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Research Article

Computer-Related Vision Problems in Osogbo, South-Western Nigeria

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ABSTRACT

Widespread use of computers for office work and e-learning has resulted in increased visual demands among computer users. The increased visual demands have led to development of ocular complaints and discomfort among users. The objective of this study is to determine the prevalence of computer related eye problems and their associations among computer users in Osogbo, South Western Nigeria. A written semi-structured questionnaire was used to collect information on computer related symptoms among bankers, office workers and students in Osogbo, South Western, Nigeria. A total of 416 respondents completed and returned the questionnaire. All the respondents had at least one computer related symptom. The most prevalent symptom was neck and shoulder pain which was reported by 62% computer users. Backache and headache were reported by 60.8% and 58.4% of the respondents respectively. Blurring of vision while working on the computer was the commonest symptom that stopped respondents while using computers. No significant association was found between symptom scores and gender, duration of computer use, type of computer screens, and use of screen filter. Symptom scores were significantly related to presence of pre-existing eye problems. Symptoms were also related to ergonomically inappropriate workstation environments of respondents. Computer related vision symptoms occur frequently among computer users in South Western Nigeria. Improvement in workstation environments of computer users and treatment of pre-existing eye problems require attention to prevent occurrence of epidemics of computer related visual problems in this part of the world.

Keywords: Asthenopia, Computer use, workplace, accommodation, Nigeria

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INTRODUCTION

Computer use has grown significantly all over the world since the last century. The widespread availability of internet services has also contributed to the use of computers. Worldwide, there were 3,366,261,156 internet users by the end of November, 2015, representing 46.40% internet penetration (Internet World Statistics, 2015). In Africa, internet penetration stood at 27.0% of her population by the end of June, 2015 (Internet World Statistics, 2015). Nigeria had 92,699,924 internet users (51.1% penetration) by mid-2015, contributing 29.6% of all internet users in Africa (Internet World Statistics, 2015).

Ownership and access to computers in Nigeria was quite low. A recent survey carried out by the Nigerian Bureau of Statistics and the Central Bank of Nigeria in 2010 revealed that about 4.5% of Nigerians either owned or accessed computer while only 0.9% of the Nigerian population actually owned a personal computer (Nigerian Bureau of Statistics, 2012). The survey also put ownership and access to personal computers in Osun State at 10% of her population while only 8.5% of persons living in Osun State had access to internet services in 2011 (Nigerian Bureau of Statistics, 2012).

Studies have shown that the widespread use of computers leads to increase visual demands among the users. These visual demands result in ocular complaints and discomfort among these users. The American Optometry Association (AOA) described the combination of eye and vision problems associated with the use of computers as Computer Vision Syndrome (CVS) (AOA, 2014). The symptoms of CVS have been classified into two broad categories by Sheedy *et al.* (2003). The external symptoms which relate to dry eye include

burning, irritation, ocular dryness and tearing. The internal symptoms which include eye strain, headache and eye ache are caused by refractive, accommodative or vergence abnormalities (Sheedy *et al.,* 2003).

Prevalence and patterns of CVS symptoms vary worldwide. The prevalence of eye symptoms among computer users vary between 25% and 93% (Thomson, 1998). The prevalence was 31.9%, 63.4% and 68.5% in Italy (Mocci *et al*., 2001), Australia (Sánchez-Román *et al*., 1996) and Mexico (Dain *et al*., 1988) respectively. The prevalence was 46.3% in an Indian study carried out among students and faculty of a university (Bhanderi *et al*., 2008). In a study among users of Cathode-Ray Tube (CRT)-based Visual Display Units (VDUs) in Benin, Nigeria, 42.7%, 45.7% and 28.2% of respondents had eyestrain, blurred distance vision and headache respectively (Chiemeke *et al.*, 2007).

There is dearth of information on computer-related visual problems in Nigeria despite dramatic rise in the use of computer and other digital devices in the country. The aim of this study was to determine the prevalence of computer-related eye problems among computer users in Osogbo, South Western Nigeria and to elucidate the associated factors.

SUBJECTS AND METHODS

This cross-sectional study was conducted among computer users in Osogbo, Osun State. The estimated sample size for this study was 424, assuming prevalence of computer-related symptoms = 0.463 (from a previous study in Ilorin, Nigeria (Adepoju *et al*., 2005)), $Z_{\alpha/2}$ = 1.96, d= 5% and non-response rate = 10%.

Sampling technique: Participants in this study were selected through multistage sampling technique. In the first sampling stage, 10 Federal Government parastatals, 5 Osun State Government parastatals, 5 Osun State Government ministries and 5 business/computer centres were randomly selected. Separate lists of federal and state government ministries and parastatals were made. The required number were selected from each list using computer generated random numbers. In the case of business centres, a major street was randomly selected by balloting. Five business centre/computer centre were randomly selected on this street. In addition, all banks, telecommunication offices, and two of the 3 universities in the city were also randomly selected by balloting. In the second stage, consenting workers and students who use computers in their daily activities at the selected offices were enrolled into the study.

The study instrument, a semi structured questionnaire was self-administered and filled by each study participant. The questionnaire had three segments, namely socio-demographic characteristics such as age, sex, occupation and educational status. The second part dealt with the workstation environment while the third part explored computer-related visual symptoms. The symptoms were classified into vision, ocular, asthenopic, light sensitivity, musculoskeletal and general symptoms domains according to Sheedy and Shaw-McMinn (2003). Each symptom was scored between 0 and 10 in order of increasing severity. Total Symptom Severity Score was calculated for each participant from the data collected.

The study followed the tenets of the Declaration of Helsinki, and ethical clearance was obtained from the research ethics committee of the LAUTECH Teaching Hospital, Osogbo. Informed consent was obtained from all subjects after an explanation of the nature of the study.

Data Management: All data were entered into Statistical Package for Social Sciences, SPSS version 20 (SPSS, Inc., IL, USA). The data were cleaned and analyzed. Test of normality were carried out on all the quantitative variables using Shapiro-Wilk test. Categorical data were expressed as percentages, and numerical data were summarized as median and interquartile range (IQR).

Non-parametric data analyses were carried out. Medians of age and total symptoms severity scores were compared among categorical variables using Mann Whitney U or Kruskal Wallis tests as applicable. $P<0.05$ was taken as statistically significant.

RESULTS

Socio-demographic characteristics: Four hundred and sixteen completed questionnaires were returned. Males comprised 51.2 % of the respondents with a male: female ratio of 1.1:1. None of the quantitative variables had normal distribution by Shapiro-Wilk test ($p<0.0001$). The median age (interquartile range (IQR)) of the respondents was 32.0 (11.0) years. There was no difference in the median ages in both sexes ($p= 0.962$). Majority (38.7%) of the respondents were government workers. The median number of hours spent daily working on computers among the respondents (interquartile range) was 8.0 (4.0). The other socio-demographic characteristics of the respondents were as presented in Table 1.

Workstation environment: Arrangement of the workstation environment varies among the respondents. In 320 subjects, there were bright lights in their field of view while viewing the computer screen. There was improved visibility of the computer screen among 186 respondents who shielded their computer screen from overhead lights. In addition, the level of the eyes was higher than the center of the computer screen among 58.4% of 303 subjects who responded to the question while 31.0% of the respondents had their eyes at a level lower than the center of the computer screen. In 10.2% of these respondents, the eyes were at the same level as the center of the computer screen. The median distance between the eyes and the center of the computer screen was 50.0cm.

Computer-related vision symptoms: All the respondents had one or more computer-related vision symptoms at the time of the study. Table 2 showed the most frequently reported computer-related symptoms among respondents in this study. Neck and shoulder pain were reported by 62% of the respondents. Back ache and head ache were reported by 60.8% and 58.4% respectively.

Musculoskeletal disorders closely followed by asthenopia were the most frequent problems afflicting the respondents.

Symptoms were severe enough to interrupt work on the computers among 82 subjects. Only 50 of these subjects could identify the particular symptoms responsible for such interruption. Blurring of vision while working on the computer (16.0%) was the commonest symptom that interrupted respondents while using computer. Only 74 respondents could recollect that they had ever received treatment for computer-related vision symptoms. The commonest form of treatment ever received by this group of respondents was low radiation (UV protecting) glasses (79.7%).

Table 1:
Socio-demographic characteristics of respondents

Median age in years (Interquartile range (IQR))	**32.0 (11)**
Gender (%)	
Male	213 (51.2)
Female	193 (46.4)
Undetermined gender	10 (2.4)
Ethnicity (%)	
Yoruba	382 (91.8)
Igbo	10 (2.4)
Hausa/Fulani	5 (1.2)
Others	19 (4.6)
Education (%)	
Secondary	25 (6.0)
Tertiary	391 (94.0)
Occupation (%)	
Bankers	127 (31.3)
Civil & Public Servants	157 (38.7)
ICT workers	30 (7.4)
Health care workers/students	60 (14.8)
Other Professionals	32 (7.9)
Self-reported past eye problems (%)	
None	264 (65.3)
Refractive errors	73 (18.1)
Conjunctivitis	31 (7.7)
Glaucoma	7 (1.7)
Cataract	3 (0.7)
Others	26 (6.4)
Median number of hours working on computers daily (IQR)	8 (4.0)

Factors associated with occurrence of computer-related vision symptoms: Total symptom severity score was expressed as a function of socio-demographic characteristics such as age, sex, occupation, type of computer screen, use of computer screen filter, education, number of hours spent on computer and presence or absence of previous eye problems. Table 3 summarizes the effects of these characteristics on total symptoms severity score.

Effect of age: The median age of the respondents was 32.0 years (IQR = 11.0; range 18-70 years). There was no significant association between the symptom score and the age of the respondents (H=5.01; p=0.08).

Effect of gender: The median total symptom scores (IQR) for male respondents was 24.0 (34) and 20.5 (28) for female respondents. The difference in median total symptom scores between the genders was however, not statistically significant (U= 20084; p=0.90).

Table 2:
Ten most frequently reported Computer-related symptoms among respondents (N = 416)

Symptoms	Symptom domain	No of respondents (%)
Neck/Shoulder ache	Musculoskeletal	258 (62.0)
Backache	Musculoskeletal	253 (60.8)
Hand/Wrist ache	Musculoskeletal	214 (51.4)
Headache	Asthenopic	243 (58.4)
Eye strain	Asthenopic	218 (52.4)
Eye fatigue	Asthenopic	215 (51.7)
Slow refocusing	Vision	223 (53.6)
Blurred vision	Vision	221 (53.1)
Excessive blinking	Ocular	222 (53.4)
Itching/Burning eyes	Ocular	205 (49.3)

Effect of number of hours working on a computer: The median number of hours spent on computer (IQR) by respondents in this study was 8.0 hours (IQR= 4.0). The median total symptom scores (IQR) were 21.0 (29.0) and 24.0 (33.0) respectively for respondents who worked on computers for < 8 hours and those who worked for >8 hours on computers. However, the association was not statistically significant (U= 15500.5; p=0.41).

Effect of occupation of respondents: Majority (38.7%) of the respondents were civil and public servants. The median total symptom score (IQR) among them was 16.0 (30.0). Bankers constituted 31.3% of respondents and the median total symptom score (IQR) among them was 24.5 (25). The association between total symptom score and occupation was also not statistically significant (H= 1.17; p= 0.56).

Effect of Education: The median total symptom score (IQR) was 26.0 (33) and 21.0 (29) respectively among respondents who had secondary education and those with tertiary education. However, such association was not statistically significant (U= 4245.5; p= 0.46).

Effect of computer visual display terminals: Respondents in this study used Liquid Crystal Display (46.0%), Light Emitting Diode (30.0%) and the Cathode Ray Tube (4.8%). No statistically significant association was found between total symptom score and types of visual display terminal used by the respondents (H= 0.62; p= 0.73).

Effect of use of computer screen filters: Computer screen filters were not used by majority of the respondents (81.3%). The median total symptom score (IQR) for subjects who used filters and for those who did not use filters were 25.0 (35) and 21.0 (30) respectively. No statistically significant association was found between total symptom score and the use of screen filters (H= 3.39; p= 0.18).

Effect of previous eye problem: There were no pre-existing eye problems among 65.3% of respondents in this study. Median total symptom score (IQR) was 15.0 (29) among those without previous eye problems. Those with eye problems had median total symptom score (IQR) of 25.5 (44). There was statistically significant association between occurrence of pre-existing eye problems and total symptoms score (U= 25,248.5; $p < 0.0001$).

Table 3:
Median total symptoms score as a function of subjects' characteristics

Variables	Median total symptoms severity **score (Interquartile range)**	p-value
Sex		
Male	24.0 (34)	0.90
Female	20.5 (28)	
Age-groups (years)		
11-30	24.0 (31)	0.08
31-50	19.0 (28)	
51-70	33.0 (64)	
Number of hours working on a computer per day		
0-12	22.5 (31)	0.18
>12	12.0 (25)	
Occupation		
Bankers	24.5 (25)	0.56
Civil/Public Servants	16.0 (30)	
Others	23.0 (34)	
Use of Computer screen filters		
Computer screen filter	25.0 (35)	0.18
No computer screen filter	21.0 (30)	
Type of computer screen		
Liquid Crystal Display	19.0 (36)	0.73
Light Emitting Diode	20.5 (27)	
Cathode Ray Tube	26.0 (19)	
Education		
Secondary	26.0 (33)	0.46
Tertiary	21.0 (29)	
Previous eye problems		
None	15.0 (29)	<0.0001
Past eye problems	25.5 (44)	

DISCUSSION

This study was conducted among a wide range of computer users in Osogbo, Nigeria. Study participants ranged from students to senior civil servants. This attested to the fact that computers are used nowadays in virtually all areas of human endeavors in the city. The median age of computer users in this study was 32.0 years, a relatively younger age. Most sectors of Nigerian economic activities are currently being technologically driven by younger generations of Nigerians. Participants in this study were older than those in similar studies carried out in India (Bhanderi *et al*., 2008) and Nepal (Shrestha *et al*., 2011) where mean age of participants were 25.04 years and 25.8 years respectively. Participants of similar study carried out in New York (Portello *et al*., 2012) (mean age=39.2 years) were slightly older than those of this study. Participants of a similar study in Benin City, Nigeria (Chiemeke *et al*., 2007) (mean age = 26.0) were younger than those in this study because they were mainly university students. In a related study that was carried out among computer operators in business centers in Ilorin, Nigeria (Adepoju *et al*., 2005), the mean age of the participants was 25.4 years.

Various workers have attributed some symptoms of computer related vision syndrome to ergonomically inappropriate workstation environment. Symptoms such as backache, neck pain, wrist and joint aches were traced to improper arrangement of the workstation (Sen and Richardson, 2007). In this study, neck, shoulder and back aches are the most prominent computer related symptoms among the participants. This could be attributable to the poor arrangement of the workstation of the participants in their various offices. More than half of the participants had their eyes at a higher level than the computer screen and another 10% had their computer screen at a higher level.

Poor lighting conditions of the workstation could lead to discomfort for computer users. Constant and bright illumination from surrounding sources of light such as overhead fluorescent, large windows, desk lamps produce reflections and glare which lead to visual annoyance and fatigue (Blehm *et al*., 2005). In this study, close to 80% of the respondents had bright light in their field while looking at the computer screen. The visibility of the computer screen improved among 186 respondents after they had shielded their computers' screen from these annoying lights.

Eichenbaum (1996) noted that visual tasks carried out at a range close to the near point of accommodation for a variable period of time resulted in fatigue even in emmetropic or orthophoric subjects. Chiemeke *et al*. (2007) recommended that the distance between computer user's eyes and the screen should be between 50 and 100cm to minimize symptoms of asthenopia during computer use. They also suggested that the viewing angle should be less than 150^0. The median viewing distance in this study was 50.0 cm. However, about 45% of the participants had a viewing distance of less than 50cm. This, in addition to other factors in the workplace could explain asthenopic symptoms such as headache, eye strain and eye fatigue which were reported by 58.4%, 52.4% and 51.7% of respondents respectively.

Various studies on computer-related eye problems had identified different eye symptoms among computer users. Portello *et al*. (2012) reported that almost 40% of office workers surveyed in New York had "tired eyes" while 30% had other symptoms such as dry eyes, eye strain and/or eye

discomfort and irritated eyes. In this study, all the participants were experiencing at least one symptom of computer vision syndrome. The symptoms were severe enough to interrupt work on the computer in 82 (19.7%). The commonest symptoms reported by participants of this study were neck/shoulder ache (62%), back ache (60.8%) and headache (58.4%). It is noteworthy that most of the symptoms reported by study participants were related to asthenopia and musculoskeletal problems. Eye strain, blurred distance vision and headache were the commonest computer related vision symptoms reported by participants in a similar study in Benin, Nigeria (Chiemeke *et al*., 2007). Adepoju *et al*. (2005) found that asthenopia was a notable computer-related eye problem in Ilorin, Nigeria. The major eye symptoms reported by participants in that study were photophobia (46.7%) and eye ache (40.5%).

In a study conducted among Indian ophthalmologist, Bali *et al*. (2007) reported that the commonest computer-related symptoms were eye strain (97.8%), headache (82.1%) and tiredness (79.1%). In a study among students of 5 Malaysian universities, at least one symptom of computer vision syndrome was reported among 89.9% of the study participants (Reddy *et al*., 2013). Asthenopia was also a prominent problem in that study; the most disturbing symptoms being headache (19.7%) and eye strain (16.4%). Similarly, in Nepal, Shrestha *et al*. (2011) found that the major ocular abnormalities among computer users was accommodation infacility, and the symptoms reported by participants were related to asthenopia. Tired eye (88.1%), headache (85.5%) and sore eye (71%) were the commonest symptoms among the respondents.

Several factors have been reported to be associated with computer-related problems many workers in different parts of the world. Such factors include poor working environment, wrong positioning of computer users, uncorrected refractive errors and prolong work on the computer (Adepoju *et al*., 2005; Shrestha *et al*., 2011). Other authors reported gender, use of tear substitutes and taking frequent short breaks.

In this study, there was no significant association between the median total symptoms score and gender, age-groups, occupation and level of education of respondents. Even, the use of computer screen filters and the type of computer screen were not significantly associated with the median total symptoms score. Shrestha *et al*. (2011) did not find a significant association between computer-related visual symptom score and gender in their study of visual display terminal users in Nepal. Similarly, Bhanderi *et al*. (2008) reported that asthenopia was not associated with age, gender, habit of taking breaks during computer use and duration of computer use in their study of computer operation in Gujarat, India.

Although the median total symptom scores were different between users of computer for <12 hours and users of computer for >12 hours, the difference was not statistically significance. Workers like Portello *et al*. (2012) who reported statistically significant association between total symptom score and the number of hours spent on computers advised that their findings be interpreted with caution. Participants in this study might have under- or over-estimated their symptoms. In addition, their tasks might have been a combination of computer and hard-copy assignment as majority of the respondents were civil servants, public servants and bankers.

The only significant association found in this study was that between median total symptom score and presence/absence of previous eye problems. Median total symptom score was higher among participants with previous eye problems (25.5) than those without previous eye problem (15.0). Major previous eye problems reported by participants in this study were refractive errors, conjunctivitis and glaucoma. Sheedy (2010)) advised that correction of visual problems of computer users with spectacles or contact lenses was important to avoid eye strain.

In conclusion, computer-related vision symptoms occur frequently among computer users in Osogbo, Nigeria. Most of the affected computer users were those engaged in profitable and crucial sectors of the economy whose productive activities could be hampered if careful and due attention were not given to resolve them. This could lead to reduce productivity and economic loss.

Even though no statistically significant association was found between computer-related visual symptoms and different variables which have been previously reported, it is pertinent to pay attention to the workstation arrangement and treatment of previously existing eye problems. These actions will prevent epidemic of computer related visual problems which could occur with increasing use of computers in our society.

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