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RESEARCH ARTICLE

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Prevalence of Visual and Posture Related Symptoms of Computer Vision Syndrome among Computer User Workers of Ethiopian Roads Authority

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ABSTRACT

Background: Computer Vision Syndrome is a collective term for computer related eye, visual problems and ergonomic disorder resulted from prolonged computer usage in a maladaptive manner. Almost 90% of computer users suffered from computer vision syndrome; posing in reduced quality of life and work productivity. This study aims to describe the prevalence of visual and posture related symptoms of computer vision syndromes among workers of Ethiopian Roads Authority.
Methods: Institutional based cross-sectional study was conducted on Ethiopian Roads Authority in Addis Ababa to assess visual and posture related symptoms of computer vision syndromes from January to February 2018. Simple random sampling technique methods were used to select the study participants. The data was collected by self-administered questionnaire and edited, coded and entered by SPSS version 25. The frequency, percent, cross-tabulation, charts, Chi-square and binary logistic regression models were applied. The data was analyzed by using the SPSS version 25.
Results: A total of 272 workers were in the study from Ethiopian Roads Authority; 57% of the respondents were males, whereas; 43% were females. The 12-months prevalence of computer vision syndrome in this study population was 81.3%. The most frequently self-reported symptoms of computer vision syndrome were eye fatigue (51.1%), back pain (47.4%), burning eye (42.6%), headache (40.8%), neck pain (31.2%), eye irritation (25.4%), double vision (25%) and drying eye (20.6%). The results by binary logistic regression model showed that; job category, computer usage in hours per day, adjustable sitting chair usage, antiglare usage, and adjusting computer screen were significantly associated with the presence of symptoms for computer vision syndrome ($p<0.05$).
Conclusion: The prevalence of computer vision syndrome was high among computer user workers in the study institution. There was no significant difference in developing computer related symptoms of computer vision syndrome between male and female workers. There is a need to increase the ergonomic awareness among workers and corrective measures need to be implemented to reduce the impact of computer related symptoms of computer vision syndrome.

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KEYWORDS
Computer vision syndrome; Ethiopian Roads Authority; ergonomic; posture

Abbreviations
(CVS) Computer Vision Syndrome; (CI) Confidence Interval; (ERA) Ethiopian Roads Authority; (MSS) Muscular Skeletal Symptoms; (MSDs) Muscular Skeletal Disorders; (OR) Odds Ratio; (OOS) Occupational Overuse Syndrome; (SPSS) Statistical Package for Social Sciences.

Introduction

In today's age, computer has become a common item; its usage become an integral part of daily life [1]. Appreciably, computers have been changing the working environment, simplifying and speeding up numerous tasks across many work areas. It has increased the work efficiency and communications and has opened access to information like never before [2]. It makes the lifestyle of users too much relaxed. Huge numbers of people use computers excessively and intensively starting from official work to playing video games [3].

Continuous use of computers for long hours [4] found to have severe vision problems; even for few hours per day usage [5], that leads to various health illness. Scholars [6] have identified health risks developed from usage of computer for three hours per day such as Occupational Overuse Syndrome

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(OOS), Computer Vision Syndrome (CVS), low back pain, headaches and psychosocial stress. These risks are directly related to prolonged sitting in front of screens with poor ergonomic practices [7,8].

Collectively the computer related physical discomfort and vision problem symptoms are known as computer vision syndrome (CVS). Hence, CVS is a collective term for computer related eye problems and ergonomic disorder. It is defined by the American Optometric Association as "a complex of eye and vision problems related to activities, which stress the near vision and which are experienced in relation or during the use of computer" [9].

Mashige et al [10] divided symptoms of CVS broadly into two categories: (i) eye and vision-related symptoms (e.g. dry eyes, watery eyes, irritated and burning eyes, eye strain, eye fatigue, headache, blurred vision and double vision) and (ii) posture-related symptoms (e.g. neck, shoulder and back pain). Moreover, Ranganatha S C et.al [11] have classified into four categories: i) Asthenopic-sore eyes, eye strain, (ii) Ocular surface related-dry eye, irritation, watering, (iii) Visual-double vision, blurred vision, slowness of focus change iv) Extra ocular-shoulder pain, neck pain, back ache.

Extra ocular or posture-related symptoms of CVS can occur due to improper working conditions and poor work habits. It might be associated with maladapted monotonous use of computers that attributed to poor ergonomic practices [12]. This is described as Muscular Skeletal Symptoms, MSS; which can be led to Muscular Skeletal Disorders, MSDs. The MSDs considered as one of the contemporary health issues. It comprises two percent of global disease burden and the second highest volume of years lived with disability [1,13]; existed in 22% of patients [14]. Part of CVS categorized under musculoskeletal symptoms includes: headache, neck and back pain, and shoulder, wrist, and finger discomfort can also be [15]. These symptoms are well associated with improper placement of computer screen which lead to muscles sprain; affecting head and eye postures when working at a computer [9,16].

Most evidences show that, ocular and non-ocular CVS have been called the foremost occupational hazard of the 21st century [17]. The studies have identified that 64% to 90% of computer users have problem of CVS [18]. Study of 2014 in US shown that, on average, (45 to 70) million people spend an hour staring into a computer screen. But, recently about 143 million of workers use a computer daily [19] in U.S.A alone and 90% of whom who use three to four hours per day developed CVS [20]. Global records also estimated that nearly 60 million people suffer from CVS [6] and other study estimates that at least 10 million new cases of computer-related human health risks were reported each year [21].

Occupational related CVS and MSDs problems lead to economic costs and affect organizational effectiveness and efficiency. Excessive use of technology [22]; Duration of occupation [23]; lack of ergonomic training for workers to implement safe practices at their work place [24] have led to increase prevalence of CVS. Since CVS places an unusual strain on workers physical well-being, it decreases visual function and quality of life [25], reduces employees' effectiveness, can increase the number of errors made during a computer task as well as necessitating more frequent breaks [18] and significantly causes a resultant loss of productivity [26]. A cost analysis study in US by Rein et al [27] estimated that the annual total financial burden of major adult visual disorders is $ 35.4 billion; which was exceeded costs on breast cancer $ 25 billion [28].

So, CVSs can be considered as a significant rising non-communicable disease having the capacity of global public health threat unless serious attention is paid to it [29]. It has affected most computer users from various occupations that attract attentions of researchers from both developed and developing world.

Many studies have been conducted to address questions concerning safety and health for computer users. Most of these studies reported prevalence of CVS ranged from 63%-97% [12,22,24,30-39]. However, they were centered in Western and Middle East regions focusing on assessing knowledge, practice and magnitude of eye related problems of computer usage targeted on university communities as their study population [4,5,7,11,14,19,20,22,23,30,32,36-43]. But, every individual using computer at their office or home can develop CVS.

To the author's best knowledge there is limited study focusing on workers using computers in African region including Ethiopia. Few studies were conducted in limited states or districts: Debre Tabor and Gonder in Ethiopia to assess prevalence of CVS among computer users in town and bank

workers, respectively [31,33]; Abuja in Nigeria [35] assessed the knowledge of CVS among computer users. These studies were excluded posture related symptoms of CVS which is also a growing, but neglected, health risks among computer users. Also evidences show that posture related symptoms of CVS lead complicated MSDs. Therefore, the present study aims to describe the prevalence of visual and posture related symptoms of CVS and its associated factors among computer user workers of Ethiopian Roads Authority.

Methods and Materials

Study area, design and period

The study was conducted in Addis Ababa, the capital city of Ethiopia. The government institution at which this study conducted was Ethiopian Roads Authority, which consists about 34 departments (work units) with a total of 2928 workers (ERA census; April, 2017). An institutional based cross-sectional study design was used from January to February 2018.

Source and study population

All computer users who worked in Ethiopian Roads Authority were the source population, whereas all workers who were using computer in their day-to-day working activities for at least six months were taken as study population. Any type of duties carried out by employees was considered.

Sample size determination

The sample size was initially determined by using single population proportion formula with the following assumptions: margin of error 5%, proportion of CVS; 73.9% [34], 95% confidence interval and then using correction formula, since the study population was less than 10,000, and adding 10% of non-response rate to come up with a sample size of 272 respondents.

Sampling procedure

A pre-determined sample size was allocated to 34 work units (offices) of ERA. A simple random sampling technique was used to select participants. Then, from each selected office, study subjects were selected proportionally to their size by random sampling technique.

Operational definition

i. Computer vision syndrome (CVS): will be considered if the respondent has one or more symptoms such as headache, eye fatigue, double vision, blurring vision, dry eyes and neck or shoulder pain which were assessed as symptoms of CVS in this study [22,24,30,33]. It is characterized by visual symptoms which result from interaction with a computer display or its environment [26].

ii. Computer Vision Syndrome Positive (CVSP): The worker who reported one of the signs and or symptoms of CVS was considered as positive for CVS [22,24,33].

iii. Vision (eye)-related symptoms: includes eyestrain, eye fatigue, headache, double vision, dry eyes, excessive tearing, irritated eyes, burning eyes [44].

iv. Posture-related symptoms: includes "neck, shoulder, back, elbow, thigh, knee, and wrist/finger pain" [44].

v. Computer user workers: employees those using computer for their day-to-day life activities to perform different tasks [31] who were staff at ERA.

Data collection

Self-administered questionnaires were used to collect socio-demographic data, symptoms of CVS, information regarding ergonomics and lightening, and potential risk factors (computer work station conditions or workplace/environment) of workers on safety measures of CVS. The purpose and objectives of the study was briefed for participants before taking consent from them. The pre-designed questionnaires were distributed to each work units among the study population; completeness of the questionnaires was checked and/then collected back.

Data analysis

The collected data were edited, coded and entered to SPSS version 25 for analysis. The frequency, percent, cross-tabulation, charts used for descriptive analysis; Chi-square and binary logistic regression models were applied for inferential analysis. Chi-square test was used to determine the association between the variables. Variables with a p-value of less than 0.25 in the bivariate analysis were candidate for multivariable binary logistic regression model. The odds ratio (OR) was used for interpretations and the significance level was considered as $P<0.05$.

Ethical approval

The study was approved by the Ethics committee of the institution and therefore it had been performed in accordance with the ethical standards.

Results

Socio-demographic characteristics

Two hundred seventy two respondents were participated (response rate-100%); out of which male participants were 155 (57%) and the rest were females.

Majority (40.4%) of the study population belonged to between 21-30 years of age categories followed by 31-40 years (32.7%) age groups. Most of the respondents (167, 61.4%) were BA/BSc holders; about (44, 16.2%) of them were MA/MSc holders, and the rest (61, 22.4%) were college diploma. The majority (45.6%) of respondents were engineers. Nearly 6 out of 10 (58.1%) of the respondents reported having worked between one (1) year to five (5) years; about 25% of them worked between six to ten years, and the rest (16.9%) were worked above ten years. More than three-fourth (75.7%) of the participants were using computer above 6 hours per day; that is in the range of Ethiopian working hours (Table 1).

Table 1. Characteristics of the study population

Variables		All (N=272)	Male, 155(57%)	Female, 117(43%)
Age	21-30 years	110(40.4%)	68(43.9%)	42(35.9%)
	31-40 years	89(32.7%)	48(31.0%)	41(35.0%)
	41-50 years	48(17.6%)	24(15.5%)	24(20.5%)
	51-60 years	25(9.2%)	15(9.7%)	10(8.5%)
Education level	Diploma	65(23.9%)	19(12.3%)	46(39.3%)
	BA/BSc degree	163(59.9%)	101(65.2%)	62(53.0%)
	MA/MSc degree	44(16.2%)	35(22.6%)	9(7.7%)
Occupation type	Engineer	124(45.6%)	90(58.1%)	34(29.1%)
	Finance officer	41(15.1%)	25(16.1%)	16(13.7%)
	Human resource officer	39(14.3%)	19(48.7%)	20(51.3%)
	Office manager/ secretary	45(16.5%)	0	45(38.5%)
	Others	23(8.5%)	21(13.5%)	2(1.7%)
Service year on current job	1-5 years	158(58.1%)	101(65.2%)	57(48.7%)
	6-10 years	71(26.1%)	35(22.6%)	36(30.8%)
	11-15 years	18(6.6%)	8(5.2%)	10(8.5%)
	Above 15 years	25(9.2%)	11(7.1%)	14(12.0%)
Ergonomic training	Yes	35(12.9%)	16(10.3%)	1916.2%)
	No	237(87.1%)	139(89.7%)	98(83.8%)
Daily computer usage time	More than 6 hours	206 (75.7%)	125(80.6%)	81(69.2%)
	[3 to 5] hours	36(13.2%)	18(11.6%)	18(15.4%)
	[1 to 2] hours	30(11.1%)	12(7.7%)	18(15.4%)
Using antiglare	Yes	15(5.5%	2(1.3%)	13(11.1%)
	No	257(94.5%)	153(98.7%)	104(88.9%)
Adjusting screen	Yes	213(78.3%)	117(54.9%)	96(45.1%)
	No	59(21.7%)	38(64.4%)	21(35.6%)

Prevalence of CVS symptoms

A total of 221 workers reported a history of one or more symptoms of CVS. Consequently, the prevalence symptoms of CVS in the study population were found to be 81.3% (221/272). The most commonly reported complaint was eye-fatigue (51.1%); followed by burning eye (42.6%) and headache (40.2%) among ocular CVS symptoms. The prevalence of visual related symptoms ranged from 16.2% for excessive tearing to 51.1% for eye fatigue among ERA workers. On the other hand, back pain (47.4%) was the most frequently reported posture related symptoms of CVS followed by neck pain (31.3%) with the least frequently reported shoulder pain (3.7%). Almost there was no difference in cumulative prevalence of CVS symptoms among male (81.9%) and female (80.3%) workers (p>0.05) (Table 2) (Figure 1).

Table 2. One year prevalence of CVS and its symptoms among Ethiopian Roads Authority

Symptoms		All prevalence	Male prevalence	Female prevalence p-value	p-value
rnin	yes	221 (81.3%)	127(81.9%)	94(80.3%)	0.74
rnin	no	51(18.7%)	28(18.1%)	23(19.7%)	
Headache		111(40.8%)	67(43.2%)	44(37.6%)	0.35
Double vision		68(25.0%)	37(23.9%)	31(26.5%)	0.62
Burning eye		116(42.6%)	72(46.5%)	44(37.6%)	0.14
Eye fatigue		139(51.1%)	85(54.8%)	54(46.2%)	0.16
Eye irritation		69(25.4%)	39(25.2%)	30(43.5%)	0.9
Excessive tearing		44(16.2%)	32(20.6%)	12(10.3%)	.02*
Drying eye		56(20.6%)	33(21.3%)	23(19.7%)	0.74
Neck pain		85(31.3%)	54(34.8%)	31(26.5%)	0.14
Elbow pain		26(9.6%)	13(8.4%)	13(11.1%)	0.45
Wrist pain		37(13.6%)	12(7.7%)	25(21.4%)	.001*
Shoulder pain		10(3.7%)	8(5.2%)	2(1.7%)	0.13
Back pain		129(47.4%)	80(51.6%)	49(41.9%)	0.11
Thigh pain		20(7.4%)	17(11.0%)	3(2.6%)	.01*
Knee pain		21(7.7%)	13(8.4%)	8(6.8%)	0.64
Got doctors advice for future action	Yes	93(34.2%)	54(34.8%)	39(33.3%)	0.8
	No	179(65.8%)	101(56.4%)	78(66.7%)	

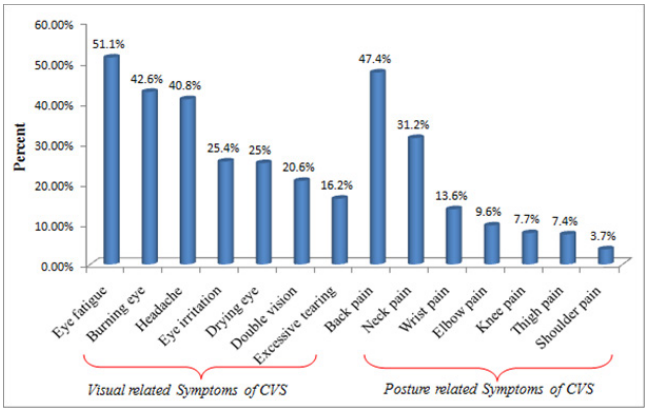

Figure 1. Visual and posture related symptoms of CVS in ERA computer user workers

Workstation environs and ergonomics related problems triggers CVS

The ergonomic hazards were part of the assessment conducted during the survey. Almost half of the respondents (49.6%) use nonadjustable chairs. More than half (50.9%) of the participants usually used desktop computers. About 44.5% of the participants used ergonomically nonadjustable sitting chair and almost half of them (50.7%) reported inadequate free space near to their computer work station.

More than quarter of respondents (26.1%) reported

as their computer screen was very bright and about 64% of the participants reported that their room illumination was very bright; the windows were not shaded. The majority (94.5%) were not using antiglare. On the other hand, 87.1% of the participants were not taken any ergonomic training related to computer usage (Tables 1-3).

Table 3. Working station environs and percentage of CVS symptoms among computer users in ERA (n=272).

Variables (working station environment)																		
Computer type used Using adjustable chair Free space availability Computer brightness Room illumination of CVS	**Computer type used**				**Using adjustable chair**			**Free space availability**			**Computer brightness**				**Room illumination**			
	Desktop	**Desktop and laptop**	**Laptop**	**P-value**	**Yes**	**No**	**P-value**	**Yes**	**No**	**P-value**	**Very bright**	**Bright**	**Dull**	**P-value**	**Very bright**	**Bright**	**Dull**	**P-value**
Headache	50.9	34.5	32	.02*	44.5	55.5	0.21	49.3	50.7	.003*	26.1	56.8	17.1	0.13	64	24.3	11.7	0.94
Double vision	27.8	20.9	36	0.19	26.3	73.7	0.62	20	80	0.05	40.5	32.3	31.2	0.9	51.5	30.9	17.6	0.06
Burning eye	50.9	37.4	36	0.08	49.6	50.4	.02*	46.4	54.6	0.19	39.8	46.7	13.5	0.13	60.3	31.1	8.6	0.11
Eye fatigue	57.4	46	52	0.21	60.6	39.4	.002*	55	45	0.19	33.1	56.2	10.7	.005*	64.7	27.4	7.9	0.12
Eye irritation	33.3	20.1	20	0.05	27	73	0.53	24.3	75.7	0.67	44.6	34.4	21	.035*	60.9	27.5	11.6	0.89
Tearing	14.8	17.3	16	0.87	21.9	78.1	.01*	20	80	0.1	29.5	56.8	13.7	0.55	63.6	34.1	2.3	0.06
Drying eye	24.1	17.3	24	0.38	26.3	73.7	.02*	25	75	0.06	38.7	45.8	14.5	0.78	64.3	30.4	5.4	0.2
Neck pain	31.5	28.5	40	0.58	31.2	68.8	0.76	47.1	52.9	0.33	43.5	42.4	14.1	.03*	63.5	23.5	13	0.85
Elbow pain	12	6.5	16	0.17	9.6	90.4	0.71	9.6	90.4	0.88	34.6	57.7	7.6	0.33	53.8	8.5	7.7	0.26
Wrist pain	9.3	17.3	12	0.19	13.6	86.4	0.82	13.6	86.4	0.49	24.3	45.9	29.7	0.08	59.5	29.7	10.8	0.81
Shoulder pain	6.5	2.2	0	0.12	3.7	96.3	0.06	3.7	96.3	0.23	60	30	10	0.28	40	60	0	0.03
Back pain	50.9	47.5	32	0.23	47.4	52.6	0.99	47.4	52.6	0.69	34.9	56.6	8.5	.00*	62.8	27.1	10.1	0.64
Thigh pain	11.1	5	4	0.15	7.4	92.6	0.97	51.5	48.5	0.23	45	20	35	0.06	35	30	35	.002*
Knee pain	4.6	10.1	8	0.28	7.7	92.3	0.79	7.9	92.1	0.93	28.6	66.7	4.8	0.23	57.1	33.3	9.5	0.68

Factors associated with CVS

Gender, age, education level, service year, computer type, ergonomic training, wearing eye glass at work, free space availability and room illumination were no significant association with the occurrence of CVS symptoms (p>0.05). Patterns of computer usage in hours per day, job category, adjusting computer screen, antiglare usage, adjustable sitting chair and occurrence of CVS symptoms were significantly associated (p<0.05)(Figure 2).

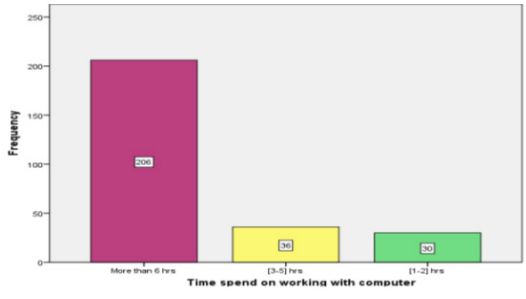

Figure 2. Frequency of workers' working hours with computer per day.

Results of the logistic regression analysis

In bivariate analysis variables such as age of the respondents, education level, service year, ergonomic training, occupation type, computer type, computer usage, free space availability, computer brightness, using antiglare, and adjusting computer screen were found to be a candidate variables ($p<0.25$) associated with CVS. But, chair adjustability was not associated with CVS ($p>0.25$) yet it was assumed as most critical factor especially for posture related symptoms of CVS.

Taking all candidate variables with critical factors (adjustable sitting chair) in final model, only job categories: (human resource officer (AOR: 0.001), engineers (AOR: 0.002), office managers/ secretaries (AOR: 0.003)), computer usage: (using from 3 to 5 hours per day (AOR: 0.028); using from 1 to 2 hours per day (AOR: 0.122)), anti-glare usage (AOR: 6.425), adjusting computer screen (AOR: 0.287) and adjustable sitting chair usage (AOR: 3.736) were statistically significant factors of CVS as shown in Table 4.

Table 4. Result of binary logistic regression model for symptoms of CVS among ERA workers (n=272).

Variables		Computer vision syndrome		AOR	95% CI	*P-value*
		Yes	No			
Job category	Finance and accountant (R)	34(15.4%)	7(13.7%)			
	Human resource officer	30(13.6%)	9(17.6%)	0.001	0.000-0.015	0
	Engineer	116(52.5%)	8(15.7%)	0.002	0.000-0.049	0
	Office manager/ secretary	40(18.1%)	5(9.8%)	0.003	0.000-0.063	0
	Others	1(0.5%)	22(43.1%)	0.002	0.000-0.031	0
Computer usage per day	More than 6 hours (R)	179(86.9%)	27(13.1%) m,			
	3 to 5 hours	28(77.8%)	8(22.2%)	0.028	0.004-0.213	0.001
	1 to 2 hours	14(46.7%)	16(53.3%)	0.122	0.016-0.936	0.004
Anti-glare usage	Yes	9 (4.1%)	6(11.8%)	6.425	1.218-33.89	0.028
	No	212(95.9%)	45(88.2%)			
Adjusting computer screen	Yes	193(87.3%)	20(39.2%)	0.287	0.099-0.835	0.022
	No	28(12.7%)	31(60.8%)			
Adjustable sitting chair	Yes	111(50.2%)	26(51.0%)	3.736	1.070-13.05	0.039
	No	110(49.8%)	25(49.0%)			

Discussion

In the present study 81.3% of ERA workers had one or more than one symptoms of computer vision syndrome, which is very high computer related morbidity. This finding is higher than studies reported prevalence of CVS ranged from 63-80% [22,24,30-36] 63% in Public University of Putra, Malaysia, among administrative staffs [30]; 67.2% in Karachi, Pakistan, among medical students of Bahria university [22]; 67.4% in Sri Lanka among office workers [24]; 69.5% in Debre Tabor, Ethiopia, among government office workers [31]; 72% in Ajman, United Arab Emirates [32]; 73% in Gondar, Ethiopia,

among bank workers [33]; 73.9% in University of Gondar, Ethiopia, among data processors [34]; 74% in Abuja, Nigeria [35] and 80.3% in Chennai, India, among medical and engineering students [36]. This is fairly in consistent with the findings in Mysuru, Karnataka, India which was reported to be 83.5% among software professionals [12].

The higher prevalence observed in this study is possibly due to the inclusion of ergonomic (posture) related non-ocular symptoms to the definitions of CVS as a risk factor; whereas in the aforementioned studies only ocular symptoms, except headache, were used to define CVS. On the other hand, most respondents in this study were secretaries and engineers, who were experienced on daily usage of computers for long period of time as evidenced by Mekuriaw et al [34] and Logaraj et al [36], respectively. Hence, these inconsistencies might be a possible justification for the determined higher prevalence in the present study.

The common vision related symptoms of CVS were eye fatigue (51.1%), burning eye (42.6%), headache (40.8%) and eye irritation (25.4%). This is coincided with findings which were reported in similar figures among computer office workers from other developing countries [24]. The main posture related symptoms of CVS in this study were back pain (47.4%), neck pain (31.2%) and wrist pain (13.6%) among ERA workers (Figure 1). This is agree with Pandey et al [13] who reported such symptoms nearly in the same manner. Remarkably ocular symptoms (average: 31.7%) were reported more frequently than posture related or extra ocular symptoms (average: 17.23%) in present study. This is aligned with a study done by Noreen et al who indicated that on average ocular complaints (55%) were higher than neck, shoulder, back pain (12%) in their study groups [22]. On the contrary, Logaraj et al [36] and Abudawood et al [38] shown neck and shoulder pain, and headache were more frequently reported extra ocular than ocular symptoms of CVS.

In gender wise, almost there was no difference in general prevalence of CVS symptoms among male (81.9%) and female (80.3%) workers (Chi-square: 0.111, df: 2, p-value=0.428). But, in particular excessive tearing (p=0.02), thigh (p=0.009) and wrist/fingers (p=0.001) pain were observed symptoms of CVS associated to gender (Table 3). An excessive tearing was more prevalent in males than females. Similarly, thigh pain was more prevalent among male participants. This association agrees with the findings by Ranasinghe et al [24] which showed a significant higher tearing rate among male computer users. In contrast, Abudawood et al and Pandey et al found significantly higher prevalence of excessive tearing symptoms among females than males [13,38].

On the other hand, wrist/fingers pain was more prevalent among females which is similar to Pandey et al [13]. Possible justification might be due to the proportion of female in job categories. Out of 117(43%) female participants in current study, the majorities were office secretaries 45(38.5%) who have higher chance to develop wrist/finger pain since their job is related to comprehensive usage of computers. Strengthening this information, Dessie et al found that secretaries were significantly impacted by CVS compared to other workers [31].

Out of all (272) respondents participated in this study, the majority 110(40.4%) of them belonged to age category of 21-30 years old followed by age groups between 31-40 years 89(32.7%). No significant association was found between the ages of workers with CVS development in present study. Nevertheless, it might be revealed that most computer based work was dominated by younger generation. This is in line with other study conducted by Abudawood et al in King Abdulaziz University, Jeddah, Saudi Arabia [38]. The current finding disagree with the study by Alemayehu et al [34] who reported that older aged were at higher risk of developing CVS within their study population.

In this study, most of respondents (58.1%) had one to five years of working experiences with computer on their current job position. Then again, about 237(87.1%) of ERA workers had not taken any ergonomic training. This indicating that, ergonomic oriented training on computer use corresponding to their job categories is needed to manage CVS impacts. So that practice of ergonomics improves working efficiency, comfort and easiness to use without compromising health and safety while using computer [1,23].

Pearson chi square test was applied to find out the association between types of computer related characteristics and prevalence of CVS symptoms among study participants. The Pearson chi square test (Chi-square=7.646, df: 2, p-value=0.002) showed association between prevalence of CVS; headache (49.5%) and users of both desktops

and laptops workers. This might be resulted from view distance which was revealed by scholars in previous studies. Shantakumari et al found that the prevalence of headache decreased in computer users who viewed the screen at a distance greater than 50 cm [32]. Another evidence shown that users who viewed computers at a distance of less than arm and forearm length (<50 cm), have to be suffered from CVS symptoms significantly [44].

Out of 221 who had CVS symptoms, 212 (95.9%) of them did not use anti-glare during computer use in this study (p=0.03). This is greater result than similar study performed by Venkatesh et al who found 73.1% having CVS symptoms did not use antiglare [12]. In the present study, almost 5 out of 10 (50.4%) of ERA workers were used adjustable chair which was inconsistent with Logaraj et al [36] who reported that 61.5% of respondents in their study used chairs with adjustable backrest while working on their computer.

Additionally, just 48.5% of the respondents were complaining about free space availability near to their working station. Although this is not significant in present study, it may be one factor that triggers for self-reported muscular skeletal symptoms such as 47.4% back; 40.8% headache; 31.3% neck; 13.6% wrist, 9.6% elbow; 7.7% knee, 7.4% thigh and 3.7% shoulder pains among our study participants. This might be moderately explained by either the sample size for those predictor variables were not adequate or due to other conditions not controlled.

Multivariate logistic regression analysis result shown that job categories, computer usage in hours per day, adjusting computer screen, anti-glare usage and adjustable sitting chair usage were risk factor significantly associated with symptoms of CVS (p<0.05). Compared to the finance and accountant officers, engineers were more likely to develop symptoms of CVS (AOR: 0.002; 95% CI: 0.000-0.049, p=0.000). Office managers/secretaries were most likely at risk of CVS symptoms (AOR: 0.003; 95% CI: 0.000-0.063, p=0.000) among workers of all job types. This is possibly, due to office secretaries staring prolonged period of time on working with computer. Strengthening this, Mekuriaw Alemayehu et al reported that secretaries and data processers were more likely to have suffered from CVS as compared to other participants in their study [34].

Daily computer using time was another most statistically significant risk factor in this study. Workers who used computers for 3 to 5 hrs per day (AOR: 0.028; 95% CI=0.004-0.213, p=0.001) were 2.8% times less likely to develop CVS as compared to those who used computers ≥ 6 hrs per day. On the other hand, computer user workers using for 1 to 2 hours per day (AOR: 0.122; 95% CI=0.016-0.936, p=0.004) were 12.2% times less likely to develop symptoms of CVS comparing to those who used more than 2 hours per day. This finding is in agreement with numbers of the previous findings [5,22,23,36,38] including a report by the American Optometric Association [9].

Moreover, Noreen et al [22] and Logaraj et al [36] reported that among CVS positive groups, users who spent more than four hours were significantly at higher risk of developing CVS than who spent less than four hours. Other similar studies also shown that the longer the time spent on computer, the more prevalent and extent are risks of CVS symptoms appreciably [4,24,36]. Even higher CVS was found significantly among computer users staring for more than two hours [37]. Hence, either reducing daily exposure time spent on computer or taking mini breaks [23] are important to prevent and control CVS.

Our study shown that computer users who did not adjust their computer screen were more likely to develop symptoms of CVS by 28.7% than those adjusting their computer screen (AOR: 0.287, 95% CI: 0.099-0.835, p=0.022). As noted previously by numerous scholars, higher screen brightness and reflections from the monitor significantly increase sensitivity to light which prone to higher risk of CVS [32,38,45]. Specifically, Shantakumari et al found that higher screen brightness increased the incidence of headache, eye irritation and eye fatigue [32]. Present study also reveals that, workers who did not use anti-glare during computer use were 6 times more likely to develop symptoms of CVS (AOR: 6.43, 95% CI: 1.218-33.89, p=0.028) as compared to those using anti-glare. Thus, screen brightness and contrast should be adjusted to provide balance with light sources or using anti-glare improves screen visibility by reducing reflections on monitor [9,45]. In view of the fact that lowering screen brightness and reduced light reflections from computer screen will generally minimize the CVS impacts.

This study also shown that computer user workers sitting on ergonomic adjustable chair were 3.7

times less likely to develop CVS than those using nonadjustable sitting chair (AOR: 3.74, 95% CI: 1.07-13.05; p=0.039). This is supported by the previous study which describes that sitting on inappropriate chair in front of computer screen cause muscle stiffness, headache, and back pain as muscles and tendons become inflamed due to prolonged sitting [13]. Strengthening this, evidence explaining that musculoskeletal symptoms are well related to improper seating posture and placement of the screen [16].

A well-designed chair may positively affect the posture, blood circulation and the extent of strain on the spine. The chair should allow the feet firmly on the floor or a footrest should be used to support the feet. Most chairs used by computer users in properly designed computer facilities and institutions have adjustments to make them comfortable to sit on and therefore preventing back pains [23]. That's why, American Optometric Association recommend that proper ergonomic design with adjustable tools of computer in an adequate workstation can increase productivity and workers comfort by decreasing the visual demands of the task [9].

Unluckily, in this study some important variables like service years of work with computer, wearing computer eye glass, computer type and room lightning were not significantly associated with CVS. This might be partly explained by the sample size for those predictor variables were not adequate. It is better to conduct further studies on an outsized scale to determine the extent of the symptoms of CVS risks among employees using computer at stakeholders including higher institutions, government sectors and private companies in Ethiopia. Evidence based information will be used by organizations to raise awareness about CVS among staffs and for designing intervention to reduce the impact of CVS at workplace.

Limitations

The major limitation to this study was that, only self-reported symptoms were considered excluding ophthalmic examinations using cross-sectional study design and the data was collected from single institution. Besides to this, other ergonomic parameters such as workstation furniture and viewing distance of computer screen might be associated with CVS were not taken into consideration. Consequent follow up on workers with CVS positive and without CVS is required to recognize risk factors for CVS.

Conclusions

Visual and posture related problems constitute an important part of computer vision syndrome. Ethiopian Roads Authority computer user workers had a high prevalence of Computer Vision Syndrome. Patterns of computer usage in hours per day, job category, personal factors (i.e., adjusting computer screen brightness, using antiglare), and adjustable sitting chair are modifiable risk factors for visual and posture related symptoms of CVS in this study. Multi-programmed approaches; decreasing the number of hours/day staring at the computer screen, proper illumination, increasing frequent rest (mini breaks) with motivation for exercises (to stand, stretch, and move around) at workplace, looking away from computer screen frequently, regular health check-ups and proper positioning is needed to prevent CVS. What is more, further future consequent follow up studies on workers with and without CVS is required to recognize identified risk factors for CVS.

Author's Contribution

Belay Negassa design the study, overall supervising the study, carried out the data processing and drafted the manuscript. Abraham Shiferaw participated in data analysis and reviewing of the manuscript. Girum Gebremeskel and Tizalegn Tesfaye were participated in reviewing the manuscript. All authors read and approved the final manuscript.

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Competing Interests

The author declares that there is no competing interest.

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