Effect of Educational Intervention about Computer Vision Syndrome on the Severity of Eye Complaints among Computer Users

[(1)] Samia Farouk Mahmoud, [(2)]Mona Emad Eldien Hussien Sabbour

[1-] Assistant professor of community health nursing, Community Health Nursing, Faculty of Nursing, Zagazig University

[2-] Lecturer of community health nursing, Community Health Nursing, Faculty of Nursing, Mansoura University

Abstract

The Computer Vision Syndrome (CVS) related to the usage of computers has been due to low compliance with ergonomic features. The aim of that research was to assess the effectiveness of educational intervention about computer vision syndrome on the severity of eye complaints among computer users. **Design:** A quasi-experimental interventional study with pre-post evaluation was performed. **Setting:** The research was concluded in the administrative buildings of Zagazig University/Egypt. **Subjects:** Seventy-five computer operators were included in the current study. **Tools**: Three questionnaires were used for data gathering, which includes I. computer user's self-administered questionnaire, and Self-reported eye complaints' and computer users' CVS knowledge scale, II. Observation and measurement of the employees' computer ergonomic practices, and III. Assessment of the computer workstation design. **Results**: Following educational intervention by 1 and 3 months, the total-eye-complaints score, total-knowledge score, and the total protective ergonomic practices scores showed a statistically significant difference. Additionally, after one and three months, the overall workstation score showed a substantial mean difference. **Conclusion:** As a result of the educational intervention regarding computer vision syndrome and its preventive ergonomic practices, computer users' observed eye symptoms decreased, their knowledge about computer vision syndrome improved. Their protective ergonomic practices and workstation proposal were remodeled. **Recommendation**: Based on the study findings, it is recommended that application the educational intervention about the ergonomic training program Computer operating employees, and acquiescence to recommend office ergonomics are essential to alleviate the growing prevalence in CVS cases.

Keywords: Computer Vision Syndrome, Eye Complaints**,** Education Intervention, Knowledge, Ergonomic Practices, Computer Users, Workstation Design.

Email: samia.mahmoud78@yahoo.com

Introduction

The American Optometric Association identifies computer vision syndrome (CVS) as a mix of eye and vision issues connected to close labour observed while using a computer or to connect with it. This is attributed to the excessive use of devices having screens, e.g. computers, tablets, e-book readers, handheld game consoles, and smartphones. Computer vision syndrome is also identified as Digital Eye Strain (DES). A digital screen display differs from reading a printed page. As letters or figures published in newspapers and books usually comprise dense black letters with precise boundaries and a great contrast with a bright background; they do not produce focus difficulties and exhaustion in healthy eyes **(Klamm & Tarnow, 2015).**

Computer vision syndrome is caused by activities that stress nearby vision while using a computer or digital screen and defines any vision damage induced by exposure to a digital Computer screen and its environment. Nowadays, CVS is one of the most common workplace hazards, particularly among office workers. **(American Optometric Association, 2017).** The extent of CVS has received more consideration in the literature review due to the technological revolution. Additionally, CVS is a severe problem that distresses a lot of persons. In 2018, the Vision Council released a new report that recorded that after spending at least two hours per day on electronic devices, 59% of American grownups have CVS **(The Institute of Occupational Health and Safety, 2019)**. The Occupational Safety and Health (OSH) confirm that CVS is an unintentional result of continued computer usage unless suitable ergonomic rules are applied. In 2018, the Occupational Safety and Health Administration stated that around 64-90% of computer manipulators showed CVS complaints, particularly those who work about three or more hours per day on electronic devices and found that about 88% of them will experience CVS at any period in their lives **(Gowrisankaran & Sheedy, 2015).**

Computer vision syndrome is a term composed of external and internal complaints. External complaints comprise irritability, burning sensation, distress, lacrimation, and dehydration along with neck and shoulder pain, while internal complaints including exhaustion, pain and headache in the eyes. Computer-related symptoms were divided into two groups: comfort-related complaints (such as blurred vision, blurry distance vision, and difficulty in refocusing of different distances) and complaints correlated to dehydrated eye (irritability/burning) sensation, eye fatigue, pain, excessive light sensitivity, and eye distress) **(World Health Organization, 2019).**

The most significant method in treating computer-related symptoms is removing the causes producing the symptoms (Table 1). Many computer-related symptoms can be prevented with suitable policies in the workplace. Preventive procedures comprise **(i)** adjustment of environmental factors and (ii) proper eye protection by computer users.

The Community Health Nurse (CHN) is a significant participant that can prevent CVS and encourage safe, ergonomic rules. CHN can achieve a precise hazard assessment of potential personal and ecological hazard factors; promote and share in yearly eye investigation for refractive or binocular vision complaints after 40 and refer risky groups accordingly. The CHN can also advise for proper good lifestyles, particularly sleep quality, to reduce general tiredness. CHN can make the organizational management system aware of the problem to apply suitable protective infrastructure procedures. CHN plays an important role as a health instructor with a strategic location to implant and conducts a personalized educational interference that offers individual health education about CVS as definition, etiology, signs and convenient, protective, and safe practices to limit the growing epidemic of CVS related to technological development **(Rathore, 2017).**

1.1. Significance of the Study

Computer-related symptoms are a new issue in this century after using electronic devices at home and work. There is a relationship between eye complaints such as pain, redness, dryness, blurred vision, double vision, other head and neck strain and computer use. Prevention is the key strategy in the treatment of computer-related symptoms. It has been shown that CVS can contribute to reducing the quality of life of computer users and the accuracy of work that can reduce work productivity **(Ranasinghe et al., 2016).** Thus, modification in the ergonomics of the occupation environment, education of computer users, enhancement of their knowledge and proper eye protection are significant policies in inhibiting computer-related symptoms.

1.2. Aim of the Study:

Assess the effectiveness of educational intervention about computer vision syndrome on the severity of eye complaints among computer users.

Table (1): Factors leading to Computer-related symptoms adopted by **Loh and Reddy (2008)**.

Factors leading to Computer-related symptoms	
Individual factor	Discomfort seating position Inappropriate vision distances Inappropriate vision angle Eye diseases Medicinal diseases Elderly related diseases
Ecological factor	Low illumination imbalanced of light between the computer screen and the neighboring
Electronic device factor	Low resolution Low contrast Glower of the display Sluggish refresh rate

1.3. Research Hypothesis:

Computer users who obtain the educational intervention about computer vision syndrome and its protective ergonomic and workstation practices display a greater knowledge level and less severity of reported eye symptoms in post-test than pretest.

2. Subjects and Methods

2.1. Research Design

A quasi-experimental interventional strategy with pre-post evaluation was utilized.

2.2 Setting: At Zagazig University, there are four administrative buildings of Zagazig University; and then the researchers randomly selected two of them for the study.

2.3 Subjects: Simple random sample was used in this study. A total sample of 75 computer users of employees was recruited to participate in this study. Their inclusion criteria: Using computers for at least a year, for at least 3 hours or more per day, and willing to engage in the study

2.4. Sample size: The sample size was calculated using power analysis, based on the following equation:

$$\boldsymbol{N} = \frac{\boldsymbol{N}\ \boldsymbol{x}\ \boldsymbol{p}(\mathbf{1}-\boldsymbol{p})}{\{\boldsymbol{N}-\mathbf{1}\ \boldsymbol{x}\ (\boldsymbol{d}^{2} \div \boldsymbol{z}^{2})\} + \boldsymbol{p}(\mathbf{1}-\boldsymbol{p})\}}$$

Where;

Type I error with significant level (α) = 0.05.

Type II error by power test (1-B) = 95% (Sayed et al., 2020).

2.5. Tools for Data Collection

Three questionnaires were used to gather the necessary data for reaching the research objectives, and there are several different questions like MCQ and essay.

Tool I: Computer User's Knowledge about computer vision syndrome, self-administered questionnaire. It was created by the researchers following a thorough examination of current literature and is divided into three sections as follows:

Part 1: Individual and computer use related to their characters and medical history composed of six parts:

1. Individual characteristics: Age, sex, marital status, income, and education.

2. Medicinal history: Co-morbidity, history of ocular complaints, and history of ocular operation.

3. Electronic devices use related information: Period of computer usage in years, everyday use in hours, and use of ocular glasses or lenses during computer use, type of screen and asking the employees whether prolonged use of Computer has bad effects on the eyes.

4. Preventive measures: Taking breaks in between use, looking at distant objects, massage of eyes, use eye drops, and use eye protector over screen.

5. Level of the computer screen: Level of the computer screen during work.

6. Lighting in the room: Type of lighting used in the room, fluorescent light, natural light and both.

Part 2: Assessment of self-reported eye complaints guided by **Arif and Alam (2015).**

It includes 20 self-reported questions categorized as visual (4), ocular (9), light (3) and non-vision related symptoms of CVS (4). They were ranked on a three-point Likert scale to indicate how many times computer users had experienced any eye difficulties in the previous month. Their answers are scored as following; zero, never, one occasionally, two commonly. The total score was calculated and ranged from zero to forty; It was divided into three categories; Mild < 50% (0<20); Moderate 50- <75% (20<30), and severe ≥ 75% (≥ 30).

Part 3: Computer users' CVS knowledge scale

It includes 32 questions about CVS; definition, etiology, signs, safe protective ergonomic practices, and treatment. It was guided by **Rosenfield (2011);** and American Optometric Association (2017). According to the literature, the correct responses were pre-determined and scored as follows: (2) right answer, (1) incomplete right and (0) not right or unknown answers. The whole knowledge score was measured and ranged from zero to thirty-two, which is classified into three levels (**Agarwal et al., 2013**); poor knowledge < 50% (<16), fair knowledge 50- < 75% (16<28), and good knowledge ≥ 75% (≥ 28).

Tool II: Ergonomic Practices Observational Checklist

It comprised observations and measures of ergonomic variables at each employee's workstation. It was developed depending on the **American Optometric Association (AOA) (2017)** recommended instructions for the avoidance of CVS. It includes 12 questions divided into three dimensions as follows:

- **The first-dimension** eye to monitor distance composed of 10 items explained in the following:
  1. The participant's eye watching angle level to computer screen top (10°–20°)
  2. The participant's eye watching angle level to the computer screen bottom (31°–40°)
  3. The watching distance horizontally to the screen top (18–28 cm)
  4. The watching distance horizontally to the screen bottom (40–60 cm)
  5. The watching angle of the participant's eye level to computer screen center (21°–30°)
  6. The watching distance from the eye to the horizontal center of the screen (50–70 cm)
  7. Watching distance between the eye to keyboard (63–82 cm)
  8. Height of the keyboard from the floor (60–82 cm)
  9. The light intensity between participant and computer (75–150 Cd/m2)
  10. The light intensity of room (200–500 Cd/m2)
- **The second dimension:** Seat height.
- **The third dimension:** Monitor height.

The total score was scaled on a three-point Likert scale; two correctly done, one incorrectly done, and zero not done that producing a total score varied from zero to 24. The total score was classified into three levels as follows **(American Optometric**

Association, 2017; Assefa et al., 2017); the **scoring system include p**oor practice < 50% (<12), fair practice from 50 to < 75% (12-<21), and good practice ≥ 75% (≥ 21).

Tool III: Assessment of the Computer Workstation Design

It includes 28 questions distributed over five domains as follows: posture (6), digital screen (4), chair (6), key (4), anti-glare screen and lightning (6), general supplies (2). Each question had a score (2) if present, (1) if absent, and zero if not applicable. The full score for computer workplace design was measured and ranged between zero- 50 and classified into three levels as follows **(American Optometric Association, 2017)**: poor workstation < 50% (<25), fair workstation 50- < 75% (25-<32), and good workstation ≥ 75% (≥ 32).

3. Fieldwork:

The investigation was carried out in the following manner:

1. Administrative and ethical considerations:

After explaining the study's purpose, an official letter from the Faculty of Nursing was submitted to the competent authority of Zagazig University's administrative building to obtain their authorization for data collection. All ethical issues were taken into consideration during all phases of the study.

2. Tools development:

The researchers made changes to the instruments after reviewing recent literature.

3. Tools Validity:

A jury of five experts in Community Health Nursing from the Faculty of Nursing and Faculty of Medicine at Zagazig University assessed all the study's tools for content validity, and proposed improvements were made.

4. Tools Reliability:

Cronbach's Alpha was used to conduct the reliability test, and the tools appeared to be reliable. Where, the self-reported eye complaints (r =0.75), CVS knowledge scale (r= 0.89), and Computer workstation design observational checklist (r= 0.86), and preventive ergonomic practices observational checklist (r= 0.84), which indicate high internal consistency.

5. Pilot study:

Before conducting the main study, a pilot study was carried out on ten computer users who were later excluded from the main study sample. The purpose of the pilot study was to test questions about any ambiguity and feasibility of the tools. It also helped the researchers to estimate the time required to fill in the forms.

6. Data collection process:

The overall data collection process took about seven months (beginning of June 2020 to end of December 2020).

7. Program:

The educational intervention for computer vision syndrome was devised and implemented in the following stages:

I. Assessment phase (Pre-intervention phase):

Once permission was granted to proceed with the study, the researchers visited the study setting (the administrative building of Zagazig University) and explained the survey. The researchers usually started by introducing themselves to computers users, explaining the study's aim and nature briefly, and reassured them that information obtained is strictly confidential and would not be used for any purposes other than research.

II. Planning phase:

Based on a literature review, characteristics of the sample and the results obtained from the assessment phase, the researchers designed the intervention sessions' content. The researchers made a learning booklet, and its content was proved and then distributed to computers users to be used as a guide for self-learning.

The investigators established the CVS educational intervention for the studied subjects according to the following steps:

a. Setting the program objectives

- **General objective:** To increase computer users' knowledge and practices to prevent computer vision syndrome and reduce eye problems.
- **Specific objectives: after finishing current** program, the computer operators should be able to: -
  - Define the computer vision syndrome.
  - Discuss the etiology of computer vision syndrome.
  - Apply the exercise practice of the eye for reducing the severity of CVS.
  - Explain the safe, ergonomic practices for the prevention of computer vision syndrome.
  - Remolding the computer workstation design to prevent computer vision syndrome.

b. Preparation of the content

The researchers created the CVS educational intervention's material to meet all of the stated goals. It was created based on a study of recent relevant research, pre-assessment results, and computer user characteristics and eye complaints. The following were included in the content: a definition of CVS, its causes, and probable indications and symptoms, as well as safe, ergonomic measures for CVS prevention and correct computer workstation design.

III. Implementation phase:

All computer users were subject to a health education intervention. The message was delivered using a question-and-answer approach to ensure the participation of all computer users. Sessions focused on the definition of computer vision syndrome (CVS), its causes, eye exercise practice, safe, ergonomic practices for the prevention of computer vision syndrome, and how to modify the design of a computer workstation to prevent computer vision syndrome. A PowerPoint presentation supported this, and four videos are shown to all computer users in the current study on a laptop computer, followed by a group discussion with computer vision users about the contents. In addition, researchers helped employees gain knowledge of feedback. Also, brochures with attractive images and simple, clear text were distributed on CDs to guide them after the intervention.

IV. Evaluation phase:

This stage was done twice; One month (September 2020) and three months (December 2020) a health education intervention using the same tools. The researchers performed an observational evaluation of the preventive ergonomic practices of the study group and computer workstation design. The program efficiency on computer operators' eyes complaints and comfortable preventative knowledge and techniques for CVS prevention was estimated by comparison of the variances between pre-, post-, test and mean total scores.

Ethical Consideration After describing the study's goal, each computer user gave informed oral permission. Before the commencement of the study, assumed privacy and the ability to withdraw from the study at any moment were realized. During the data collecting procedure, privacy and confidentiality were respected.

2. Statistical Analysis

Data collected from the studied sample was revised, coded and entered using Personal Computer (PC). Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS), version 22. Data were presented using descriptive statistics in the form of frequencies, percentages and Mean±SD. The Friedman test is the non-parametric alternative to the one-way ANOVA with repeated measures, used to test for differences between groups when the dependent variable being measured is ordinal. Spearman correlation measures the strength and direction of association between two ranked variables. Significance of the results (Highly significant at p-value < 0.01; significant at p-value<0.05; non-significant at p-value ≥ 0.05).

Results:

Table 1 reveals that the mean age of studied computer users was 38.5±7.9 years, 66.7% were female, and 88% were married. Also, the same table shows that 97.3% of surveyed computer users had a university education. As related to medical history, only 5.3% had a medical history, 10.7% of them had previous eye surgery, and 30.7% were using eyeglasses and 39.1% of them for 10 – 20 years.

Table (2) demonstrates that the mean duration of using a computer was 12.18±6.23 years, and the mean daily use of a computer was 11.32±3.58 hours. Concerning the type of screen, 86.7% of studied computer users had LCD screens. Regarding awareness about long time using computer adverse effect on the eye, this table detects that 96% had awareness about this issue.

Table (3) reports that 76%, 96%, and 96% of studied computer users were not taking breaks, neither was looking at distanced objects, nor were massaging one eye, respectively. Also, the same table detects that 94.7%, 94.7% and 54.7% of the studied computer users neither are using eye drops nor using eye protectors over the screen or used screen below the level, respectively.

Table (1): The distribution of studied computer operators related to their features and medical history (n=75).

Items		N	%
Age			
20 – <40		47	62.7
40 – 60		28	37.3
Mean ± SD	38.5±7.9		
Gender			
Male		25	33.3
Female		50	66.7
Marital status			
Married		66	88
Unmarried		9	12
Income			
Insufficient		4	5.3
Sufficient		71	94.7
Educational level			
Diplome		2	2.7
University		73	97.3

Medical history		
Yes	4	5.3
No	71	94.7
Previous eye surgery		
Yes	8	10.7
No	67	89.3
Use eyeglass		
Yes	23	30.7
No	52	69.3
Duration (n=23)		
1 – <10	14	60.9
10 - 20	9	39.1

Table (2): Distribution of Studied Computer Users Related to Characteristics of using Computer (n=75)

Items		N	%
Duration of using Computer (day)			
2 - <10		23	30.7
10 - <20		40	53.3
20 – 30		12	16
Mean±SD	12.18±6.23		
Daily use of Computer (in hours)			
4 – 9		25	33.3
10 – 15		37	49.4
16 – 19		13	17.3
Mean SD	11.32±3.58		
Type of screen			
CRT		10	13.3
LCD		65	86.7
Awareness about long time using Computer had an adverse effect on eye			
Yes		72	96
No		3	4

Table (3): Distribution of Studied Computer Users Related to Preventive Measures of CVS (n=75)

Items	N	%
Taking breaks		
Don't practice any measures	57	76
Practice measures	18	24
Looking at distant objects		
Don't practice any measures	72	96

Practice measures	3	4
Eye massage		
Don't practice any measures	72	96
Practice measures	3	4
Using eye drops		
Don't practice any measures	71	94.7
Practice measures	4	5.3
Using eye protector over the screen		
Don't practice any measures	71	94.7
Practice measures	4	5.3
Level of screen		
Above	12	16.0
At the same level	22	29.3
Below the level	41	54.7
Light		
Fluorescent light	45	60.0
Natural light	2	2.7
Both	28	37.3

Table (4): Mean scores of Studied Subjects Related Severity Symptoms of CVS at Pre, Post and Follow up Interventions (n=75).

Items	Time of Educational intervention			Friedman test	
	Pre-intervention	1 m post-intervention	3 m post-intervention	Test	P-value
1. Eyestrain	2.61±0.80	1.98±0.72	1.0±0.75	6.5	0.008**
2. A burning feeling	2.40±0.91	1.72±1.02	1.0±0.92	9.46	0.003**
3. Itching	2.20±1.05	1.48±1.13	1.02±1.02	5.99	0.009**
4. Sensation of a foreign body	2.05±1.03	1.33±1.18	0.786±0.97	7.45	0.007**
5. Tears	2.09±1.04	1.38±1.17	0.933±1.01	3.29	0.011*
6. Excessive blinking	1.92±1.02	1.14±1.14	0.746±0.93	4.71	0.010*
7. Redness of the eye	2.24±0.97	1.53±1.06	0.94±0.94	5.87	0.009**
8. Eye pain	2.32±0.96	1.61±1.06	0.92±0.89	6.59	0.007**
9. Heavy eyelids	2.34±0.96	1.62±1.04	1.01±0.922	4.30	0.011*
10. Dryness	2.22±1.00	1.52±1.13	0.85±0.88	3.85	0.019*
11. Blurred vision	2.34±1.01	1.66±1.09	0.933±0.84	6.41	0.007**
12. Double vision	2.37±1.02	1.66±1.06	0.933±0.82	7.11	0.006**
13. Difficulty focusing on near	2.36±1.00	1.66±1.10	0.986±0.89	5.01	0.009**
14. Increased sensitivity to light	2.32±1.01	1.61±1.14	0.960±0.90	3.99	0.010*
15. Feeling of worsening eyesight	2.41±1.10	1.90±1.04	1.30±0.92	4.88	0.009**
16. Headache	2.74±0.67	2.21±0.81	1.33±0.82	4.29	0.012*
17. Musculoskeletal problems such as back pain	2.61±0.89	1.98±0.89	1.25±0.87	6.438	0.006**
18. Musculoskeletal problems such as wrist pain	2.28±1.04	1.61±1.08	0.96±0.84	7.62	0.005**
19. Muscle tenderness	2.65±0.86	2.02±0.85	1.26±0.84	5.911	0.008**
20. Neck pain	2.66±0.85	2.01±0.84	1.14±0.72	6.47	0.006**

Table (4) reveals that there were highly statistically significant differences related to mean scores of eye strain, a burning feeling, itching, sensation of a foreign body, muscle tenderness, and neck pain between pre, post one month after the educational intervention and three months follow up interventions at p-value <0.01. While the same table shows that there were slight significant differences related to the mean score of tears, excessive blinking, dryness, increased sensitivity to light and headache between pre, post and follow up interventions at p-value <0.05.

Figure 1 illustrates that the total mean scores of studied computer users related severity symptoms of CVS changed from 54.13±8.55 in pre-intervention to 33.8±7.26 one month after the educational intervention and reached 20.13±6.11at follow up intervention.

Table (5) shows statistically significant differences between the mean score of definition between pre, post and follow up interventions at p-value <0.05. Meanwhile, there were highly statistically significant differences in etiology, signs, preventive measures, treatment and total knowledge between pre, post and follow up interventions at p-value <0.01.

Figure 2 illustrates that the total mean scores of studied computer users related knowledge level of CVS increased from 0.997±0.87 in pre-intervention to 9.85±1.47 post one month after the educational intervention and slightly decreased to 9.65±2.3 at follow up intervention.

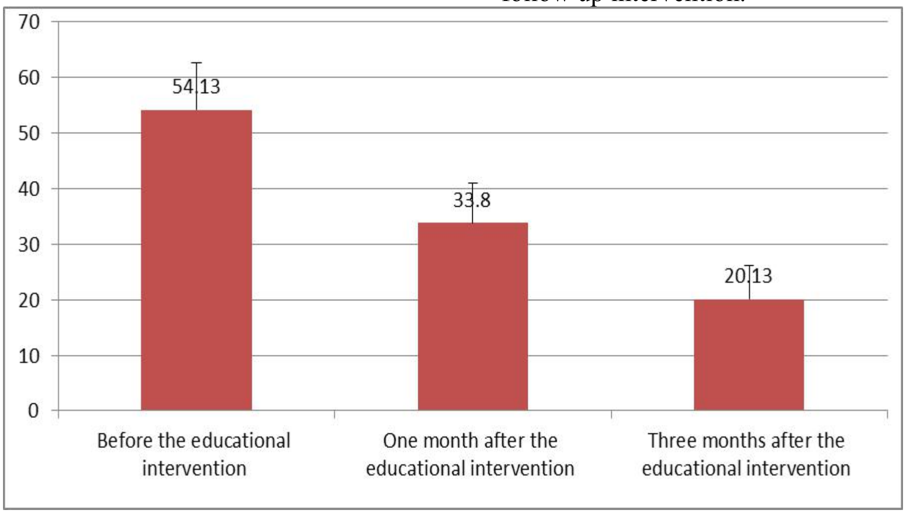

Figure (1): Total Mean Scores of Studied Computer Users Related Severity Symptoms of CVS throughout Educational Program

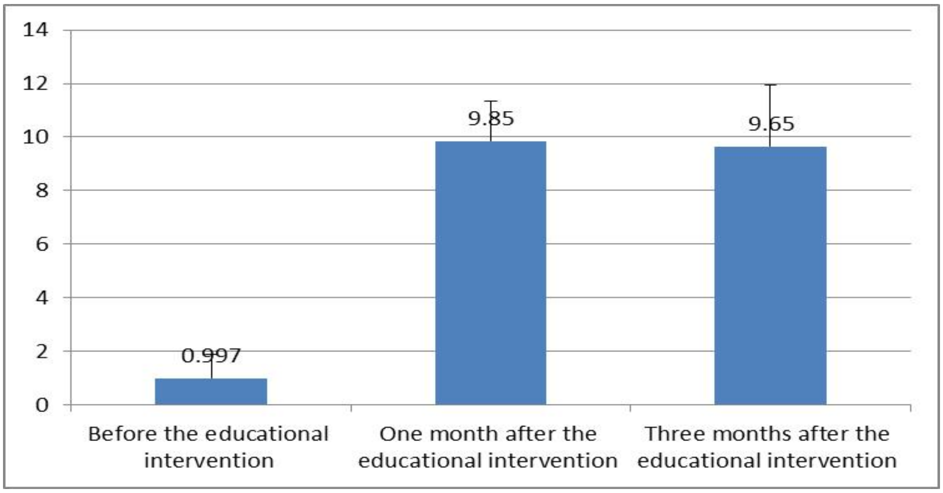

Figure (2): Total Mean scores of Studied Computer Users Related Knowledge Level Related CVS throughout Educational Program

Table (5): Mean Distribution of Studied Computer Users Related Knowledge Level Related CVS throughout Educational Program (n=75).

Items	Time of Educational intervention			Friedman test	
	Pre-intervention	1 m post-intervention	3m post-intervention	Test	P-value
Definition	0.253±0.59	1.97±0.16	1.93±0.25	2.945	0.017*
Etiology	0.186±0.52	1.97±0.16	1.93±0.25	6.899	0.007**
Signs	0.186±0.52	1.97±0.16	1.93±0.25	6.899	0.007**
Preventive measures	0.186±0.52	1.97±0.16	1.93±0.25	6.899	0.007**
Treatment	0.186±0.52	1.97±0.16	1.93±0.25	6.899	0.007**

Table (6): Mean Distribution of Studied Computer Users Related Ergonomic Practices Throughout Educational Program (n=75).

Items	Time of Educational intervention			Friedman test	
	Pre-intervention	1 m post-intervention	3m post-intervention	test	p-value
Eye to monitor distance	5.86±1.99	16.93±3.10	18.66±2.41	14.785	<0.001**
Seat height	0.58±0.83	1.69±0.49	1.86±0.34	9.306	0.004**
Monitor height	0.58±0.83	1.69±0.49	1.86±0.34	9.306	0.004**

Table (6) indicates that there were highly statistically significant differences between mean scores of the eye to monitor distance, seat height, monitor height and total ergonomic practices at pre, post and follow up interventions at p-value <0.01.

Figure 3 illustrates that the total mean scores of studied computer users related ergonomic practices improved from 7.02±2.4 in pre-intervention to 20.31±4.88 post one month after the educational intervention and increased to 22.38±5.60 after three months of intervention.

Table (7) shows that there were highly statistically significant differences between mean scores of postures, sitting on a chair and total workstation design at pre, post, and follow up at p-value <0.01. On the other hand, there were no statistically significant differences between mean scores of keyboards, light and general supplies at pre, post and follow up interventions at p-value >0.05.

Figure 4 illustrates that the total mean scores of studied computer users related workstation design improved from 28.26±5.11 in pre-intervention to 43.11±7.89 post one month after the educational intervention and noticed a change to 45.60±8.46 at follow up intervention.

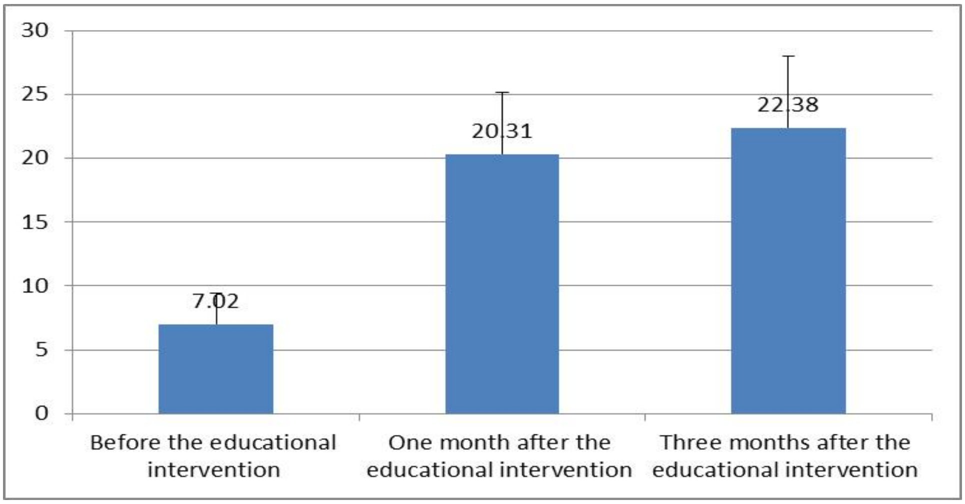

Figure (3): Total Mean scores of Studied Computer Users Related Ergonomic Practices throughout Educational Program

Table (7): Mean scores of Studied Computer Users Related Workstation Design at Pre, Post and Follow Up Interventions (N=75).

Items	Time of Educational intervention (months)			Friedman test	
	Pre-intervention	1 m post-intervention	3m post-intervention	Test	P-value
Check the posture	2.56±0.99	10.48±2.63	11.52±3.60	12.909	<0.001**
Sitting on chair	3.12±0.86	9.52±3.01	10.84±2.97	14.006	<0.001**
Keyboards	7.74±0.19	7.94±0.11	7.98±0.02	1.034	0.074
Light	10.98±0.67	11.20±0.57	11.31±0.57	1.485	0.067
General supplies	3.86±0.29	3.94±0.34	3.95±0.26	2.106	0.059

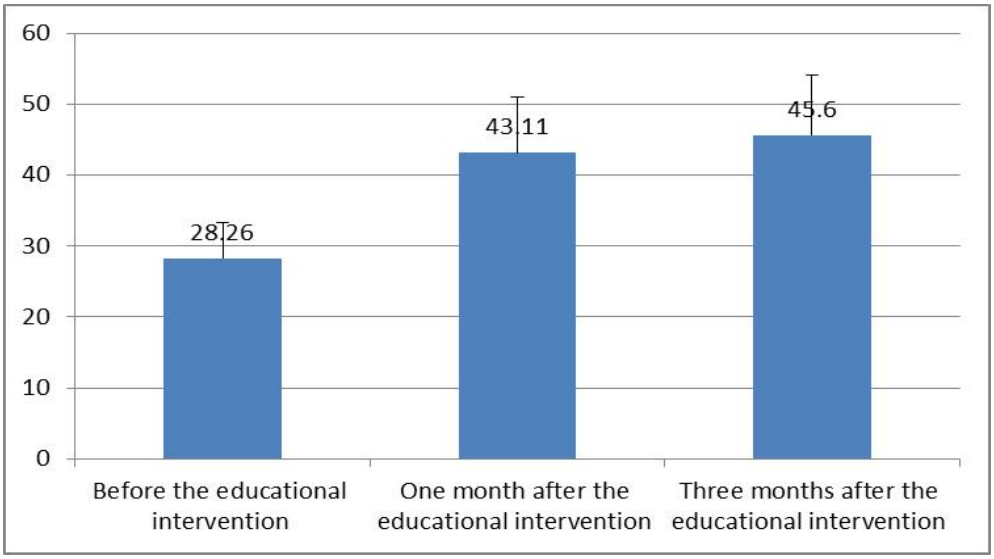

Figure (4): Total Mean scores of Studied Computer Users Related Workstation Design at Pre, Post and Follow Up Interventions

Table (8): Mean distribution between studied computer users according to their total knowledge, eye complaints, preventive ergonomic practices and workstation design at pre, post and follow up interventions

Items	Time of Educational intervention (months)			Friedman's test	
	Pre-intervention	1 m post-intervention	3 m post-intervention	test	p-value
Total eye symptoms	47.13±8.55	33.8±7.26	20.13±6.11	19.067	<0.001**
Total knowledge	0.997±0.87	9.85±1.47	9.65±2.3	12.430	<0.001**
Ergonomic practices	7.02±2.4	20.31±4.88	22.38±5.60	13.900	<0.001**
Workstation design	28.26±5.11	43.11±7.89	45.60±8.46	16.990	<0.001**

Table (8) portrays highly statistically significant differences between mean scores of studied computer users related to total eye symptoms, total knowledge, ergonomic practice, workstation design between pre, post and follow up interventions at p-value <0.01.

Table (9) portrays the studied computer users' total eye complaints score. Before the educational intervention, they were mild (5.3%), moderate (65.3%) and severe (29.4%) levels, while at one month after the educational intervention, the highest of them was at a moderate level (81.3%). In contrast, 37.3% were at a mild level after three months, and 62.7% were at a moderate level. Regarding the total knowledge score of the studied computer users before the educational intervention, only 2.7% of computer users were a good knowledge level compared to 70.7 after one month and slightly decreased after three months to 68%. A considerable change was noticed between the studied sample pre one month and three months related to ergonomic practices. Concerning total workstation design score, 12%, 52% and

57.3% of the study group were good levels before the intervention, after one month and three months, respectively.

Table (10) indicates highly statistically negative correlations between severity of eye symptoms with total knowledge, ergonomic practices and workstation design at p-value <0.01.

Table (9): Distribution of the studied computer users according to their eye complaints, total knowledge, preventive ergonomic practices and workstation design

Items	Pre-intervention		1 m post-intervention		3 m post-intervention		Friedman test	
	N	%	N	%	N	%	test	p-value
Total eye symptoms							19.07	<0.001**
Mild	4	5.3	9	12	28	37.3		
Moderate	49	65.3	61	81.3	47	62.7		
Severe	22	29.4	5	6.7	0	0		
Total knowledge							12.43	0.001**
Good	2	2.7	53	70.7	51	68		
Fair	33	44	20	26.6	19	25.3		
Poor	40	53.3	2	2.7	5	6.7		
Ergonomic practice							13.90	<0.001**
Good	3	4	35	46.7	38	50.7		
Fair	47	62.7	35	46.7	34	45.3		
Poor	25	33.3	5	6.6	3	4		
Workstation Design							16.99	<0.001**
Good	9	12	39	52	43	57.3		
Fair	41	54.7	34	45.3	32	42.7		
Poor	25	33.3	2	2.7	0	0		

Table (10): Correlations between the total scores of severities of eye symptoms, and total knowledge, preventive ergonomic practices and workstation design pre-intervention.

Items	Correlation Coefficient/p-value	Severity of eye symptoms
Total knowledge	r.	-0.596
	p	0.007**
Ergonomic practices	r.	-0.612
	p	0.004**
Workstation design	r.	-0.504
	p	0.006**

Discussion

Continuous computer use over two hours was considerably associated with the incidence of CVS symptoms. Outstanding visual complaints appear in persons who spend 6-9 hours a day in front of a computer. Spending a lot of time on the digital screen nonstop can also shift focus to keyboard and screen documents. The continuous process of drifting and refocusing on the unclear pixels of text on the screen can lead to eye strain and fatigue. Computer workplace lightening, screen contrast, period of computer use, vision distances and angles, specific occupation task, stress and attention, screen reflection, image quality, and workstation ergonomics have all been observed to play an important role in displaying complaints of computer users. The digital screen can be placed at, above, or below the computer handler's eye level. A higher percentage of people whose digital screens were at or above eye level observed CVS **(Arif & Alam, 2015).**

The target population of the current study was selected as they are part of a group of professionals that were at greater hazard for having computer-related eye complaints. Cape Coast university performs a decentralized administrative system which use more staff who have appointed a sample to study from among them. Several similar studies included employees with the same target as **Ranasinghe et al. (2016)** in **Sri Lanka, Assefa et al. (2017) in Ethiopia,** and **Sayed et al. (2020) in Egypt.**

The current study showed that CVS is a common issue among computer users at Zagazig University. Before the educational intervention, the research revealed that about two-thirds of them had moderate eye complaints, and about one-third had severe eye strain. Furthermore, headache, back pain, muscle tenderness and eye fatigue were the most severe and frequently reported symptoms among computer users, and the overall mean of eye complaints was 54.13 ± 8.55. This can be clarified by the prevailing ergonomic practices and workplace design. In addition, only two employees had good knowledge about CVS before the study's educational intervention. In addition to prolonged duration of action 10 < 20 hours per day, infrequent rest periods are strongly associated with ocular surface complaints. Furthermore, the average time of computer use was 12.18 ± 6.23 years.

The results of the present research were in agreement with those of a very recent study by **Sayed et al. (2020)** in **Egypt**, which aims to assess the effectiveness of an interactive digital educational intervention about computer ocular fatigue on the severity of eye symptoms and protective ergonomic knowledge and applies between computer handlers. They found that the entire study sample had moderate (57.1%) or severe (42.9%) complaints, correspondingly. This finding was in the same vein as a study by **Mashige et al. (2013)** in **South Africa**, which aimed to investigate the ergonomic factors that lead to computer vision syndrome among computer users. They found that eye fatigue, visual fatigue (89%), headache (81%), and neck and back pain (77%) were the most severe and frequently reported symptoms among participants. The results of a study by **Chauhan et al. (2018)**, which aims to assess CVS knowledge, awareness, and practice in users of digital devices, depicts the generally poor knowledge about DES and ergonomics among studied computer handlers. Similarly, and in agreement with the results of the current study, high prevalence rates of CVS for different groups of computer users have been reported elsewhere at 74.0% in **Nigeria (Akinbinu & Mashalla, 2013)**, 80.3% in **Chennai, India (Logaraj et al.**, **(2014)** and 67.4% in **Sri Lanka (Ranasinghe et al., 2016)**.

This present research had an important prevalence of CVS among computer users similar to that of three studies. **First, Agarwal et al. (2013)** The study conducted in **India,** which aimed to assess the factors contributing to eye complaints in computer users, showed that most of their computer users reported eye complaints such as eye strain (53.8%), itching (47.6%) and burning (66.7%) in subjects who used a computer for more than 6 hours. **Second, Assefa et al. (2017)** revealed that 75% of the computer users studied had CVS. **Third, Egyptian research** by **Iqbal et al. (2018)** indicated that 86.0% of the sample had CVS complaints where dehydrated eyes, distorted vision and pain were the most serious problems. All these studies confirmed that lower ergonomic practices and workplace design were important attributes to CVS. Very recent research finding also supports these previous findings by **Boadi-Kusi et al. (2020)**, which aimed to evaluate the spread of computer-related symptoms and related ergonomic factors university administrative staff in **Ghana** found CVS was 51.5% among staff members. More than a third of respondents used computers for 6 hours or more per day. A significant association was found between CVS and poor resting practices (X2 = 15.175, P = 0.001).

After implementing the educational intervention, the current study hypothesis was largely realized as computer users who received the educational intervention about computer vision syndrome and its protective ergonomic practices showed less severe eye symptoms. From the researchers' point of view, these improvements may be due to their interest and enthusiasm to participate in the program and willingness to attend future educational programs. In addition, almost all computer users who studied had a university education. This justification was supported by the results of a new study conducted by **Khatri and Karel (2018)** in **Egypt**, which indicated that a significant decrease in ocular symptoms was justified by taking rests, recurrent blinking, and lowering the digital screen Computer.

The present research results shed light on the effect of an educational intervention about CVS in decreasing the severity of ocular complaints among computer users. This can be attributed to proper assignment and presentation of software content which may have a prominent role in augmenting computer handlers' awareness and obedience with protective ergonomic practices, which could help reduce the severity of eye symptoms. Consistent results were revealed by investigating four evidenced studies. First, **Lertwisuttipaiboon et al. (2017)**, in **Thailand** that the percentage of CVS significantly reduced between the intervention group 1 and 2 months after program application. **Second, Konarska et al. (2015)** stated that their ergonomic interference was accompanied by decreased eye fatigue among computer handlers. **Third, Gupta et al. (2014)** that their three-month intervention using eye exercises, health education and workplace design was affected in decreasing CVS symptoms among computer users. **Fourth, Amick et al. (2012)** assess the effectiveness of training on office ergonomics and a highly suitable seat on ocular complaints in a public sector institution, and they observed that ergonomic practices greatly reduce the severity of ocular complaints between the office employees after the educational interference and its effect lasted for a year.

The present research results showed the significance of the educational intervention program about CVS in improving the knowledge of the learned computer workers about CVS in terms of its definition, causes, complaints, and treatment. The current research found that the whole study group had risen to good knowledge after one month and decreased slightly after three months. In addition, a positive mean change in the total knowledge scores was shown among computer users with a statistically significant difference in the studied sample after implementing the program. Most of them have a university education level. This can help in better formation and retention of knowledge. Similar improvement in knowledge score has been reported by **Sam and George (2015)** and **Menaria et al. (2018)** in **Udaipur city**, they observed a significant rise in the mean knowledge scores of the computer workers following applying for their educational program as the highest percentage of the participants had insufficient awareness about CVS and its inhibition before the educational intervention which significantly changed to the good knowledge level in the test posterior. The American Optometric Association (AOA) has recommended several ergonomic practices to reduce CVS; to escape brightness on the screen by using blinds and lamps with low wattage; Placing reference materials over the keyboard and under the digital screen or appropriate use of the papers holder; Take rest for (15 minutes) after 2 hours of uninterrupted computer work or distance looking for 20 seconds every 20 minutes of computer use and blinking regularly to escape dry eyes **(The Institute of Occupational Health and Safety, 2019).**

The current study's findings verified that the overall protective ergonomic training score showed a statistically significant positive mean improvement among the study group at one and three months following the educational intervention. This can aid in reducing Computer-related symptoms among computer workers. Concurred findings were detected in two novel studies. **First, Hussein (2012),** in **Alexandria University,** observed a significant mean change in the learned computer workers' ergonomic training in relation to position, seat, use of paper holder and screen modification after the intervention. **Second, in Thailand**, **Lertwisuttipaiboon et al. (2017)** demonstrated that the mean practice score of the studied sample before the intervention was poor; One month and two months after starting the programme, it was raised to the level of good practice.

The present research results indicated that the sum of preventive comfortable practice scores showed a positive change on average between the studied sample after one and three months of the educational intervention with a statistically significant difference. This can help reduce computer vision syndrome among computer users. Agreed results were revealed in two new studies. **First, Hussein (2012),** at **Alexandria University**, showed a mean significant change in computer users' studied practices regarding the position, seat use, paper holder use, and screen modification alongside educational interference. **Second, Lertwisuttipaiboon et al. (2017)**, in **Thailand**, which the average practice score of the studied sample before the interference was at the level of lower practice; nevertheless, one month and two months following the program's implementation, it was elevated to the level of high practice.

This study demonstrated that unwell designed workplaces were accompanied by a significant prevalence of eye problems among the studied computer workers, particularly low lighting, unavailability of height-modified seats, and an anti-glare screen. In addition, the present study demonstrated the importance of a CVS educational intervention program in aiding informed computer users to modify their workplace style. Furthermore, a positive change was found in the mean overall workstation design scores between the studied sample after one and three months of the educational interference with statistically significant variance. Definitely, a significant change in mean scores was detected across all workplace characters. In the researchers' view, poor workstation or ergonomic office practices cause many visible symptoms and non-visual complaints related to computer usage. The improper placing use of computer and its accessories and incorrect vision angles cause neck, shoulder and back pain. It was found that the restriction of the workplace style is mostly due to administrative struggle and the lack of necessary resources. These findings are supported by several researches such as that by **Jomoah (2014)**, in **Saudi Arabia**, **Ranasinghe et al. (2016)**, in **Sri Lanka** and **Assefa et al. (2017)**, in **Ethiopia.** They reported that unwell prepared workplaces were accompanied by a high prevalence of visual complaints among the studied computer workers. These results were recently in accordance with those of **Sayed et al. (2020)**, who in their study conducted a study in **Egypt**, which aimed to assess the effectiveness of digital educational intervention about digital ocular fatigue on the severity of eye symptoms and ergonomic preventive knowledge and training between computer workers, found that the whole studied group was fair (71.4%).

Moreover, the overall workstation design score after one month had risen to the appropriate level (50.0%), while after three months of educational intervention, many of them had been increased to a high level (94.3%). These findings are in the same vein as those of **Konarska et al. (2015),** who conducted a study evaluating an interventional cohort study to evaluate computer vision syndrome among computer workers. They found that well-informed computer users had inappropriate working circumstances, including poor illumination, improper seats without hand support, and a good vision angle. The present research demonstrated significant development in the workstation design after the intervention, mainly in the seat, illumination and posture. Consistent results were depicted by **Ketola et al. (2012)**, evaluating the effectiveness of comfortable interference in working with video exhibition units. They demonstrated a significant positive change in average workplace ergonomics scores at two months and ten months besides the tutorial, which mainly included modifications to the screen, forearm supports, mouse, keyboard and seat.

Conclusion:

Depending on the current study results, it could be concluded that the research hypothesis was justified, and the educational intervention about CVS and its preventive comfortable performs had an effect in reducing the severity of uses' computer eye problems, improving their awareness level about CVS and adjusting their protective comfortable performs and workplace style.

Recommendations:

Based on the present study findings, the following recommendations are suggested:

- To combat the rising number of CVS cases, it is important to establish an educational intervention on ergonomic training for all computer users and compliance with recommended workplace ergonomics. It is well to provide ocular health education for computer workers on handling computers and the complaints, management choices and prevention measures of CVS.
- Periodic eye examination for all computer user employees.
- Using ergonomically designed furniture and maintaining good posture are important factors preventing adverse physical health if the computer is used for an extended time.

References:

Agarwal, S., Goel, D., & Sharma, A. (2013): Evaluation of the factors which contribute to the ocular complaints in computer users. J. Clin. Diagn. Res; 7(2):331-5.

Akinbinu, R., & Mashalla, Y. (2013): Knowledge of computer vision syndrome among computer users in the workplace in Abuja, Nigeria. Journal of Physiology and Pathophysiology; 4(4):58–63. doi: 10.5897/jpap2013.0078.

American Optometric Association (AOA). (2017): Computer vision syndrome/digital eye strain. https://www.aoa.org/.

Amick, B., Menéndez, C., Bazzani, L., Robertson, M., DeRango, K., Rooney, T. & Moore A.A. (2012): Field intervention examining the impact of office ergonomics training and a highly adjustable chair on visual symptoms in a public sector organization. Applied ergonomics; 43(3): 625-631.

Arif, K., & Alam, M. (2015): Computer vision syndrome: Review article. Faridpur Medical College Journal; 10(1): 33-5.

Assefa, N., Weldemichael, D., Alemu, H., & Anbesse, D. (2017): Prevalence and associated factors of computer vision syndrome among bank workers in Gondar City, northwest Ethiopia. Clinical Optometry; (1): 67-79.

Boadi-Kusi, S.B., Abu, S.L., Acheampong, G.O., Adueming, P.O., Kwasi, E. & Abu, EK. (2020): Association between poor erg ophthalmologic practices and computer vision syndrome among university Administrative Staff in Ghana, https://pubmed.ncbi.nlm.nih.gov/32405305.

Chauhan, S., Dhasmana, R., & Raj, A. (2018): Knowledge, awareness and practice of CVS in digital device users. Sudanese J Ophthalmol; 10(1): 18-24.

Gowrisankaran, S., & Sheedy, J. (2015): Computer vision syndrome: A review. Work; 52: 303-14.

Gupta, R., Gour, D., & Meena, M. (2014): Interventional cohort study for evaluation of computer vision syndrome among computer workers. International Journal of Medical Research and Review; 2(1): 40-4.

Hussein, N. (2012): Impact of guideline application on the prevention of occupational overuse syndrome for computer users. Unpublished doctoral dissertation. Alexandria University; Faculty of Nursing,

Iqbal, M., El-Massry, A., Elagouz, M., & Elzembely, H. (2018): Computer vision syndrome survey among the medical students in sohag university hospital, Egypt. Ophthalmology Research: An International Journal; 8(1): 1-8.

Jomoah, I. (2014): Work-related health disorders among Saudi computer users. Scientific World Journal; (1):1-28.

Ketola, R., Toivonen, R., Hakkanen, M., Luukkonen, R., Takala, E.P., & Viikari-Juntura, E. (2012): Effects of ergonomic intervention in work with video display units. Scand J Work Environ Health; 28(1): 18-24.

Khatri, A., & Kharel, R. (2018): Knowledge, attitude, and practice of computer vision syndrome among medical students and its impact on ocular morbidity. Journal of Nepal Health Research Council; 16(3): 291-296.

Klamm, J., & Tarnow, K.G. (2015): Computer vision syndrome: A review of literature. Medsurg Nurs; 24(1): 89-93.

Konarska, M., Wolska, A., Widerszal-Bazyl, M., Bugajska, J., Roman-Liu, D., & Aarås, A. (2015): The Effect of an Ergonomic Intervention on Musculoskeletal, Psychosocial and Visual Strain of VDT Data Entry Work: The Polish Part of the International Study. International Journal of Occupational Safety and Ergonomics ; 11(1): 65-76.

Lertwisuttipaiboon, S., Pumpaibool, T., Neeser, K., & Kasetsuwan, N. (2017): Effectiveness of a participatory eye care program in reducing eye strain among staff computer users in Thailand. Risk Management and Healthcare Policy; 10(1):71-80.

Logaraj, M., Madhupriya, V., & Hegde, S. (2014): Computer vision syndrome and associated factors among medical and engineering students in Chennai. *Annals of Medical and Health Sciences Research* ;4(2):179–185. doi: 10.4103/2141-9248.129028.

Loh, K.Y., & Reddy, S.C. (2008): Understanding and preventing computer vision syndrome. Malaysian Family Physician the Official Journal; 3(3):128–130.

Mashige, K.P., Rampersad, N., & Oduntan, O.A. (2013): A study of ergonomic factors leading to computer vision syndrome among computer users. Ergonomics SA; 25 (1): ISSN Number: 1010-2728 3.

Menaria, K., Goswami, Y., & Kumar, S. (2018): Evaluate the effectiveness of self-instructional module on knowledge regarding computer vision syndrome and its prevention among IT Workers in selected IT centers at Udaipur City, Rajasthan. IOSR Journal of Nursing and Health Science; 7(4): 13-28.

Ranasinghe, P., Wathurapatha, W., Perera, Y., Lamabadusuriya, D., Kulatunga, S., Jayawardana, N., & Katulanda, P. (2016): Computer vision syndrome among computer office workers in a developing country: An evaluation of prevalence and risk factors. BMC Research Notes; 9:150.

Rathore, I. (2017): Computer vision syndrome- An Emerging Occupational Hazard. Research **J.** Science and Tech; 9(2):293-297.

Rosenfield, M. (2011): Computer vision syndrome: a review of ocular causes and potential treatments. Ophthalmic Physiol Opt; 31(5):502-515.

Sam, SH., & George, R. (2015): Effect of SIM on knowledge regarding computer vision syndrome and its prevention among computer professionals: A Quasi-Experimental Approach. International Journal of Science and Research, (IJSR); 4(12):1028-1031.

Sayed, S.H., Abd El Wahed, A.Y., & Madian, A.A.M. (2020): Effect of interactive digital-based educational intervention about digital eye strain on the severity of eye complaints, knowledge and preventive ergonomic practices among computer users. American Journal of Nursing Research; 8 (1):48-59 Available at http://pubs.sciepub.com/ajnr/8/1/6 Published by Science and Education Publishing DOI:10.12691/ajnr-8-1-6.

The Institute of Occupational Health and Safety. (2019): Computer vision syndrome [internet]. https://www.iosh.com/resources-and-research/our-researchprogramme/.

World Health Organization (WHO). (2019): WHO guideline: Recommendations on digital interventions for health system strengthening. https://apps.who.int/iris/bitstream/handle/10665/311941/9789241550505-eng.pdf