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Effectiveness of the 20-20-20 Algorithm in Reducing the Risk of Computer Vision Syndrome (CVS) Among Military Medical Cadets at the Republic of Indonesia Defense University

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Abstract

Background: The digital era has changed many aspects of life, especially in education and professional fields, with increased reliance on computers and visual display terminals for work, communication, and learning. In academic environments, particularly among medical students, computers are essential for accessing information and completing assignments. However, excessive screen use can cause eye strain and visual discomfort. One common condition associated with prolonged screen time is computer vision syndrome (CVS). To reduce the risk of CVS, the 20-20-20 algorithm is recommended: taking a 20-second break every 20 minutes to look at an object 20 feet away. This study aimed to evaluate the effectiveness of the 20-20-20 algorithm among medical students at the Republic of Indonesia Defense University. **Methods:** This study used a one-group pretest-posttest design. A total of 77 cadets from the Military Medicine Study Program participated. Respondents underwent CVS symptom measurement before the intervention, applied the 20-20-20 algorithm for two weeks, and repeated symptom measurement after the intervention. Data were analyzed using the McNemar test. **Results:** There was a significant change in CVS symptoms after implementation of the 20-20-20 algorithm. Of 77 respondents, 34 respondents did not experience CVS symptoms at pretest and remained asymptomatic at posttest. A total of 25 respondents who previously experienced CVS symptoms no longer experienced CVS after intervention. Statistical analysis showed a p-value of 0.000, indicating a significant difference before and after intervention. **Conclusion:** The 20-20-20 algorithm was effective in reducing the risk of CVS among military medical students. With $p < 0.05$, this algorithm can be considered an effective, simple, and practical solution for computer users at risk of CVS.

Keywords: *Computer Vision Syndrome; 20-20-20 algorithm; military medical student; eye health*

Background

The digitalization era has transformed various aspects of life, particularly in education and professional fields. Rapid technological advancements have increased reliance on computers and visual display terminals for work, communication, and learning.[6] In academic environments, especially among medical students, computers play a crucial role in accessing information, conducting research, and completing tasks efficiently. However, despite these benefits, excessive screen time poses potential health risks, particularly eye strain and visual discomfort.[7] Medical students frequently engage in long study sessions and heavily rely on computers to optimize their learning experience.[2] Digital resources such as e-books, online journals, and medical simulations have become integral to academic success.[10] Continuous screen exposure without adequate breaks can lead to fatigue, reduced concentration, and vision-related problems, highlighting the importance of preventive measures to mitigate long-term impacts of computer use.[2]

One of the most common conditions associated with prolonged screen time is computer vision syndrome (CVS), characterized by eye strain, dryness, blurred vision, and headaches.[1] Several factors contribute to CVS, including poor room lighting, close viewing distance, prolonged focus without breaks, and non-ergonomic posture.[9] To reduce CVS risk, the 20-20-20

algorithm is recommended. This strategy involves taking a 20-second break every 20 minutes to look at an object 20 feet away, allowing the eye muscles to relax and reducing screen-induced eye strain.[11]

Previous studies have explored the impact of prolonged computer use on eye health, emphasizing factors such as room lighting, viewing distance, duration, and posture. However, research specifically examining the effectiveness of the 20-20-20 algorithm among medical students in Indonesia remains limited. Prior research reported reductions in CVS symptoms after implementation of the 20-20-20 algorithm, with statistically significant findings.[3,4] This study seeks to bridge the existing research gap by evaluating the effectiveness of the 20-20-20 algorithm among military medical students at the Republic of Indonesia Defense University.

Methods

This study used a one-group pretest-posttest design to evaluate the effectiveness of the 20-20-20 algorithm in reducing the risk of CVS. Participants underwent a pretest to measure CVS symptoms before the intervention, followed by implementation of the 20-20-20 algorithm for two weeks. After the intervention, a posttest was conducted to assess changes in symptoms. The study sample was determined using a total sampling technique involving 77 cadets from the Military Medical Study Program, Cohort 3, at the Republic of Indonesia Defense University (UNHAN RI). The study was conducted at the Republic of Indonesia Defense University, IPSC Area, Sentul, Bogor Regency, West Java, from June 2024 to February 2025.

Inclusion criteria

1. Cadets of the Undergraduate Medical Study Program, Cohort 3, at UNHAN RI;
2. Cadets who use computers for academic or personal purposes;
3. Cadets who agreed to participate in the study;
4. Respondents with complete data, including CVS pretest and posttest information.

Exclusion criteria

1. Cadets who were absent during research socialization due to unavoidable circumstances;
2. Respondents with incomplete or missing data;
3. Cadets who did not consent to participate in the study.

Data collection

1. Socialization on CVS and the 20-20-20 algorithm;
2. Completion of the CVS Questionnaire (CVS Q) pretest;
3. Implementation of the 20-20-20 algorithm for two weeks;
4. Completion of the CVS-Q posttest.

Data analysis

The McNemar test was used to analyze the effectiveness of the 20-20-20 algorithm in reducing CVS symptoms. This test was selected because it is appropriate for analyzing changes in paired categorical data, specifically the presence of CVS symptoms before and after intervention. Data were entered into Microsoft Excel, verified for accuracy and completeness, and then analyzed using SPSS. A p- value < 0.05 was considered statistically significant.

Results

The findings describe the demographic distribution of respondents by age and gender, pretest and posttest CVS symptom scoring, and the effectiveness analysis of the 20-20-20 algorithm.

Table 1. Distribution of respondents by age and gender

Characteristic	Frequency (N)	Percentage (%)
Age of respondents		
18	1	1.3
19	12	15.6
20	38	49.4
21	23	29.9
22	3	3.9
Mean	20.19	
Median	20	
Minimum	18	
Maximum	22	
Gender		
Male	41	53.2
Female	36	46.8
Total	**77**	**100**

Table 1 shows that among 77 respondents, 41 (53.2%) were male and 36 (46.8%) were female. The mean age was 20.19 years, with ages ranging from 18 to 22 years. Most respondents were 20 years old (49.4%).

Table 2. Distribution of respondents according to pretest CVS symptoms

Symptom	Never	Sometimes x Moderate/ Moderate	Sometimes x Severe/ Intense	Often/ Always x Moderate/ Moderate	Often/ Always x Severe/ Intense
Burning	29	41	1	3	3
Itching	24	48	0	3	2
Foreign body sensation	57	19	0	0	1
Tearing	61	16	0	0	0
Excessive blinking	45	27	0	2	3
Eye redness	24	48	0	2	3
Eye pain	45	24	0	2	6
Heavy eyelids	41	29	3	2	2
Dryness	38	30	1	6	2
Blurred vision	31	32	1	3	10
Double vision	57	16	0	3	1
Difficulty focusing for near vision	57	14	1	3	2
Increased sensitivity to light	38	28	0	4	7
Colored halos around objects	72	5	0	0	0
Feeling that sight is worsening	54	19	0	1	3

At pretest, symptoms with notable frequency included itching, eye redness, burning sensation, blurred vision, dryness, and increased sensitivity to light. These findings indicate that CVS-related ocular discomfort was present in a substantial proportion of respondents before the intervention.

Table 3. Analysis of CVS-Q pretest and posttest results

Pretest results	Posttest: Not experiencing CVS N	%	Posttest: Experiencing CVS N	%	Total N	%
Not experiencing CVS	34	44.2	0	0	34	44.2
Experiencing CVS	25	32.5	18	23.4	43	55.8
Total	**59**	**76.6**	**18**	**23.4**	**77**	**100**

The cross-tabulation shows a significant change in respondents condition between pretest and posttest. Of 77 respondents, 34 (44.2%) did not experience CVS at pretest and remained asymptomatic at posttest. Among 43 (55.8%) respondents who experienced CVS at pretest, 25 (32.5%) no longer experienced CVS at posttest, while 18 (23.4%) still experienced CVS. After intervention, the number of respondents without CVS increased to 59 (76.6%).

Table 4. Effectiveness analysis of the 20-20-20 algorithm

Relationship between variables	p-value (McNemar)
Relationship between CVS-Q pretest and posttest results	0.000

The McNemar test showed $p = 0.000$. Because $p < 0.05$, the 20-20-20 algorithm had a statistically significant influence on changes in CVS-Q results, indicating reduced CVS after intervention.

Discussion

Based on the research results, 34 (44.2%) respondents who did not experience CVS at pretest remained without CVS at posttest. Meanwhile, 25 (32.5%) respondents who experienced CVS at pretest no longer experienced CVS after the intervention, and 18 (23.4%) respondents still experienced CVS at posttest. Thus, there was improvement in a substantial number of participants, shown by the decreased number of respondents with CVS after two weeks of intervention. The McNemar test produced $p = 0.000$, indicating a statistically significant change in CVS condition before and after treatment. This finding suggests that the 20-20-20 algorithm had a real influence in reducing the incidence of CVS among respondents.

The present study shows that applying the 20-20-20 algorithm, which recommends looking at an object 20 feet away for 20 seconds after every 20 minutes of computer use, is effective in reducing the risk of CVS.[4] These findings are in line with previous studies reporting that structured rest strategies can help reduce symptoms of eye strain caused by long-term computer use.[11,3] Consistently scheduled short breaks provide an opportunity for eye muscles to relax and reduce the strain caused by excessive focus on the computer screen.[3]

Physiologically, the success of the 20-20-20 algorithm may be explained by the mechanism of the ciliary muscles in the eye.[8] When the eyes focus on a computer screen at close range for a long time, the ciliary muscles experience continuous contraction, which may cause muscle fatigue and accommodative spasm.[5] By shifting gaze to a distant object for 20 seconds, the ciliary muscles are allowed to relax. In addition, this algorithm may help increase blink frequency, which tends to decrease during computer use, thereby helping maintain ocular surface hydration and minimizing the risk of dry eye.[3]

The results of this study support the research hypothesis that there is a relationship between CVS pretest and posttest results. The 20-20-20 algorithm was statistically proven to be effective in reducing CVS risk in cadet students of the Undergraduate Medical Study Program, Cohort 3, at the Republic of Indonesia Defense University.

Conclusion

The use of the 20-20-20 algorithm was effective in reducing the risk of CVS in cadet students of the Undergraduate Medical Study Program, Cohort 3, at the Republic of Indonesia Defense University, with $p < 0.05$. The 20-20-20 algorithm provides an opportunity

for the eye muscles to relax, reduces tension caused by excessive focus on a computer screen, and may help increase blink frequency so thatthe ocular surface remains hydrated. These results confirm that the 20-20-20 algorithm can be an effective solution for computer users who are at risk of CVS.

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Author Contributions

All authors act as the guarantor of the manuscript. MDAP is the main investigator of this study. NP, SP and EF participated in the conception, data acquisition, data interpretation, writing of the study, and data analysis and statistical analysis of the study.

Conflict of Interest

None.

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