The effect of trick intervention 20-20-20 on computer vision syndrome incidence in computer workers

Putri Anggrainy [1], Rodiah Rahmawaty Lubis [2], Taufik Ashar [3]

[1] Department of Occupational Health and Safety, Faculty of Public Health, Universitas Sumatera Utara

[2] Department of Ophthalmology, Faculty of Medicine, Universitas Sumatera Utara

[3] Department of Environmental Health, Faculty Public Health, Universitas Sumatera Utara

Medan (Indonesia)

E-mail: rahma.lubis@yahoo.com

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Computer Vision Syndrome is a collection of symptoms that occur due to overwork with computers, including laptops, desktops, tablets and other display devices (such as smartphones and other electronic reading devices). Resting your eyes continuously and regularly has a huge effect in overcoming the syndrome.
The purpose of this study was to analyze the effect of trick intervention 20-20-20 on the incidence of computervision syndrome in computer workers.
The research method used is Quasi Experimental Design with the form of Nonequivalent Control Group Design. The total sample of this study was 76 people divided into two groups, namely the intervention and control groups. The samples in each group amounted to 38 people obtained by purposive sampling. Bivariate analysis used the Wilcoxon test for paired samples and the Mann-Whitney test for unpaired samples with a significance level of 95% ($\alpha = 0.05$).
The results of statistical tests in the intervention group showed significant differences in the score of computer vision syndrome between before and after the intervention ($\rho < 0.05$). The results of statistical tests between the intervention and control groups also showed a significant difference in the incidence of computer vision syndrome between the intervention and control groups ($\rho < 0.05$).
The conclusion in this study was that there was a significant effect of trick intervention 20-20-20 on the incidence of computer vision syndrome in respondents.

Introduction. The use of computers at this time is very broad, almost all activities in offices use this technology to complete their work. Aside from being a data processing tool, the computer also functions as a communication and information delivery tool. Computers are widely used in important offices, research institutions, universities, companies and government agencies. Computers are almost used by all employees, both administrative staff and field officers. With computers work becomes more practical and efficient. In addition, it cannot be denied that computers also have the potential to cause occupational diseases. Occupational diseases caused by computer use must be considered carefully so that their utilization can really increase work productivity [1].

The use of computers that are too long and continuously can lead to diseases including Occupational Health Hazard, commonly referred to as Computer Vision Syndrome and this syndrome is the number one occupational hazard in the 21st century [2] The National Institute for Occupational Safety and Health in the United States says that around 90 % of people who spend 3 hours or more a day on a computer can cause Computer Vision Syndrome (CVS) [3]. CVS is a condition where the eye focuses on paying attention to a computer or other display device for a long time continuously. The most common symptoms are eye fatigue, headaches, blurred vision, dry eyes and neck or shoulder pain.4,5 Some studies show that people who work more than 2-3 hours a day with computers run the risk of CVS [6, 7, 8] Employees who are most at risk of experiencing CVS include computer data entry officers, programmers, telephone operators, graphic artists, architects, insurance guarantors, air traffic controllers, journalists, lawyers, bank tellers and secretaries [7].

The main causative factors associated with CVS are environments such as improper lighting, monitor position and visibility. Other factors are the user's visual abilities such as refraction errors that are not corrected, oculomotor disorders and the presence of abnormalities in the eyes [9] While Mowry & Ison (2015) say that CVS risk factors consist of physiological factors and environmental factors. Physiological factors such as the frequency of blinking, age, gender, systemic disease, treatment, use of contact lenses and cosmetics, and environmental factors include display, length of exposure, lighting, contrast, glare, temperature, humidity, noise, ergonomics, furniture, radiation including the workload given [10].

The average worker in the United States works using a computer for seven hours / day both at work and at home, and according to the results of the 2015 American Eye-Q survey on technology and eye health report that 58% of adults experience eye strain or vision problems as a result directly from the use of the display device. In addition, additional findings were found that 59% of those surveyed

answered that desktop and laptop computers were typical of the most annoying them while cellphones were second with 26%, followed by tablets at 8% [5].

Symptoms of CVS are classified into four symptoms: internal ocular symptoms (tense and sore eyes), external ocular symptoms (dry eyes, irritation and burning), visual symptoms (blurred eyes, double vision) and musculoskeletal symptoms (neck and shoulder pain) [9].

The impact of computer usage that is too long in general is headache (30.9%), tense eyes (30.9%), double vision (12.9%), watery eyes (10.8%), viewskabur (10.1 %), and redness (4.3%) [11]. Other studies found that on average workers in developing countries work with computers for 6-9 hours per day, the prevalence of CVS events for one year is 67.4% and the most frequently reported complaints are headache (45.7%), followed by dry eyes (31.1%) and pain around the eyes (28.7%) [12].

In Indonesia, a study of 49 accounting employees at Hasan Sadikin Hospital was also conducted, showing that the symptoms of neck pain (59%), painful eyes (49%) and headaches (35%) were the symptoms that most employees complained of. In addition, there are also many employees who complain of other supporting symptoms such as eyebrows and around the eyes that are painful [13].

Continuous and regular rest is very influential in overcoming the symptoms of CVS, it is highly recommended to do tricks 20-20-20 which is every work for 20 minutes, rest for 20 seconds by focusing vision to an object 20 feet (6 meters) while working in in front of the computer, this trick is very helpful to alleviate the symptoms of CVS experienced by computer users [5, 14, 15, 16]. Gupta, et. al (2014) has proven that this trick can reduce CVS symptoms in computer workers by up to 46.5%. There was a significant reduction in asthenopic symptoms after the intervention but the results obtained were still limited due to inadequate infrastructure in the workplace, subject disobedience and limited intervention time [15].

The results of the initial survey conducted on 60 employees of the Port Health Office of Medan in 2017, found that 90% (54 people) of employees worked ≥ 2 hours per day continuously and all experienced symptoms of CVS with a number of symptoms that varied, at least 1 and maximum 11 symptoms. Of the 13 symptoms of CVS that were asked to respondents found the most frequent complaints were tired eyes (72%), neck pain (65%), eyes tense (52%), back pain (47%) and blurred vision (45%). Adequate rest can help reduce the incidence of CVS in employees, but there is still little research on ideal rest hours and keep in mind that interruptions that are too frequent will have less effective effects on the work being done. Therefore the authors are interested in trying to apply tricks 20-20-20, and want to know how they affect CVS complaints experienced by Medan Class I KKP employees in dealing with CVS symptoms, because of the short time, and the employee does not need to leave the job too long so work can be completed on time.

Materials and methods

The research method used in this study is Quasi Experimental Design with the form of Nonequivalent Control Group Design. The study population was employees of Port Health Office in Medan. The sampling technique in this study is a non-probability sampling technique using purposive sampling technique, namely sampling techniques chosen with certain considerations, so that only populations that meet the criteria can be sampled [17]. The number of samples is determined using the two populations hypothesis test formula [18]. Of the calculation results obtained a sample of 38 people both for the intervention group and the control group. The intervention group is a group of respondents who carry out tricks 20-20-20 when working with computers, while the control group works as usual without using tricks 20-20-20. The treatment is carried out for 5 working days.

The dependent variable in this study is the incidence of CVS. The type of data collected is primary data in the form of complaints from CVS symptoms felt by respondents, data obtained from interviews using questionnaire tools. The symptoms of CVS that were asked to the respondent consisted of 13 symptoms: tense eyes, pain in the eyes and around the eyes, tired eyes, headache, dry eyes, irritation, red eyes, blurred vision, double vision, neck pain, shoulder pain and pain in wrist / finger [9]. If the respondent answers no complaints, a value of 0 will be obtained and if yes the value is 1. The maximum score for this variable is 13 and the score is at least zero. Whereas to improve the compliance of respondents implementing independent variables (intervention tricks 20-20-20) researchers installed the Eye Care - Protect Your Vision application on each respondent's computer / laptop. This application will clink every 20 minutes accompanied by the appearance of 20-20-20 trick reminder notifications. This is so that each respondent always remembers and applies tricks 20-20-20 every time he works with a computer. This study consisted of three stages, namely pre intervention, intervention and post intervention. Test data analysis using the SPSS softwer. Submission of descriptive data for categorical types is presented in the form of percentage and frequency distribution, while numerical data will be seen as mean, 95% CI, standard deviation and minimum and maximum values. Bivariate analysis uses the Wilcoxon non-Paramatetric statistical test to determine differences in CVS complaints before and after treatment in the paired group. Furthermore, to compare CVS complaints between the experimental group and the control group, the Mann Whitney test with a confidence level of 95% ($\alpha = 0.05$).

Results

1. Distribution of Respondents' Length of Work with Computers Per Day

Table 1 shows the accumulation of respondent's length of work for one day working with computers on average 5.53 hours in the intervention group with a standard deviation of 1.520, working for a minimum of 3 hours and

a maximum of 10 hours. In the control group, the average respondent worked for 4.42 hours a day with a standard deviation of 2.113, a minimum of 2 hours working and a maximum of 10 hours. Based on the length of work continuously, the average intervention group worked for 3.37 hours continuously, at least working continuously for 2 hours and a maximum of 7 hours. While the control group worked for an average of 2.74 hours continuously, at least working for 2 hours and a maximum of 5 hours.

2. Respondent Frequency Distribution Based on CVS Events Before and After Intervention

The frequency distribution of CVS complaints experienced by respondents (Table 2) showed that there was a decrease in the frequency of CVS symptoms after a trick intervention 20-20-20 in the intervention group. The symptoms that most often appear in the intervention group before the trick is done 20-20-20 are tired eyes as many as 35 people (92%) decreased to 10 people (26%), neck pain as many as 31 people (82%) decreased to 7 people (18%), back pain 29 people (76%), decreased to 7 people (18%), eyes felt tense as many as 25 people (66%) decreased to 3 people (8%), and no more respondents experienced vision running away from the original 23 people (61%). In the control group there were not many changes in CVS complaints experienced by respondents, there was a slight decrease in the frequency of symptoms, there were even some symptoms that experienced a slight increase in frequency. CVS complaints that most often appear in the control group are tired eyes, on the initial examination there were 32 people (84%) and when the final examination increased to 33 people (87%), then neck pain was 24 people (63%) and not there is a change in frequency after working for 5 days.

3. Scores of CVS Symptom Before and After Intervention in the Intervention and Control Group

Based on CVS scores experienced by respondents (table 3) it appears that the number of CVS symptoms experienced by respondents in the intervention group averaged 6.21 symptoms, a minimum of 2 symptoms and a maximum of 9 symptoms. After the intervention decreased to 1.16 symptoms with symptoms of at least 0 symptoms and a maximum of 4 symptoms. While in the control group, CVS symptom scores experienced by respondents in the initial examination averaged 4.79 symptoms with a score of at least 1 symptom and a maximum of 9 symptoms and not too many changes when examined after 5 working days obtained an average number of symptoms experienced by 4.89 symptoms of respondents with a value of at least 1 symptom, a maximum of 9 symptoms. Based on the results of the Wilcoxon Statisk test of CVS complaints before and after intervention in the control group, a Significancy number of 0.001 was obtained. Because the value of $\rho < 0.05$, it can be concluded that there are significant differences in CVS incidence scores between respondents before and after the intervention of tricks 20-20-20. Whereas the control group obtained a Significancy number of 0.206. Because the value of $\rho > 0.05$ can be concluded that there is no significant difference in the CVS incidence score between before and after treatment.

4. Results of the Mann Whitney Test of CVS Complaints Score in the Intervention and Control Groups

The results of the Mann-Whitney test analysis (table 4) between the intervention group and the control group on the CVS complaint score after applying trick intervention 20-20-20 for 5 days working with computers obtained a significance value of 0.001 ($\rho < 0.05$) indicating that there was a significant difference between CVS incidence scores in the intervention group and the control group after applying the intervention, the difference in the mean difference between the intervention and control groups after treatment was 3.73. Based on the pre and post intervention gain score, it was found that the average gain score of CVS complaints before and after intervention in the experimental group was 5.05 while in the control group -0.11 the results of the statistical test showed a value of $\rho = 0.001$ which means there are significant differences between the gain values score of CVS pre and post complaints in the intervention and control groups.

Discussion

Based on research it is known that tricks 20-20-20 are very effective for reducing symptoms of CVS. CVS occurs because the eyes focus too long on the computer (laptop or PC) or other digital devices such as tablets and mobile phones.5 The results of the study found that employees work at the computer continuously ± 3 hours per day and for one flat working day -that they can spend ± 5 hours per day working at the computer both in the office and outside the office. The employees are at high risk of experiencing CVS, this is proven by the average number of respondents in the intervention group experiencing CVS complaints of 6.21 symptoms, a minimum of symptoms experienced by 2 symptoms and a maximum of 9 symptoms. Not much different from the control group, where the average complaints experienced in this group were 4.79 symptoms with a symptom score of at least 1 symptom and a maximum of 9 symptoms. The most common symptoms in both the intervention and control groups were tired eyes, neck pain, back pain, blurred vision and tense eyes. This is in accordance with Rahman and Sanip's (2011) study, found that respondents generally use computers more than half their working hours which is 8 hours per day (average = 5.9 hours). Working too long and continuously with a computer is a predisposition for someone experiencing CVS [19]. The results of these studies are also supported by Reddy et al. (2013), based on research found that as many as 90% of students in Malaysia who use computers for more than two hours constantly experiencing symptoms of CVS more often. The most common symptom of CVS is headache, followed by tense eyes [8].

Symptoms of CVS are non-permanent symptoms. This CVS complaint can be lost if the user no longer uses a computer or other display device. Regular breaks have a huge effect in preventing CVS for computer users. Small breaks between jobs really help to reduce CVS symptoms [8]. To

prevent CVS complaints from arising from computer workers it is recommended that you rest for 20 seconds every 20 minutes working with a computer. During breaks computer users are encouraged to focus their eyes on objects as far as 20 feet (6 meters) or it can also close their eyes [5, 14, 15]. This intervention is commonly called a trick 20-20-20 and is proven to be effective in reducing CVS symptoms in computer users. Respondents' disobedience in implementing the intervention in Gupta's research, et al. May be caused by respondents being too focused on their work so that respondents forget to apply tricks 20-20-20 when working with computers. Low levels of self-awareness often make computer workers not aware of discomfort or other symptoms associated with CVS [16]. So that the respondent always remembers to rest his eyes, the researcher installs the Eye Care-Protect Your Vision application on each computer of the intervention group respondents. This application is like an alarm that will always remind the respondent. This application will calculate the break time with a countdown and when the time runs out a sound will emerge clinking, accompanied by a reminder notification and instructions that can be done by the respondent during a 20 second break.

Based on the results of the Wilcoxon statistical test obtained a significance value of 0.001, because the value of $\rho<0.005$ then the hypothesis in this study was received there was a significant effect of trick intervention 20-20-20 on the incidence of CVS on computer workers. Unlike the control group, there was not much difference in CVS scores experienced by respondents after working as usual with computers for 5 days. The results of the analysis test obtained significance number 0.206 ($\rho>0.005$), it can be concluded that there was no significant difference in the CVS incidence score between the initial examination and the final examination on the respondents. Test analysis was also carried out in the unpaired group, namely between the intervention group and the control group. The results showed that there were significant differences in CVS incidence scores between the intervention group and the control group ($\rho<0.05$).

The decrease in the number of symptoms experienced by the intervention group after applying tricks 20-20-20 for 5 days working with computers proved the truth of the Web of Causation theory introduced by MacMahon and Pugh in 1970. In this concept MacMahon explained that to prevent a person's disease do not have to know the cause and effect mechanism of the disease as a whole. Knowledge of just one component can sometimes be used as a preventive measure. Success or failure of a precaution depends on which chain can be removed [21].

Rosenfield said that CVS can affect work productivity between 64 to 90%. This syndrome occurs due to the use of a computer that is too long. Computer vision syndrome also known as digital eye strain is a combination of eye and vision problems associated with the use of computers (including desktops, laptops and tablets) and other electronic displays (eg smartphones and electronic reading devices) [21, 22]. Internal ocular symptoms such as eyes tension, pain in the eyes and around the eyes, and tired eyes are most likely related to refractive errors such as accommodation, increased convergence (close reading) and involvement of other ocular muscle tension. Abnormalities and disturbances in accommodation have a significant contribution to CVS symptoms experienced by computer users [9]. Frequent taking breaks when using a computer has been shown to improve work efficiency because rest tends to relax the accommodative system of the eye thereby reducing eye fatigue and headache [9, 11]. Resting continuously and regular influence is very large in overcoming these symptoms. During rest, the ciliary muscle will relax, the eyes are not in a state of accommodation, the frequency of blinking of the eyes increases, the muscles in the neck and shoulders relax, so the ocular, visual and musculoskeletal complaints will decrease [23, 24].

Conclusions and recommendations

Based on the results of research and discussion, it can be concluded that there are significant differences between CVS incidence scores before and after trick intervention 20-20-20 in the intervention group ($\rho = 0.001$). While in the control group who worked as usual without applying tricks 20-20-20 it was obtained $\rho = 0.206$ which means there was no significant difference between CVS scores before and after treatment.

To prevent CVS from being advised to always apply tricks 20-20-20 while working with a computer, ie every 20 minutes it works, rest for 20 seconds by focusing vision on an object as far as 20 feet (6 meters) or it can also close your eyes. This rule helps the eyes stay relaxed and prevents the eye from accommodating continuously. Install the sotfwer EyeCare - Protect Your Vision application or other similar applications on each employee's computer, so workers always remember to apply tricks 20-20-20 every time they work with a computer.

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Table 1. Distribution of Respondents' Length of Work with Computers Per Day

Characteristics	Intervention Group (n = 38)	Control group (n = 38)
Long accumulation of work per day		
Average	5,53	5,13
Elementary School	1,520	1,877
95%	5,03 - 6,03	4,51 - 5,75
Minimal	3	2
Maximum	10	10
Duration of work continuously		
Average	3,37	3,11
Elementary School	1,239	0,978
95%	2,96 – 3,78	2,76 – 3,45
Minimal	2	2
Maximum	7	6

Source: Primary Data 2018

Table 2. Distribution of Frequency of Respondents Based on CVS Events Before and After Intervention

Symptoms of CVS	Intervention Group		Control Group	
	Before	After	Before	After
	n (%)	n (%)	n (%)	n (%)
Ocular Symptoms				
Internal Ocular Symptoms				
The eye feels tense	25 (66)	3 (8)	16 (42)	14 (37)
Pain in the eyes and around the eyes	14 (37)	3 (8)	12 (32)	11 (29)
Tired Eyes	35 (92)	10 (26)	32 (84)	33 (87)
Headaches	22 (58)	3 (8)	10 (26)	11 (29)
External Ocular Symptoms				
Sensation of burning in the eyes	3 (8)	0	2 (5)	4 (11)
The eye feels irritated	12 (32)	1 (3)	17 (45)	15 (39)
Dry eyes	17 (45)	5 (13)	12 (32)	12 (32)
Red eyes	10 (26)	2 (5)	8 (21)	10 (26)
Visual Symptoms				
Double Vision	4 (11)	0	8 (21)	10 (26)
Blurred Vision	23 (61)	0	19 (50)	18 (47)
Musculoskeletal Symptoms				
Pain in the neck	31 (82)	7 (18)	24 (63)	24 (63)
Back pain	29 (76)	7 (18)	14 (37)	39)
Pain in the hands and fingers	11 (29)	3 (8)	8 (21)	9 (24)

Source: Primary Data 2018

Table 3. CVS Symptom Scores Before and After Intervention in the Intervention and Control Group

CVS's scores	Intervention Group (n=38)			Control group (n=38)		
	Before	After	ρ	Before	After	ρ
Average	6,21	1,16	0,001	4,79	4,89	0,206
Elementary School	1,919	1,366		2,395	2,425	
95%	5,58 -6,84	0,71 – 1,61		4,00 – 5,58	4,10 – 5,69	
Minimal	2	0		1	1	
Maximum	9	4		9	9	

Source: Primary Data 2018

Table 4. Results of Mann Whitney Test Analysis on CVS Complaints Score Intervention and Control Groups

CVS's score	Intervention n = 38	Control n = 38	ρ
After Intervention, average (SD)	1,16 (2,395)	4,89 (2,425)	0,001
Gain score pre dan post, average (SD)	5,05 (1,830)	-0,11 (0,509)	0,001

Source: Primary Data 2018