Prolonged computer use and its effects on vision among undergraduates in University of Colombo, School of Computing

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Abstract— *Computer Vision Syndrome (CVS) is a group of visual symptoms experienced in relation to the use of computers. Nearly 60 million people suffer from CVS globally, ranging from 64% to 90%, resulting in reduced productivity at work and reduced quality of life of the computer worker. The present study aims to describe the prevalence of CVS and its associated factors among undergraduates in University of Colombo, School of Computing.A cross sectional study was carried out in the University premises on 2nd, 3rd and 4th year students of University of Colombo School of Computing. Pattern of computer use, prevalence and extent of visual symptoms and some associated factors were analyzed. Statistical data is provided about the prevalence of visual symptoms and its co-relationship with the duration of exposure and associated other factors that have been identified. For the categorical variables chi square test was used and for continuous variables Students T Test was used.*

Sample size was 112 (response rate – 74.6%). Mean age was 21.9±1.2 years (range 19-25 years) and 73 (65.2%) of the sample were males. Only 39 (34.8%) of the sample were females. Percentage of individuals with visual symptoms in the study population was 79 (70.5%). 33 (29.5%) students were asymptomatic. The most commonly reported complaint was headache (54.5%), followed by pain (33.9%), whereas the least common complaint was double vision (3.6%).

High prevalence of visual symptoms was observed (70.5%) among the study group. Technology professionals who have nearly similar exposure to the computer screens have shown similar percentage of prevalence of visual symptoms but findings are much more less than the researches which were done on students. There is no association between prevalence of visual symptoms and duration of continued gaze upon the monitor and the duration of the course. But there is a significant association with the distance from the monitor and duration of daily computer usage.

Keywords— **vision, computer, visual symptoms, computer vision syndrome**

I. INTRODUCTION

As we enter the 21st century, the growing use of computers in the home and office brings with it an increase in health risks, especially for the eyes. Effect of long term computer use on vision, called Computer Vision Syndrome (CVS), is affecting more and more people who find themselves constantly in front of computer screens. Reduced visual abilities, the pain and discomfort associated with the problem can affect quality of life, workplace performance & the enjoyment of day to day activities. According to Heyes et al., 2007, globally computer vision syndrome affects 64% - 90% among computer users & according to SenA et al., 2007, nearly 60 million people suffer from CVS globally & a million new cases of CVS occur each year. Worldwide there are several studies which have been done to determine the prevalence of computer vision syndrome, but there are only few studies done here in Sri Lanka.

Seshadhri et al, 2014, conducted a study to determine the prevalence of computer vision syndrome among Information Technology professionals working in software companies in Chennai. Study included a sample of 179 persons. Their inclusion criteria included persons working in current job for past 6 months & who use computer for more than 3hours per day or 15hours per week. The prevalence of computer vision syndrome found in this study was 69.3% which belongs to the category of moderate level overall incidence. They had also shown that there was no association between computer vision syndrome & total hours of working on computer per day (Seshadhri et al, 2014). In the above, study they have selected professionals working in software companies & also they haven't mentioned about the associated factors of computer vision syndrome. Our study is focused on university students where there is less exposure to computer screen comparing to above professionals & associated factors.

There was another study conducted by Logaraj et al., 2014 in same region as above study, Chennai. They had assessed the prevalence of CVS among medical & engineering college students of a University situated in the suburban area of Chennai. According to this study the prevalence of CVS among engineering students was 81.9% & among medical students was 78.6%. They also have shown that the students who used computers for 4-6 hours were at higher risk of developing the visual symptoms such as redness, burning sensation & dry eyes. This study had shown that there was a significant correlation between the increased hours of computer use & visual symptoms. This fact is against the conclusion made by the previous study (Logaraj et al., 2014).

A study which was conducted in Malaysia, had described the prevalence of some important visual symptoms

among undergraduate students studying computing & medicine and some secretarial staff. They had found out 55% with burning sensation in the eyes, 61% with headache, 46% with redness of the eyes & majority, 87% with eye fatigue, among the symptoms of CVS. When the duration of the computer use was increased, the above scores also had increased supporting the fact that there was a significant correlation between the increased hours of computer use & visual symptoms (Sen and Stanley, 2007).

Recently, Reddy SC et al, 2013, had conducted a study on CVS to determine the prevalence visual symptoms, associated factors & knowledge and practices of computer use among university students in Malaysia. According to this study, there was 89.9% prevalence of one or more visual symptoms of CVS & the most disturbing symptom that they had found was headache (19.6%) followed by eye fatigue (16.4%). The associated factors which increase the prevalence of visual symptoms were computer use of more than 2hours, wearing spectacles, computer screen at or above the level of eye and which decrease the prevalence of visual symptoms were looking at far objects in between work, use of eye drops, computer screen below the level of eye. Usage of radiation reducing filters & taking breaks in between computer use had not been shown to reduce visual symptoms (Reddy et al, 2007).

A study which was done among University students of Ajman, United Arab Emirates had shown the patterns of computer usage & related visual problems. The symptoms reported in this study were Headache with a prevalence of 53.3%, Burning sensation in the eyes with a prevalence of 54.8% & Fatigue eye with a prevalence of 48%. The females were at higher risk of developing visual symptoms. When the display screen was viewed at a distance more than 50cm, the prevalence of headache reduced by 38%. When screen radiation filters were not used, the prevalence of fatigue eyes was increased by 89% (Shantakumari N. et al., 2014). This study elaborates that the screen viewing distance & radiation filter usage are associated with the development of visual symptoms in long term computer use.

Brightness adjustment, Antiglare screens & Type of the monitor are some other associated factors which give rise to visual symptoms in computer vision syndrome. A study had shown that adjustment of the brightness of the screen, usage of antiglare screens & LCD monitors resulted in less prevalence of visual symptoms (Smita et al., 2012). When considering all these studies, it elaborates that there is a higher prevalence of computer vision syndrome worldwide, ranging from 64% to 90% which in turn reducing the quality of life, productivity, etc. & resulting in permanent eye damage. This highlights the importance of doing a research on Computer Vision Syndrome in Sri Lanka & also there are very few studies done here regarding this problem until present.

The common visual symptoms associated with the long-term computer use are the headache, eye strain, eye redness, periorbital pain & Dryness of the eyes. The common associated external factors are duration of exposure to computer screen, usage of spectacles, level of the eyes & computer screen, activities during computer use, usage of eye drops, radiation reducing screen filters, antiglare screens, brightness adjustment, type of monitor, screen viewing distance.

II. METHODOLOGY

A cross sectional descriptive study was carried out on 2nd, 3rd and 4th year undergraduates of University of Colombo School of Computing, completing their degrees on information systems and computer science who have used computer more than 1 hour per day during past 2 months.

Modified version of an expert validated, self-administrated questionnaire, which has been used in a previous research on computer use and associated visual and musculo-skeletal symptoms in Sri Lanka (Ranasinghe P., et al., 2011) was used to gather information under headings of basic personal details, history of computer use, visual symptoms and factors related to computer use and vision. Visual symptoms sought for included dry eyes,sore eyes, red eyes, blurred vision (near and distal), retro orbital pain, excessive tearing, headache, disturbances of colour vision, double vision, twitching of the eyelids and the associated factors of interest were presence of diagnosed visual defect, use of lubricating eye drops, use of contact lenses, characteristics of the display monitor used and its placement. Data analysis was done using IBM SPSS Statistics 20th version.

Socio demographic characteristics, prevalence of long term computer use (using computer more than 3 hours per day for 6 months), prevalence of visual symptoms and prevalence of associated factors were described. Individual with even one visual symptom was considered as a symptomatic while presence of none of the symptoms was considered as asymptomatic. Presence of visual symptoms >3 was considered as severe while mild being presence of symptoms <3.

Any significant association between the associated factors of computer use and being symptomatic was sought using chi square test. Mean values of daily exposure to computer, distance to the monitor, duration of continued gaze upon the computer screen between asymptomatic and symptomatic groups were compared using student T test.

III. RESULTS

A. Socio-demographic characteristics.

The Sample size was 112 (response rate – 74.6%). Mean age was 21.9±1.2 years (range 19-25 years) and 73 (65.2%) of the sample were males. Only 39 (34.8%) of the sample were females. Total number of 48 (42.9%)

students had daily computer usage less than 6 hours while 64 students are using computer more than 6 hours per day. 61 students (54.5%) have been following the course for duration of less than a year. 91 (81.3%) of students were using computer for study purposes while 6 are (5.4%) using it for graphic designing and 14 (12.5%) are using it to access internet, mainly.

Table 1. Presence of visual symptoms

	N (%)
Symptomatic	79 (70.5)
Severe	41 (51.9)
Mild	38 (48.1)
Asymptomatic	33 (29.5)
Long term users	17 (15.2)
Short term users	95 (84.8)

B. Presence of Visual Symptoms

Percentage of individuals with visual symptoms in the study population was 79 (70.5%). 33 (29.5%) students were asymptomatic. 17 (15.2%) students were found to be using computer more than 3 hours per day for 6 months. 95 (84.8%) were short term computer users. 41 (51.9%) were having severe visual symptoms while 38 (48.1%) were found to be having mild visual symptoms. 38 (33.9%) had pain around the eye and headache was present among 61 (54.5%). 25 (22.5%) had blurred near vision and 15 (13.5%) had blurred distant vision. 26 (23.2%) had dry eyes after computer use while 29 (25.9%) had sore eyes. 22 (19.6%) had red eyes, 27 (24.3%) had excessive tearing, 4 (3.6%) had double vision, 15 (13.5%) had twitching of the eyelids and (4.5%) disturbances in colour vision.

The most commonly reported complaint was headache (54.5%), followed by pain (33.9%), whereas the least common complaint was double vision (3.6%). The prevalence of each symptom in all participants, males and females are presented in Table 2. There was no significant association between visual symptoms and gender. There was no significant difference between the genders for any of the visual symptoms.

C. Factors associated with visual symptoms

1) Characteristics of the monitor: 68 users were using 15'' monitors while 39 (30.4%) and 6 (5.4%) using 17'' and 19'' monitors. Majority were LED/LCD screen users 92 (82.1%) while only a very few 2 (1.8%) used only CRT monitors.

*2) Other associated factors:*Prevalence of diagnosed eye conditions among the population was 3 (2.7%). 86 (76.8%) individuals used to change brightness according to the state of the light of the environment. Total number of VDT filter users were 24 (21.4%) and 32 (28.6%) had noticed there's a glare in the screen when they were working. Total number of spectacle users were 42 (37.5%) and 10 (8.9%) used to use lubricating eye drops to reduce prevalence of visual symptoms. Total number of contact lens users was 2 (1.8%).

Table 2. Prevalence of visual symptoms and association with gender.

Symptom	N	Total %	Female %	Male %	P value*
Pain around the eye	38	33.9	28.2	37	0.350
Headache	61	54.5	61.5	50.7	0.272
Blurred near vision	25	22.5	23.1	22.2	0.918
Blurred distant vision	15	13.5	7.9	16.4	0.212
Dry eyes	26	23.2	25.6	21.9	0.657
Sore eyes	29	25.9	20.5	28.8	0.342
Red eyes	22	19.6	25.6	16.4	0.243
Excessive tearing	27	24.3	28.2	22.2	0.483
Double vision	4	3.6	2.6	4.1	0.692
Twitching of eyelids	15	13.5	10.3	15.1	0.476
Changes in colour visualization	5	4.5	2.6	5.5	0.477

*p value for association with gender

Table3. Characteristics of the monitors

		N	%
Monitor size			
1.	15''	68	60.7
2.	17''	39	30.4
3.	19''	6	5.4
Distance to Monitor from the eye			
1.	< 20 cm	69	61.6
2.	20 < cm	41	36.6
Type of Monitor Used			
1.	CRT	2	1.8
2.	LCD/LED	92	82.1
3.	Both	18	16.1

The association between presence of visual symptoms and gender, cleaning the monitor screen, using a filter,presence of screen glare, use of lubricating eye drops and use of contact lenses was assessed by using chi square test. Results are summarized in table 4. There was

no statistically significant association between any of those factors and visual symptoms.

		Asymptomatic	Symptomatic	Total	X2	df	P value
Gender							
	Male	19	54	73	1.192	1	0.275
	Female	14	25	39			
	Total	33	79	112			
Cleaning the Screen							
	Cleaning	22	49	71	0.216	1	0.462
	Not Cleaning	11	30	41			
	Total	33	79	112			
Filter use							
	Present	8	16	24	0.220	1	0.619
	Absent	25	63	88			
	Total	33	79	112			
Screen glare							
	Present	9	23	32	0.039	1	0.844
	Absent	24	56	80			
	Total	33	79	112			
Lubricating eye drops							
	Present	1	9	10	2.002	1	0.157
	Absent	32	70	102			
	Total	33	79	112			
Contact lens							
	Present	0	2	2	0.851	1	0.356
	Absent	33	77	110			
	Total	33	79	112			

Table 4. Association of visual symptoms to vision related and computer related factors.

For students with visual symptoms mean values for course duration up to the date of data collection was 13.2 months and their mean daily computer usage was 7.37 hours. They kept monitor at a mean distance of 20.65 cm and mean duration of continuous staring at the monitor was 136 minutes. Students without visual symptoms had a mean course exposure of 14.58 months and 5.94 hours of mean daily computer usage. They also had a mean distance of 16.84 cm head to the monitor and mean duration of continuous staring of 102.88 minutes. Students T test was done to compare these results. There is a significant difference at 95% confidence level, between the mean values for daily computer usage for symptomatic students 13.2, $p = 0.033$ ($p < 0.05$) and with the distance to monitor, $p = 0.008$ ($p < 0.05$). There was no observed significant difference between mean values for course exposure and continuous gazing at the screen.

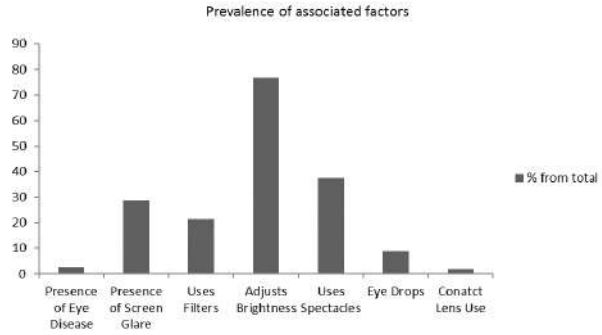

Figure 1. Prevalence of other associated factors

Table 5. Results of the student T tests

	N	Mean	SD	Significance value
Duration of the course				
Symptomatic	79	13.2	8.662	0.481
Asymptomatic	33	14.58	10.912	
Daily Usage (hours)				
Symptomatic	79	7.37	3.081	0.033
Asymptomatic	33	5.94	3.455	
Distance to monitor (cm)				
Symptomatic	79	20.65	7.174	0.008
Asymptomatic	31	16.84	5.014	

Duration of gazing continuously (mins)				
Symptomatic	75	135.59	186.821	0.378
Asymptomatic	33	102.88	151.874	

IV. DISCUSSION

Majority of the study population were males 73 (65.2%) and used computer more than 6 hours a day 62 (57.2%). Majority, 61, was following the course for a period of time less than a year (54.5%).

High prevalence of visual symptoms was observed (70.5%) among the study group, which is nearly similar to the findings (69.3%) in some of the previous researches on long term computer users. (Sheshadhri et. Al, 2014). But it appears near to the lower limit of the range of the global prevalence of visual symptoms (64% - 90%) that the other researches have revealed (SenA et al., 2007).

Compatible with the Reddy SC et al., 2007 and Shantakumari N. et al., 2014 headache was the most prevalent symptom. Technology professionals who have nearly similar exposure to the computer screens have shown similar percentage of prevalence of visual symptoms but findings are much more less than the researches which were done on students. (89.9% Reddy SC et al., 2007) (Logaraj et al., 2014). Since there was no significant difference was observed in the T test there is no association between prevalence of visual symptoms and duration of continued gaze upon the monitor. But there is a significant association between daily computer usage and visualsymptoms. Mean value for students with visual symptoms for daily computer use was 7.37 hours while asymptomatic students had a value of 5.94 hours. Risk for developing visual symptoms, therefore, increases as the daily computer usage increases, as suggested by the student t test.There was observed significant association between visual symptoms and increased distance to the computer monitor. There were no previous researches supporting this evidence.

Contradictorily to the findings of Smita et al., 2012, there was no significant association between brightness adjustment, using antiglare screens. There was no association between prevalence of visual symptoms and VDT filter usage. This is supported by the results of Reddy SC. Et al., 2007 while findings of Shantakumari N. et al., strongly suggest vice versa. This again could be due to less number of VDT filter users in the sample.

In contrast to the results of Reddy SC. Et al., 2007 there was no significant reduction of visual symptoms caused by using eye drops.

Main conclusion to be drawn was there is a high prevalence of visual symptoms among long term computer users. This is compatible with the researches done on the area by other Asian countries. But it appears to be lying in the lower margin of the range suggested by those researches. Hence, though long term computer users have high prevalence of visualsymptoms, it appears to be lower in comparison with the globally accepted range. Most common visual symptom caused by computer use is headache.

According to the results there is no influence of gender upon prevalence of any of the visual symptoms observed. Increased daily duration of computer use is associated with high prevalence of visual symptoms while duration of the course or duration of continuous gaze upon the screen without taking a rest had no effect on the visual symptoms.

Results regarding contact lens use and visual symptoms prevalence could be a result of the smaller population size and smaller number of contact lens users taking part in the research. Further research focused on the subject is needed for a better conclusion in that matter.

According to the conclusions we recommend the computer users to keep their daily exposure to computer screen less than 6 hours. We also strongly suggest doing prospective studies on association between duration of daily computer use and prevalence of visual symptoms. Using an objective method to identify prevalence of symptoms would help in acquiring a higher accuracy.

It would be better to select a larger population size in future researches focused on individual factors associated with visual symptoms. Researches more focused on association between contact lens use, distance to the monitor screen and visual symptoms might suggest difference results compared to our study. We suggest doing studies more focused on these areas with use of proper inclusion and exclusion criteria to include a reasonable number of participants.

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