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Effects of Computer use on Visual Acuity and Colour Vision Among Computer Workers in Zaria

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Abstract

The incidence and degree of visual defects among computer users were studied in 100 subjects (50 computer users and 50 non computer users). Visual acuity and colour vision tests were conducted using standard Snellen's chart and Ishihara chart respectively. The visual acuity of computer users showed a significant decrease ($P<0.05$) when compared to non computer users. The incidence of colour vision is higher among computer users than non computer users. It has also shown that there is a significant difference between subjects with visual defects that use computers and duration of exposure with ($P<0.01$) when compared to non computer users. Visual defects are correlated to duration of exposure to the use of computers and eye disease. The long use of computers may cause eye strain which lead to visual defects.

Keywords: Visual acuity, visual defects, computer users, eye strain, colour vision.

Introduction

In the twentieth Century, technology is at its peak in the world. This technology includes research, stock market sharers, computers, medical advances and a vast variety of other things: among the advanced technology is a breakthrough of (17, 19) computer use. Computers have taken the world and reshaped the possibilities of ideas and dreams in the past decade. This work on the computer can range from five minutes a day to eight hours a day depending on the type of job a person holds. Today's job

market, employees are accustomed to working with a computer. This could include data entry clerks, an internet consultant, a researcher, a teacher, a librarian, and especially secretaries (7).

The complex of eye and vision problems related to near work experienced during computer use has been termed "Computer Vision Syndrome". Eye strain is the leading problem in computer use (21). Eye strain is defined as blurred or double vision, irritation, headaches, eye fatigue, colour perception change, decrease visual efficiency, more frequent errors (10) and decrease efficiency (3, 7). Many computer operators have reported seeing colour changes while working. Visual discomfort and related symptom occurring in computer workers must be recognized as a growing health problem (16).

Computer users are generally encouraged; this is to keep up with the fast moving world of technology, research and science. Researchers have come to an agreement that this could actually be harmful, if not properly managed for future generation (6, 16). Accordingly, the aim of this investigation was to examine the incidence and degree of visual defects due to the use of computers among computer operators. We hypothesized that prolonged eye strain due to computer use may be associated with visual defects.

Materials and Methods

Materials: The following materials were used for the test; questionnaire, weighing scale, metre tape, Standard Ishihara chart and Snellen's letter chart.

Data collection: The study was compiled with the ethical committee guidelines of Ahmadu Bello University Teaching Hospital, Zaria and the procedures followed were in accord with the ethical standards of Ahmadu Bello University, Zaria, Nigeria. The data of 100 subjects (50 computer users and 50 non computer users) was collected using a questionnaire in Zaria, Kaduna state, Nigeria. The data collected from all the subjects with an age range of 20-45 years by random sampling are; age (years), weight (kg), height (m), body mass index (BMI), visual acuity, colour vision.

Climate of the research area; The research was carried out in Zaria with the following climatic conditions: mean annual rainfall 1000mm, mean annual temperature 27ºC, longitude and latitude 11º 3´ N, 7º 42´ E, height 670m above sea level and 664km away from the sea, with a dry and (14) wet season.

Statistical Analysis: All data are expressed as Mean ± S.E.M. The data obtained were analyzed using one way analysis of variance (ANOVA) and Turkey-Kramer *post hoc* test for multiple comparisons (4). The ($P<0.05$) will be accepted as significant.

Results

The results of visual acuity and colour vision among computer users were analyzed by comparing the mean ± SEM of non computer users and computer users, using one way analysis of variance as shown in table 1. The visual acuity values and duration of exposure showed a significant ($P<0.05$) statistical difference among computer users and non computer users.

Table 1: Mean ± S.E.M. of visual acuity and Anthropometric values in non computer users and computer users.

Parameters	Type	N	Mean
Age(years)	Non-Computer Users	50	23.32±0.60
	Computer Users	50	28.98±0.87^{NS}
Weight (kg)	Non-Computer Users	50	54.12±1.13
	Computer Users	50	64.62±1.38^{S}
Height (m)	Non-Computer Users	50	1.58±0.02
	Computer Users	50	1.69±0.01^{NS}
Body mass index (BMI)	Non-Computer Users	50	21.87±0.48
	Computer Users	50	22.42±0.39^{S}
Time / hour	Non-Computer Users	50	0.00±0.00
	Computer Users	50	10.60±0.75^{S}
Duration/ year	Non-Computer Users	50	0.00±0.00
	Computer Users	50	4.68±0.40^{S}
Visual acuity of right eye	Non-Computer Users	50	0.90±0.02
	Computer Users	50	0.62±0.03^{S}
Visual acuity of left eye	Non-Computer Users	50	0.90±0.02
	Computer Users	50	0.62±0.03^{S}
Eye Defect	Non-Computer Users	50	1.80±0.05
	Computer Users	50	1.24±0.06^{S}

NS = Not significant; S = Significant.

One hundred subjects comprising of 39% female and 61% male were randomly grouped into two groups (non computer users and computer user). The non-computer users have distribution 19 female subjects and 31 male subjects, while computer users have 20 female subjects and 30 male subjects. The mean ± standard error mean of visual acuity and anthropometric values in non computer users and computer users as shown in table 1.

Table 2: Distribution of the response in subjects among non-computer users and computer users.

Parameters	Response	NCU	%	CU	%	Total	%
History of eye disease	None	44	55	36	45	80	13.3
	Yes	6	30	14	70	20	3.4
History of eye defects	None	45	52.3	41	47.7	86	14.3
	Yes	5	37.3	9	64.7	14	2.3
Contact with eye service	None	47	59.5	32	40.5	79	13.2
	Yes	3	14.3	18	85.7	21	3.5
Subjects that use glasses	None	49	53.8	42	46.2	91	15.2
	Yes	1	11.1	8	88.9	9	1.5
Colour vision	Blind	2	25	6	75	8	1.4
	Normal	48	52.8	44	47.2	92	15.3
Computer vision syndrome	None	43	81.1	10	18.9	53	8.8
	Yes	7	14.9	40	85.1	47	7.8
Total		**300**	**50**	**300**	**50**	**600**	**100**

NCU = Non-computer users; CU = Computer users

The subjects in table 2 have the distribution of 80% with no history of eye disease while 20% have history of eye disease. Out of the 50 non-computer users, 44 subjects have no history of eye disease and 6 subjects with history of eye disease. The computer users, 36 subjects have no history of eye disease and 14 with history of eye disease. The history of eye defects also has a distribution of 86% subjects with no history of eye defects and 14% subjects with history of eye defects. In table 2 the 50 non-computer users, 44 subjects have no history of eye defects and 6 subjects with history of eye defects. In case of the 50 computer users, 36 subjects have no history of eye defects and 14 subjects

with history of eye defects. Distribution of subjects based on status of contact with eye service, 79% subjects have no contact with eye service and 21% have contact with eye service. In table 2, out of the 50 non-computer users, 47 subjects have no contact with eye service and 3 subjects have contacts with eye service. The computer users 32 subjects have no contact with eye service and 18 subjects have contacts with eye service. The distribution of subjects based on using glasses in table 2 also have, 91% subjects don't use glasses and 9% use glasses. Among the non-computer users, 49 subjects don't use glasses and only one subject use glass, while in case of the computer users 42 subjects don't use glasses and 8 of them use glasses. The distributions of subjects based on colour vision 92% of the total subjects are normal and 8% are colour blind in table 2. The non-computer users have 2 subjects are colour blind and 48 subjects are normal. The computer users have 6 subjects that are colour blind and 44 subjects are normal. In table 2 also have the distribution of subjects based on response to computer vision syndrome 53% of subject have no CVS and 47% have CVS. Out of the 50 non-computer users, 7 of subjects responded to computer vision syndrome and 43 subjects did not respond. The computer users have 40 subjects responded to computer vision syndrome and 10 did not respond.

Table 3: Visual acuity distribution of left (L) and right (R) eye of non computer users and computer users

Visual acuity	Eye	NCU	%	CU	%	Total	%
2/6	L	1	12.5	8	87.5	9	4.5
	R	1	11.1	7	88.9	8	4.0
3/6	L	3	13.6	19	86.4	22	11
	R	3	13.5	21	87.5	24	12
4/6	L	3	23.1	10	76.9	13	6.5
	R	4	28.6	10	71.4	14	7.0
5/6	L	10	66.7	5	33.3	15	7.5
	R	9	69.2	4	30.8	13	6.5
6/6	L	33	80.5	8	19.5	41	20.5
	R	33	80.5	8	19.5	41	20.5
Total	**L and R**	**100**	**50**	**100**	**50**	**200**	**100**

The distribution of visual acuity incidence of the two eyes of non-computer users and computer users in table 2, showed a significant ($P<0.05$) statistical difference. The visual acuity with abnormal values of 2/6, 3/6 and 4/6 showed a significant incidence among computer users than non computer users while the normal value 6/6 is higher in non computer users.

Table 4: Distribution of visual defects in non computer users and computer users

Parameters	NCU	%	CU	%	Total	%
Visual acuity	8	16	42	84	50	47.6
Colour vision	2	25	6	75	8	7.6
Computer vision syndrome	7	14.9	40	85.1	47	44.8
Total	**17**	**16**	**88**	**84**	**105**	**100**

The distribution of visual defects among non computer users and computer users are; a total of 50 subjects (47.6%) with visual acuity defects, 42 subjects are computer users and 8 subjects' non computer users. About 8 subjects (7.6%) are colour blind, 6 of subjects are computer users and 2 of the subjects are non computer users. 47 of the subjects have computer vision syndrome (44.8%), 40 subjects are computer users and only 7 of subjects are non computer users.

Discussion

The results of the present study reported that, visual acuity and colour vision among computer users decreased with a significant statistical value ($P<0.05$) when compared to non computer users. Out of

the fifty subjects that use computers, forty two have visual defects (84% of the computer users) whereas eight subjects (16% of computer users) do not have visual defects. It has shown that there is a significant difference ($P<0.05$) between subjects that use computers with visual defects and subjects that use computers without visual defects. People who spend more than two hours on a computer everyday will experience symptoms (3, 5) of Computer Vision Syndrome (CVS). The most common symptoms include headaches, focusing difficulties, burning eyes, tired eyes, general eyestrain, aching eyes, dry eyes, double vision, (21) blurred vision, light sensitivity, and neck and shoulder pain. CVS is caused by decreased blinking reflex while working long hours focusing on computer screens. The normal blink rate in human eyes is 16–20 per minute. Studies have shown that the blink rate decreases to as low as 6–8 blinks/minute for persons working on the computer screen (15). Intermittent light stimuli of low frequency give a flickering visual sensation. When the frequency of light stimuli increases gradually, light flashes fuse slowly to give a sense of continuous smooth stimulus (1). The minimal frequency at which intermittent light stimuli appear as one continuous stimulus is the “critical fusion frequency” (CFF). The CFF increases proportionately with the logarithm of luminance and speed of movement. The CFF in scotopic vision is 10stimuli/sec and in photopic vision is 60stimuli/sec. Fusion of image occurs because positive afterimage fills the gaps between the intermittent primary images and this gives the impression of continuous stimulation of the retina. Intermittent light stimuli cause strong activation of retinal nerve cells and cells in primary visual cortex (1, 10). Prolonged work at the computer monitor could cause the symptoms of computer vision syndrome and refractive error, since accommodation is an active process requiring muscular effort and can therefore be tiring. Indeed, the ciliary muscle is one of the most used muscles in the body. The degree to which the lens curvature can be increased is of course, limited and light rays from an object very near the individual like the case of computer users cannot be brought to a focus on the retina even with the greatest of effort (9). This may strain eyes especially the ciliary muscles which could affect the visual acuity.

Furthermore, out of forty two subjects that use computers and have visual defects, twenty nine subjects (58% of computer users) use computers between 2-5 years but with exposure of greater than 10 hours per day. Whereas all the thirteen subjects that use computers between 6–15 years have visual defects. Moreover, all the eight subjects that use computers with no visual defects use computers between 1-5 years whereas none of the subjects use computers over six years. It has shown that there is a significant difference between subjects with visual defects that use computers and duration of exposure, with ($P<0.01$).

Out of the one hundred sampled subjects, fourteen subjects have family history of eye defects, of which, all have visual defects. It has shown that there is a significant difference between subjects that have visual defects and family history of eye defects with ($P<0.05$) and also between subjects that use computers with eye defects and history of eye diseases, with ($P<0.05$). Eight subjects have colour blindness (protanopes or deuteranopes) deficiency whereas some subjects cannot identify some figures (monochromat). 9% of the sampled subjects were using glasses, whereas 79% were not in contact with the eye care services. With vision being our principal sensory contact (8, 11) with the environment, it is not surprising that uncorrected focusing can have significant influences, so much so that separate myopic and hypermetropic personalities (12) have been recognized. The nearest point to the eye at which an object can be brought into clear focus by accommodation is called the near point of vision. The near point recedes throughout life, slowly at first and then rapidly with advancing age, from approximately 9 cm at age 10 to approximately 83 cm at age 60. This recession is due principally to increasing hardness of the lens, with a resulting loss of accommodation due to the steady decrease in the degree to which the curvature of the lens can be increased (9, 10).

Most of the subjects with visual defects due to the use of computers complain of burning dry eyes, eyes becoming sore while at the computer, difficulty in colour perception and physical symptoms like neck and shoulder pain and overall body (8, 19) fatigue when at the computer are in consonance with the work (2, 3, 7) of other scholars. Visual defect is correlated to age, duration of exposure and

eye disease, while colour vision is correlated to age. From this study, it can be inferred that, the use of computers causes eye strain, which lead to visual defect. Visual defects are correlated to duration of exposure to the use of computers and eye disease. Untreated eye disorders expose computer users to higher risk of having visual defects with a substantial proportion.

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