Comparison Of Two Exercise Program on Student's Eye Health with Prolonged Digital Engagement.

[1]Meenu Suthar,[2]Mrs. Monalisa Pattnaik,[3]Dr. P.P. Mohanty,[4]SV NIRTAR

[1]MPT
[2]MPT, head of department (PT), Monalisa
[3]Ph.D. , Director, SV NIRTAR
[4]Olatpur, Bairoi, Cuttack, Odisha, INDIA.

ABSTRACT

Background: Prolonged gadget use may lead to various eye health problems, termed as asthenopia. Continuous use of gadgets may lead Computer Vision Syndrome (CVS) which is now a major problem affecting 70 percent of all people. Studies suggest that there might be a relation between eye exercises and improvement in asthenopic symptoms.

Method: An experimental study with pre-test post-test design was performed on 60 subjects who were then divided into 3 groups with equal subjects as group A eye exercises; group B as combined eye and neck exercises, group C as control with no exercises. Intervention provided for 8 weeks and measured using CVS-Q before and after 8 weeks. Group A consisted of palming, blinking, sideways viewing, Front and sideways viewing, Rotational viewing, Up and down viewing, preliminary nose tip gazing, Near and distant viewing. Group B was provided neck active range of motion exercises, neck isometrics and core stabilisation exercises and eye exercises.

Result: There was total 60 students. Out of 60 students, 20 (32.8%) were male and 40 (65.6%) were female (Fig 1). Mean age was found to be 23.15 years (Table 1) Students were divided into three groups. The Kruskal Wallis test revealed that there was significant difference in treatment group as compared to control group, H=38.57, df= 2, p=0.00 (p<0.05). Median of pre CVSQ score among groups was same, irrespective of group. Post CVS Q median has revealed that there was a significant difference in the CVS Q score in group 1 and 2 while group 3 median of score has been shifted upward. The pairwise comparison of group showed that there was no significant difference between group 1 and group 2, p>0.05 (p=1.00). However, significant difference was seen between group 1 and 3 (p=0.00) and, group 2 and 3 (p=0.00).

Conclusion: 8 weeks eye exercise protocol as well as combined eye and neck exercises protocol improved score of computer vision syndrome questionnaire and eye health of students involved in prolonged gadget use more than no treatment group (control). Both the exercises protocol showed similar results in improving score.

KEYWORDS: CVS, asthenopia, eye exercise, neck exercises.

INTRODUCTION:

The human eye is a sense organ that reacts to light and allows vision. Our eyes play an important role in moving, functional activity, and enjoyment of life. For this reason, it is necessary to maintain good eye health. National Academies of Sciences, Engineering, and Medicine, (2016) defined eye and vision health as "creating the conditions where people can have the fullest capacity to see and that enable them to achieve their full potential." [1]. Because of a rapid advancement in the technology, books are being replaced by the gadget. Technology helped the population in various ways, but everything has its own disadvantage along with advantage. Use of gadgets like smartphones, computers, etc. among students has increased a lot during this pandemic disease and its increased used have led to the psychological and physical stresses.

Continuous use of gadgets like computer or smartphone has led to the development of the term computer vision syndrome (CVS). American optometric association, (2019) defines CVS or digital eye strain as "group of eye and vision-related problems that result from prolonged computer, tablet, e-reader and cell phone use". According to internet world stat 2020, around half of the 1.37 billion Indians had used internet in 2020. About 60 million people all over world is suffering from this computer vision syndrome global. [2] CVS is now known to be a major problem of 21st century affecting 70 percent of all the people who have been involved in computer work [3].

During the prolong engagement with the devices such as computer, laptop, smartphones, one may face variety of symptom. The symptoms occurring with computer use typically include eyestrain, eye fatigue, discomfort, burning, irritation, pain, ache, sore eyes, tired eyes, and headache. Along with these symptoms one may develop photophobia, blur and double vision, itching, tearing, dryness, and foreign-body sensation [4].

Satayananda S., stated that if you read with mind and eyes relax one may not develop the symptoms. But, the focus mechanism of our eyes is not same for reading books and for smart phones or digital screen. In both these tasks response is different [5]. Both have different distance viewing, rate of blinking, gaze angles, texts appearance, accommodation, and working of palpebral fissure. Each printed letter is made up of a well-defined character throughout its surface, whereas Visual Display Terminals (VDT) letters are made up of pixels [6,7]. In digital screen pixel at the centre is the brightest and at the periphery its brightness decreases. So, one cannot maintain focus on the pixel constantly. Instead, the focusing system lags behind the computer screen due to the vertical position of gaze which is preferred position by computer user relative to reading a printed text termed as dark focus [8]. Whenever visual stimulation is degraded like in night or in bad weather, the eyes tend to adjust involuntarily for a distance determined by the individual's resting or tonus state and this resting focus is known as dark focus. Hence, the eyes keep on relaxing to dark focus and try to gain the focus on the pixels character on the screen and this continuous focus and refocus of eye by ciliary body results in

fatigue in the eye leading to accommodation symptoms related to computer vision [9]. This accommodation lag leads to asthenopic symptoms. Also, when the gadgets are used excessively it involves prolong near vision work which may lead to spasm of accommodation and hence in ciliary muscles. This spasm may lead to initiation of these symptoms [10].

The computer vision syndrome and the related symptoms are found to be improved by eye exercises proved by many researchers [11,12,13]. Eye exercises include strengthening of muscles surrounding the eye. In a study [12], a participatory eye care (PEC) program given to the 35 computer users in university of Thailand for 8 weeks. There was a significant reduction in eye strain post treatment.

Eye motility dysfunction is also seen in the cases of soft tissue injury of cervical region [14]. Although, studies related to effectiveness of neck muscle strengthening in improving ocular symptoms or asthenopia are limited but, there are studies which suggest that there is some relation between neck muscle and eye muscle activity. Study showed that there is an association between contraction of ciliary muscle and trapezius muscle activity.

There is ever rising of incidence of visual symptoms in population who work for prolonged hours especially students whose hours of computer and smart phone usage has been found to increase because of increased online classes due to covid-19 breakdown. Eye exercises have been found helpful in reducing these problems [11, 12, 15]. There is a paucity of literature about the effect of eye exercise and combined eye and neck exercise in reducing the impact of digital life on student's eye health. The comparative analysis is also not been well established. This current study has been designed with the aim to compare the effects of eye exercise and combined eye and neck exercise.

METHODOLOGY:

A total of 60 subjects male and female students who frequently use computers or smart phones were taken in a study with inclusion criteria as Indian subjects with or without refractory error, aged 15-30 years who work with computer ≥4 hours/day for 5 days a week, with vision related symptoms (headache, dryness, irritation, grittiness, blurring, difficulty focusing, eye muscle fatigue, eye pain, burning etc.) and excluded on the basis of those who have colour blindness, organic diseases like glaucoma, eye infections, eye injury, malignancy, any surgery for refractive errors, squint. Subjects suffering from medical conditions known to impact cognitive functioning like neurological disorders, head injuries, cardiovascular disease, diabetes and those whose parents have refractive error were not taken as a part of study group.

Written consent was taken from those included in the study and assessed using computer vision syndrome questionnaire (CVS-Q). It assesses the frequency and intensity of 16 symptoms related to eye problems. Participants were divided into 3 groups with equal subjects of 20. Group A was provided eye exercises i.e., palming, blinking, sideways viewing**,** Front and sideways viewing, Rotational viewing, Up and down viewing, preliminary nose tip gazing, Near and distant viewing. Group B was provided neck active range of motion exercises, neck isometrics and core stabilisation exercises and eye exercises. Group C was given no treatment.

DATA ANALYSIS:

Data Analysis was done using Microsoft Excel 2019 and SPSS Statistics 26. Participants were divided randomly into three groups: GROUP A: eye exercises alone; GROUP B: eye and neck exercise; GROUP C: control group. Kruskal-Wallis Test was used to see whether there was any difference between Two different exercises program on student's eye health with prolong digital engagement. Mann-Whitney U Test was done to see whether there was any difference between CVS Q scores of participants with spectacles and without spectacles. Statistical level of significance was set at 0.05.

RESULT:

There was total 60 students. Out of 60 students 20 (32.8%) were male and 40 (65.6%) were female. Mean age was found to be 23.15 years. Students were divided into three groups. GROUP 1(n= 20) were doing eye exercises, GROUP 2 (n=20) were doing eye exercises along with neck exercises. GROUP 3 (n=20) were in control group.

Fig. 1 shows median of pre CVSQ score among groups was same, irrespective of group. In fig 2, post CVS Q median has been depicted which revealed that there was a significant difference in the CVS Q score in group 1 and 2 while group 3 median of score has been shifted upward.

The Kruskal Wallis test revealed that there was significant difference in treatment group as compared to control group, $H=38.57$, $df= 2$, $p=0.00$ ($p<0.05$) (Table 1,2).

Mann Whitney U test revealed that there was no significant difference in pre-CVS Q score ($p=0.33$) and chCVS Q ($p=0.97$) between spectacles user and non-user of treatment groups (group A and group B) (Table 3).

Table 4, shows the pairwise comparison of group. It showed that there was no significant difference between group 1 and group 2, $p>0.05$ ($p=1.00$). However, significant difference was seen between group 1 and 3 ($p=0.00$) and, group 2 and 3 ($p=0.00$).

Figure 3 depicts the graphical representation of pre and post CVSQ score of each group. In both group 1 and 2 there was an improvement in score after treatment while in group 3 (control group) the scores increased after 8 weeks. Also, there is slight better improvement in score in group 2 (eye and neck exercises) than eye exercises alone (group 2). But the difference is not significant enough to conclude that neck exercises are better than eye exercises.

DISCUSSION:

The study was done to find out the effectiveness of two different exercise programs on student's eye health and any change in asthenopic symptoms on the basis of CVS Q score.

Over all result found that there was better improvement in POST CVS Q score of both the treatment group than control group after 8 weeks. Both the treatment group had similar results in improving eye health of students. Also, pairwise comparison did not find any significant difference between group 1 and group 2. This might be explained by the fact that repetitions of exercise in group 2 was half of that in group 1 to keep the duration of protocols same because of time constraints as intervention was given through video conferencing method and hence did not show better results than group 1. If the eye exercises given in group 2 was same as group 1, we would have been able to conclude better which group showed higher results. A significant difference was seen between group 1 and group 3 and group 2 and group 3. These findings were similar to those of a previous study that reported that eye

exercises significantly decreased the visual discomfort in people working in a software company, students involved in prolong gadget use and various other computer jobs.

Similar results were found in an experimental study done by Kim, 2016. Study was done on undergraduate nursing students and performed yogic eye exercises for 8 weeks and found significant improvement in ocular fatigue scale after treatment [11]. Lertwisuttipaiboon et al., (2017) a quasi-experimental study also supported eye exercises, they found significant decrease in percentage of eye strain on questionnaire based on symptoms. Benefits gained in experimental group in our study might be due to the fact that these asthenopic symptoms are due to defects in ocular muscles occurring due to pain and tension resulting from gadget use. Eye movement helps in strengthening the eye muscle and reverting the defect in eye muscles which in return reduces the eye fatigue and other symptoms [12].

In a retrospective study**,** done in 135 patients with asthenopic symptoms and with convergence insufficiency. Orthoptic exercises were given which included both convergence and divergence therapy at office and home both. This study found similar result that asthenopic symptom reduced in 59.5% of children and 51.9% of adults after eye exercises and in 37% of people there was improvement in near point of convergence while in 38% there was no change [13].

In our study we found that combined eye and neck exercises equally improved the post CVS Q score. An experimental study also supported our result that combined eye and neck exercises are effective in improving eye symptoms. 30 physiotherapy students having neck pain along with visual symptoms within age group 18-25 years were given set of neck isometrics and four eye exercises for two weeks. OSDI, VAS, muscle strength of cervical using pressure biofeedback were taken before and after the treatment. Study found a significant reduction in student's symptoms [16].

Neck exercises are found to be effective in improving the asthenopic symptoms. Combined neck and ocular symptom are supported by the fact that neck is a necessary and sensitive sensory organ and have a greater percentage of proprioceptor which generate reflex in eyes and the inner ear. Neck is also found in controlling head, eye, and posture [17]. Neck exercises given in group 2 with addition to eye exercises shows similar results to group 1. Both the exercises protocol equally improved the post CVS Q score.

Results in our study shows that there was no significant difference between the scores of participants with and without spectacles before and after the treatment. In our study, we also observed that females had more symptoms than male participants which is similar to the findings of study done by [12]. This is supported by the fact that females are more prevalent to accommodative and vergence dysfunction and hence more prone to develop visual problems**.** However, some studies did not find any significant relation between gender and eye symptoms [15]. Our result also revealed that the participants involved in control group shows marked increase in their CVS Q score after 8 weeks i.e., the eye health deteriorated.

CONCLUSION:

From the results revealed in this study, it can be concluded that 8 weeks eye exercise protocol as well as combined eye and neck exercises protocol improved score of computer vision syndrome questionnaire and eye health of students involved in prolonged gadget use more than no treatment group (control). Both the exercises protocol showed similar results in improving score.

LIMITATIONS AND FUTURE RECOMMENDATIONS:

Repetitions given in eye and neck protocol was less as compared to the group in which only eye exercises were given to keep the duration same because of time constraint on video conference. Half of the participants did exercises through video calling and hence, was not completely under supervision. Exclusion criteria did not exclude migraine headache. Sample size was small. This study was done on university students of 18-30 years of age group only. Different age group can be studied to see the effects of exercise protocol. Effects of exercise on neck pain can also be studied in future studies. Multiple measures can be used to see the effects. Future studies should consider seeing the effect of these exercises in three different groups i.e., eye exercises alone, neck exercises alone and both eye and neck exercises.

REFERENCES:

1. National Academics of Sciences, Engineering, And Medicine (2016)
2. Sen A, Richardson S. A study of computer-related upper limb discomfort and computer vision syndrome. Journal of human ergology. 2007 Dec 15;36(2):45-50.
3. Charpe NA, Kaushik V. Computer vision syndrome (CVS): recognition and control in software professionals. Journal of Human Ecology. 2009 Oct 1;28(1):67-9.
4. J. E. Sheedy (2007) The physiology of eyestrain, Journal of Modern Optics, 54:9, 1333-1341.
5. Satyanada SS: Asana Pranayama Mudra Bandha. In: Yoga Exercises for the Eyes. India: Bihar Yoga Bharati Yoga Publication Trust, 2006, pp 74–84.
6. Lee DS, Ko YH, Shen IH, Chao CY. Effect of light source, ambient illumination, character size and interline spacing on visual performance and visual fatigue with electronic paper displays. Displays. 2011 Jan 1;32(1):1-7.
7. Chang PC, Chou SY, Shieh KK. Reading performance and visual fatigue when using electronic paper displays in long-duration reading tasks under various lighting conditions. Displays. 2013 Jul 1;34(3):208-14.
8. Ripple PH. Variation of accommodation in vertical directions of gaze. American Journal of Ophthalmology. 1952 Nov 1;35(11):1630-4.
9. Anshel J, editor. Visual ergonomics handbook. CRC Press; 2005 Jun 22.
10. Nunes FM, Oliva HN, Oliveira GD, França DS. Asthenopic symptoms prevalence in undergraduate students. Revista Brasileira de Oftalmologia. 2018 Nov;77:334-7.
11. Kim SD. Effects of yogic eye exercises on eye fatigue in undergraduate nursing students. Journal of physical therapy science. 2016;28(6):1813-5.
12. Lertwisuttipaiboon S, Pumpaibool T, Neeser KJ, Kasetsuwan N. Associations of preventive strategies with symptoms of eye strain among Sukhothai Thammathirat Open University staff in Thailand. Journal of Health Research. 2016;30(1):33-8.
13. Westman M, Liinamaa MJ. Relief of asthenopic symptoms with orthoptic exercises in convergence insufficiency is achieved

in both adults and children. Journal of Optometry. 2012 Apr 1;5(2):62-7.
14. Hildingsson C, Wenngren BL, Toolanen G. Eye motility dysfunction after soft-tissue injury of the cervical spine: a controlled, prospective study of 38 patients. Acta Orthopaedica Scandinavica. 1993 Jan 1;64(2):129-32.
15. Domkin D, Forsman M, Richter HO. Ciliary muscle contraction force and trapezius muscle activity during manual tracking of a moving visual target. Journal of Electromyography and Kinesiology. 2016 Jun 1;28:193-8.
16. Deshmukh MP, Palekar TJ, Bajare U. Effect of cervical muscle strengthening and ocular muscle training among students with smartphone adversity. Journal of Dental Research and Review. 2020 Feb 1;7(5):65.
17. del Mar Seguí M, Cabrero-García J, Crespo A, Verdú J, Ronda E. A reliable and valid questionnaire was developed to measure computer vision syndrome at the workplace. Journal of clinical epidemiology. 2015 Jun 1;68(6):662-73.

ANNEXURE: TABLES AND FIGURES:

FIGURE 1:

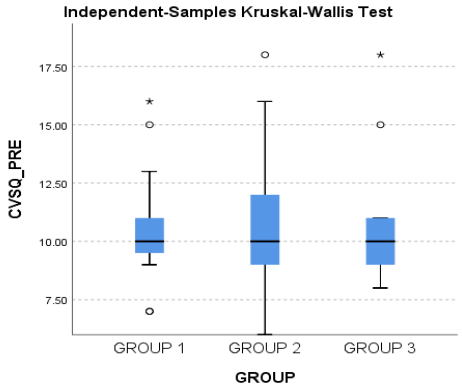

FIGURE 2:

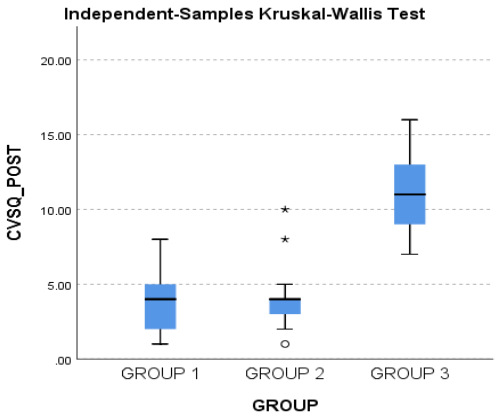

TABLE 1

Independent-Samples Kruskal-Wallis Test Summary

Total N	60
Test Statistic	38.578[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	.000

a. The test statistic is adjusted for ties.

TABLE 2:

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of chCVSQ is the same across categories of GROUP .	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

TABLE 3:

Test Statistics

	CHCVSQ
Mann-Whitney U	127.000
Wilcoxon W	163.000
Z	-.034
Asymp. Sig. (2-tailed)	.973
Exact Sig. [2*(1-tailed Sig.)]	.987[b]

TABLE 4:

Pairwise Comparisons of GROUP

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
GROUP 1-GROUP 2	-.950	5.488	-.173	.863	1.000
GROUP 1-GROUP 3	-29.500	5.488	-5.376	.000	.000
GROUP 2-GROUP 3	-28.550	5.488	-5.203	.000	.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

FIGURE 3: