclinical students. This study highlights the need for strategies to manage screen time and vitamin A consumption among students at risk of developing CVS symptoms.

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References

1. Coles-Brennan C, Sulley A, Young G. Management of digital eye strain. Clin Exp Optom. 2019;102(1):18–29. doi:10.1111/cxo.12798
2. Lema AK, Anbesu EW. Computer vision syndrome and its determinants: A systematic review and meta-analysis. SAGE Open Med. 2022;10:205031212211424. doi:10.1177/20503121221142402
3. Munshi S, Varghese A, Dhar-Munshi S. Computer vision syndrome—A common cause of unexplained visual symptoms in the modern era. Int J Clin Pract. 2017;71(7):e12962. doi:https://doi.org/10.1111/ijcp.12962
4. Choi JH, Li Y, Kim SH, et al. The influences of smartphone use on the status of the tear film and ocular surface. PLoS One. 2018;13(10):e0206541. https://doi.org/10.1371/journal.pone.0206541
5. Toh SH, Coenen P, Howie EK, Mukherjee S, Mackey DA, Straker LM. Mobile touch screen device use and associations with musculoskeletal symptoms and visual health in a nationally representative sample of Singaporean adolescents. Ergonomics. 2019;62(6):778–93. doi:10.1080/00140139.2018.1562107
6. Ganne P, Najeeb S, Chaitanya G, Sharma A, Krishnappa NC. Digital eye strain epidemic amid COVID-19 pandemic – a cross-sectional survey. Ophthalmic Epidemiol. 2021;28(4):285–92. doi:10.1080/09286586.2020.1862243
7. Wang L, Wei X, Deng Y. Computer vision syndrome during SARS-CoV-2 outbreak in

University Students: a comparison between online courses and classroom lectures. Front public Heal. 2021;9:696036. doi:10.3389/fpubh.2021.696036
8. Lem DW, Gierhart DL, Davey PG. Can nutrition play a role in ameliorating digital eye strain?. Nutrients. 2022;14(19): 4005. doi:10.3390/nu14194005
9. Chen Yun T, Ahmad SR, Soo Quee DK. Dietary habits and lifestyle practices among University Students in Universiti Brunei Darussalam. Malaysian J Med Sci. 2018;25(3):56–66. doi:10.21315/mjms2018.25.3.6
10. Atmadja TFA, Yunianto AE, Yuliantini E, Haya M, Faridi A, Suryana S. Gambaran sikap dan gaya hidup sehat masyarakat Indonesia selama pandemi Covid-19. AcTion Aceh Nutr J. 2020;5(2):195–202. doi:10.30867/action.v5i2.355
11. Prasetya H, Isradji I, Suparmi S, et al. Perbandingan aktivitas antioksidan dan toksisitas antara drop vitamin a dari karotenoid kulit pisang ambon dan ß-Karoten. 2017;49(1):1–7. http://dx.doi.org/10.15395/mkb.v49n1.981
12. Alanazi SA, El-Hiti GA, Al-Baloud AA, et al. Effects of short-term oral vitamin A supplementation on the ocular tear film in patients with dry eye. Clin Ophthalmol. 2019;13:599–604. doi:10.2147/OPTH.S198349
13. Yisak H, Elmneh R, Taklual W, Ewunetei A, Kefale B. Prevalence and associated factors of clinical vitamin A deficiency among pre-school children 1-5 years of age in rural kebeles in farta district, south gondar zone, Ethiopia: A mixed methods study. J Multidiscip Healthc. 2020;13:1191–201. doi:10.2147/JMDH.S279571
14. Cade JE, Burley VJ, Warm DL, Thompson RL, Margetts BM. Food-frequency questionnaires: a review of their design, validation and utilisation. Nutr Res Rev. 2004;17(1):5–22. doi:DOI: 10.1079/NRR200370
15. Siagian SD, Herlina S, Sidoretno WM. Kandungan Vitamin a Pada Buah Pepaya Hijau: Solusi Meningkatkan Produksi ASI. Pros Semin Nas Poltekkes Karya Husada Yogyakarta Tahun 2019. 2019;1(1):129–34.
16. Sheppard AL, Wolffsohn JS. Digital eye strain: prevalence, measurement and amelioration. BMJ Open Ophthalmol. 2018;3(1):e000146. doi:10.1136/bmjophth-2018-000146
17. Li L, Zhong H, Li J, Li C-R, Pan C-W. Incidence of myopia and biometric characteristics of premyopic eyes among Chinese children and adolescents. BMC Ophthalmol. 2018;18(1):178. doi:10.1186/s12886-018-0836-9
18. Salote A, Jusuf H, Amalia L. Hubungan lama paparan dan jarak monitor dengan gangguan kelelahan mata pada pengguna komputer. J Heal Sci Gorontalo J Heal Sci Community. 2020;4(2):104–21. doi:10.35971/gojhes.v4i2.7842
19. Solia E, Nikolaou A, Kotsira T, Filippou D. Medical Students and Computer Vision Syndrome. A review. Top Biomed Res Educ. Published online April 1, 2023.
20. Alemayehu AM, Alemayehu MM. Pathophysiologic mechanisms of computer vision syndrome and its prevention: review. World J Ophthalmol Vis Res. 2019;2(5):1–7. doi:10.33552/wjovr.2019.02.000547
21. De Sanctis V, Soliman A, Alaaraj N, Ahmed S, Alyafei F, Hamed N. Early and long-term consequences of nutritional stunting: from childhood to adulthood: early and long-term consequences of nutritional stunting. Acta Biomed Atenei Parm. 2021;92(1 SE-UPDATE ON ADOLESCENT MEDICINE):11346. doi:10.23750/abm.v92i1.11346
22. Dewett D, Lam-Kamath K, Poupault C, Khurana H, Rister J. Mechanisms of vitamin A metabolism and deficiency in the mammalian and fly visual system. Dev Biol. 2021;476:68–78. doi:10.1016/j.ydbio.2021.03.013
23. Cantó-Sancho N, Sánchez-Brau M, Ivorra-Soler B, Seguí-Crespo M. Computer vision syndrome prevalence according to individual and video display terminal exposure characteristics in Spanish university students. Int J Clin Pract. 2021;75(3):e13681. doi:https://doi.org/10.1111/ijcp.13681
24. Rochmayani DS, Cahyaningsih O. Risk factors for the incidence of computer vision syndrome (CVS) in lecturers during the online learning period. J Heal Educ. 2021;6(2):65–72. doi:10.15294/jhe.v6i2.47513
25. Stringham JM, Stringham NT, O'Brien KJ. Macular carotenoid supplementation improves visual performance, sleep quality, and adverse physical symptoms in those with high screen time exposure. Foods. 2017;6(7):47. doi:10.3390/foods6070047