**An investigation of the visual and systemic symptoms among computer users at the National Home Builders' Registration Council and British Petroleum in Johannesburg, Gauteng Province, South Africa.**

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Dissertation submitted in partial fulfillment of the requirement for Masters of Public Health Degree

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14 April 2014

## DECLARATION

I, Joyce Pheladi Mogane declare that the mini-dissertation hereby submitted to the University of Limpopo, Turfloop campus, for a degree of Master of Public Health (MPH) has not been previously submitted at this or any other university; and that it is my own work in design and execution.

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Date: 27/01/2014

## DEDICATION

This dissertation is dedicated to my late mother who always encouraged me in Northern Sotho "Kodumela moepa thutse, ga go lehumo le letswago kgauswi". To my two kids Mohau and Mosa who were an inspiration to me. A special dedication to Dr. Thabo Mothabeng, without his love and encouragement the completion of the study would have been impossible!

## ACKNOWLEDGEMENTS

I would like to convey my greatest gratitude to the following people:

My parents: My late loving mother Molokane Kgetsa Mogane and my father Michael Mogane for sacrificing all they could to make sure that I do not lack knowledge of education in my life.

My siblings: My sister Evelyn who always asked me about my graduation date, my three brothers Gordon, Jonathan and Samuel and my nephew Nkgateng for their support.

My grandfather: Rakgolo Kgethang Mogane for the financial support when I needed it the most to kick start my career.

My Supervisor, Prof Oduntan: Thank you very much Prof for believing in me, for your advices, encouragement and continuous support.

My co-supervisor, Mr Kekana: Thank you for your guidance, encouragement and the faith you had in me that I will make it.

Head of Public Health Department, Dr. Mpolokeng: Thank you for giving me the opportunity to further my studies.

Prof Amey: Thank you very much for assistance with data analysis.

Dolance, my classmate and friend, you were there with me throughout the course work.

Pastor Montle: Thank you sir, for making me realize that I cannot give up now.

The staff of NHBRC and BP: Thank you for taking time to participate in the study.

University of Limpopo (Turfloop campus): Thank you for allowing me to register and study for this degree.

Above all, Omnipotent Father, God Almighty that I serve: Thank you for making the impossible to be possible for me!!!

## ABSTRACT

### Topic

An investigation of the visual and systemic symptoms experienced by computer users at the National Home Builders' Registration Council (NHBRC) and British Petroleum (BP) in Johannesburg, Gauteng Province, South Africa.

### Background

The repetitive use of computers in the working places results in the visual and ergonomic disorders that affect the computer users adversely. The computer users experience fatigue which causes visual symptoms such as eyestrain, blurred vision, heaviness of the eyelids or forehead, dry eyes, sensitivity to light and irritated eyes. The ergonomic disorders like neck pain, backache and wrist pain are also experienced by computer users. These conditions are collectively called Computer Vision Syndrome which is considered as an occupational hazard. Uncorrected refractive errors and binocular anomalies can contribute to these symptoms. The visual and systemic symptoms that affect the computer users in the workplace need to be investigated.

### Purpose

The purpose of the study was to subjectively investigate the visual and systemic symptoms experienced by computer users in the two selected companies in Gauteng Province South Africa.

### Methodology

Structured questions, (open and close ended) were used to obtain information needed for this study. The questions covered demographic as well as information relating to the use of the computer such as the duration of working on computer, the offices/working

environment, the appearance and the distance of the screen to the eyes, the working station and visual devices *et cetera*.

## Results

Participants included 47 (72.3%) females and 17 (26.2%) males and their ages ranged from 20 to 59 years with the mean of 39.5 and the standard deviation of ± 13.1years. Many (80%) of the participants between the ages of 20 to 29 years reported experiencing eye strain. The highest (75%) percentage of slow refocus was reported by the participants that were between the ages of 30 to 39 years. Most males (58.8%) reported experiencing eye strain, slow refocus and headaches associated with computer use. The majority of the females (63.8%) reported experiencing eye strain, while (59.6%) experienced slow refocus and (51.1%) suffered from headaches. A higher percentage of males (23.5%) experienced wrist pain while lower (14.9%) of females experienced wrist pain. No males (0.0%) reported back pain and only a small (8.5%) of females reported back pain.

## Conclusion

Based on the above findings, it is concluded that visual and the systemic symptoms associated with the use of the computer affected most of the workers from the two companies. The factors that may lead to the various symptoms experienced may be ergonomic (environmental) or visual or a combination of these. The environmental factors can be the angle of gaze to the computer screen or the illumination of the working area, while visual factors could be uncorrected refractive error or binocular anomaly. Other factors may include age and working for prolonged time looking at the computer monitor. These factors may then leads to symptoms like eye strain, slow refocus, blurred vision, headaches, dry eyes and systemic symptoms such as neck pain.

## DEFINITION OF TERMS

**Asthenopia:** An eye condition that manifests itself through non-specific symptoms such as fatigue, red eyes, eye strain, and pain in or around the eyes, blurred vision, headache and occasional double vision. Symptoms often occur after reading, computer work, or other activities that involve tedious visual tasks; also referred to as weakness of sight (Kroemor *et.al*., 1994).

**Myopia:** Near-sightedness: a condition of the eye in which the rays from distant object are brought to a focus before they reach the retina, and hence form an indistinct image; while the rays from very near objects are normally converged so as to produce a distinct image (Kroemor*et.al,* 1994).

**Presbyopia:** An inability of the eyes to focus at different distances due to less flexibility of the crystalline lens inside the eye (Mian, 2011).

Photophobia: Painful intolerance and sensitivity of the eyes to light (Evans, 1995).

**Computer Vision Syndrome (CVS):** The collective word for the visual and ophthalmic disorders that is related mostly to fatigue; like eye strain and blurred vision (Natalio, 2008).

**Diplopia:** Simultaneous appreciation of two images of one objects (Kanski, 1999).

**Refractive error:** Common eye disorder in which the shape of the eye does not permit it to bend light rays properly and thus produces blurred image (Salmans, 1996).

**Ergonomics:** The study of working conditions especially design of equipment and furniture in order to help people work more efficiently. Hornby AS. Oxford Advanced Learners Dictionary, 7th" edition).

**Schimer test:** A measure for the secretion of the tears when testing for dry eyes (Saunders, 2007)

## LIST OF ABBREVIATIONS

SAOA: South African Optometric Association

AOA: American Optometric Association

CVS: Computer Vision Syndrome

PPE: Personal Protective Equipment

NHBRC: National Home Builders Registration Council

BP: British Petroleum

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# CHAPTER 1

## 1.1 Introduction

With the advent of computers in the work place, more people are exposed to the use of computers as part of their daily work. Vision and eye related problems are common among computer users, and have been collectively called the computer vision syndrome (CVS) (Izquierdo *et al.,* 2004), which is a visual and ergonomic disorder (Blehm *et al.,* 2005). The symptoms of CVS are mostly related to fatigue including eyestrain, blurred vision, irritated eyes, heaviness of the eyelids or forehead, dry eyes, sensitivity to light, temporary myopia (short sightedness) and colour vision change, backaches, headaches and muscle tension (Thompson, 1998 and Anshel, 2007). According to the (American Optometric Association, 2006) it is estimated that 50% to 90% of the workers who use computers have one or more symptoms of this syndrome. Computer requires an individual to sit in a particular position and stare at the Video Display Terminal (computer screen) for as long as one is working which may result in the following conditions: eye strain, heaviness of the eyelids or forehead, blurred distance and/or near vision, sensation of diplopia, sensitivity to light, dry eyes and irritated eyes, headache, backache, muscle tension and wrist pain (Barar *et* a/., 2007).

According to Anshel (2007), the relationship among comfort, health and productivity of work needs to be understood in order to know the options for a better ergonomic work place. Blehm (2005) has reported that the major symptom that is experienced by computer users by far is dry eyes. It has been shown that reduced blinking rates due to staring at the computer screen causes dry eyes. According to Sheedy (1992), when people converse they blink on average 22 times per minute. When reading, blinking occurs 10 times per minute but when working on a computer it occurs only 7 times per minute. When we read we normally look down but when looking at the computer we stare straight ahead and as such eyes are wide open and therefore get dryer.

Prolonged use of computers induces poor eyesight as the eyes are locked in one position (Sheedy, 1992). It has been reported that 1 out of 6 patients

requiring eye examinations have a computer-related eye problem. The business of eye examinations and glasses for computer users is estimated at 2 billion dollar industry although not all the costs are directly related to the symptoms that are experienced by the computer users (Natalio *et al.,* 2008).

The purpose of the study was to investigate the visual and systemic symptoms among the computer users in the two selected companies in Gauteng Province South Africa. The results of the study will of educate the workers on the effects of using computers for a long time on an individual's health and work productivity.

### 1.2 Problem statement

According to the United States Bureau of Labour Statistics, computers are used by 100 million people at their jobs daily in the United States (cited by Natalio *et al.,* 2008). Most of the computer users suffer from fatigue which is a result of the workers who are not taking enough breaks while using computer. At times the office window is in front or behind the computer, and the situation is worsened by the fact that such an individual is working under pressure due to deadlines that must be met. Poor lighting in the working area that can either be too dark or too bright induces eye strain (Barar *et al.,* 2007).

### 1.3 Research question

The visual and systemic symptoms that are experienced by the computer users among various groups of workers in South Africa are unknown. The research question in this study therefore was: What are the visual and the systemic symptoms of the computer users among employees at National Home Builders Registration Council (NHBRC) and British Petroleum (BP) in Johannesburg, Gauteng Province in South Africa.

## 1.4 Aim

The aim of the study was to investigate the visual and systemic symptoms among the computer users in the two selected companies in Gauteng Province South Africa.

## 1.5 Objectives

The following are the objectives of the study:

- To establish the number and percentage of workers who experience the visual and systemic symptoms after working on the computer from the two selected companies.

- To investigate personal, environmental, ergonomic and physiologic factors that might contribute to the symptoms.

## 1.6 Significance of this study

No record of previous study could be found in the literature on how the workers are affected by computers in their work places in South Africa. This study will provide useful information about the ergonomic state of the working areas from the two selected companies in South Africa. Employers and workers will be educated about the better use of computers in the work place and the interventions that can be applied to reduce the effects of using computers for a long period.

# CHAPTER 2

# 2. LITERATURE REVIEW

## 2.1 Introduction

Previous studies have shown that the general complaints by computer users were related to the environmental conditions like placement of the Video Display terminal, desk and chair in the work area (Walter and Herbert, 1996).

## 2.2 Duration of working at the computer

A study conducted in Nagasaki, Japan, suggested that there is a relationship between the work duration and physical symptoms to the mental health of 2,327 workers who worked on video display terminal (VDT) for more than two hours continuously (Ye Z *et al.,* 2007). Using a 12 item questionnaire, the participants were asked about their ages, sex, hours of VDT daily use, rest and breaks during VDT work, eyestrain and musculoskeletal pain. The analysis showed that the subjects who were less than 40 years and not taking breaks while working showed poor mental health which was associated with the presence of eyestrain and musculoskeletal pain.

According to Taino *et al.,* (2006), asthenopia, commonly called eyestrain is one of the most common symptoms of exposure to VDT work. It results from prolonged, fixed and closely oriented vision. A population of 191 VDT workers who used it for more than 20 hours each week was evaluated using standardized questionnaire. A result of ophthalmologic medical examination for the participants was taken into consideration. The findings revealed that the intensity of eyestrain was related to the duration of weekly VDT use as opposed to the number of years that an individual was working at the same company. The results also showed that the prevalence of asthenopia was not significantly affected by the refractive errors, even though such an outcome was unexpected. However, given the information that it was few workers who were hyperopic (long sightedness) from the ophthalmologic report, it was therefore understandable, as hyperopia increases asthenopia.

## 2.3 The angle of gaze

Izquierdo *et al.,* (2004) reported that computer vision syndrome is caused among other factors by the angle of gaze to the computer monitor. Twenty eight (28) participants who used computers answered a validated questionnaire that evaluated their personal, environmental, ergonomic factors and physiological response to computer use. The following were measured. The distance from the eye to the computer monitors (A), the computer's monitor height (B), the visual axis height(C). The difference between B and C was also measured and labeled as (D). Angle of gaze to the computer monitor was calculated using the formula: angle = tan (-1) (D/A).The angle of gaze was divided between the two groups, 0 to 13.9 degrees for group 1 and 14 degrees and greater for group 2. The analysis showed that all the groups depended a lot on eye drops with group 2 experiencing less pain by gazing downwards at angles 14 degrees and more.

## 2.4 Knowledge of the symptoms of computer vision syndrome

In a study that was conducted in Tilaknagar Delhi, India, a random survey of Knowledge, Attitudes and Practices (KAP) was applied on 300 Indian ophthalmologists using a 34 point spot-questionnaire. The findings suggested that many ophthalmologists are aware about computer vision syndrome and its diagnostic signs and symptoms. However, there was confusion about the treatment modalities thereof. Half of the ophthalmologists (50.7%) were not prescribing any spectacles. They did not have any preference for whatever type of spectacles. Most of the computer users were likely to have sedatives prescribed for them than the non-computer users. The main mode of treatment was tear substitutes in the form of eye drops (Bali *et al.,* 2007).

## 2.5 The use of eye drops to relief the symptoms of computer vision syndrome

A number of people in Florida, USA, are seeking medical attention for the symptoms that results from the repetitive use of computers. One of the most common and frequently used relieves measures that the video display terminal users are using is eye drops (Skilling *et al.,* 2005).

In a study conducted in Florida, Skilling *et al.,* (2005) wanted to investigate the efficacy and adverse effects of the two eye drops Optizen (Innozen, Inc., polysorbate 80 0, 5%) and Visine Original (Pfizer Consumer healthcare, tetrahydrozoline HCL 0.05%). A double-blind parallel method was used with 50 healthy men and female between the ages of 18 to 65years who had symptoms of CVS. The results indicated that both eye drops were effective and had similar efficacy in alleviating the symptoms of the discomfort after five days. The adverse effects findings showed that Visine Original caused more discomfort on instillation.

In India, New Delhi; herbal eye drops were considered to relieve the symptoms that resulted from the long use of computers. 'Itone' herbal eye drops, artificial tears and placebo drops were given to 120 patients with symptoms that resulted from the use of computers. All the patients were instructed to instill two drops of itone drops, placebo or artificial tears four times for six weeks. In patients that experienced eye strain, the herbal eye drops was found to be more effective even better than the artificial tears with no side effects (Biswas *et al.,* 2003).

### 2.6 The use of prescription glasses when working at the computer

Kent (2008) has shown that increasing number of workers who wear spectacles require an extra pair of glasses in order to deal with the symptoms that resulted from the use of computers. Even workers who do not have visual defects are compelled to do eye test and have a pair of glasses just for computer work. Also in a recent press report, the importance of long term use of glasses was highlighted.

The American Optometric Association (AOA) recently advised that Americans who use computers daily at work or at home could suffer from computer vision syndrome, which leaves them vulnerable to problems like dry eye, eyestrain, neck and/or backache, light sensitivity and fatigue. These symptoms can result from individual visual problems, poor work station configuration and improper work habits (Kent, 2008).

Productivity at work can be increased by the use of the correct pair of computer glasses which mainly improve an intermediate vision that is between the eye and computer monitor that is positioned between 20 to 26 inches (Anshel, 2007).

## 2.7 Ergonomic factors

Ergonomics must be designed to improve people's working condition and help them work more efficiently e.g. controlling the temperature and lightings in the working area. The factors of ergonomics include computer furniture set up, positioning of the computer screen, keyboard and the hard copy (Senand Richardson, 2007).

## 2.8 Conclusion

The key to comfort is flexibility; everything in the work area must be adjusted (Walter and Herbert, 1996).

# CHAPTER 3

# 3. RESEARCH METHODOLOGY

## 3.1 Introduction

The study was pre- tested by a pilot study to check whether the questionnaire could be understood by the participants. A pilot study also helps in confirming the validity and reliability of the study (Saunders, 2000). The results of the pilot study were not included in this study.

## 3.2 Research design

This study was a cross-sectional research. A quantitative method was used to investigate the symptoms experienced by computer users in the two selected companies in Gauteng Province of South Africa. The main reason for opting for the companies that are in Gauteng was for easy access to the researcher.

## 3.3 Study site and population

Five companies in Gauteng were approached by the researcher for the purpose of conducting the study. Two of the companies responded positively concerning the proposed study. The study was therefore, conducted at the two companies that responded: The National Home Builders Registration Council (NHBRC) and British Petroleum (BP) which are in Brynston and Parktown respectively in Gauteng Province, about 60km West of Pretoria. There are 365 workers at NHBRC and 300 workers at BP. The targeted population for the study was all the staff members who used computers daily as part of their work.

## 3.4 Sampling method and study sample

Convenience sampling was used for this study as the sample size was derived from the subjects that are most conveniently available (Lunsford, 1995). Even though there were more than 300 workers in the two companies, access to employees was

restricted to 55 at BP and 60 at NHBRC due to restructuring exercises taking place in the companies.

### 3.5 Data collection

The instrument used for data collection was structured questionnaires and the questions were structured to elicit symptoms that were experienced by the computer workers and their ergonomics were established. Out of the 55 and 60 questionnaires that were distributed at BP and NHBRC, 22 and 44 were received, indicating response rates of (40.0%) and (73.3 %) respectively.

### 3.6 Data analysis

Data was analyzed using the Statistical Package for Social Sciences (SPSS) software Version 15. Descriptive statistics and correlation statistics were done. The analyses gave the prevalence, significance of variables and comparisons. These analyses were done with the assistance of a statistician.

### 3.7 Reliability

Data was collected using a questionnaire that was carefully structured to address the factors that resulted in the visual and systemic symptoms of computer vision syndrome. A pilot study was conducted in order to verify the level of understanding of the participants to the questionnaire.

### 3.8 Validity

The analysis of the collected data was done by a statistician using the Statistical Packages for Social Sciences. The response rate of the participants from the two companies was 40% (BP) and 73% (NHRBC). According to Morgan and Krejcie (1994), the sample size was reasonably accepted.

### 3.9 Ethical considerations

3.9.1 Approval was obtained from:

- The Research Committee of the School of Health Care Sciences at University of Limpopo.
- The University of Limpopo ethics committee.
- Management from BP and NHBRC

3.9.2 Participants were informed about the aims and the purpose of the study and that their participation was voluntary and as such had the right to withdraw from participation.

3.9.3 Participants were requested to sign the consent form.

### 3.10 Benefit of the study.

The two companies will be given the results of the study with recommendations so that they may improve their ergonomics if need be.

### 3.11 Conclusion

The outcome of the study was to investigate the visual and systemic symptoms experienced by the computer users.

# CHAPTER 4

## 4. RESULTS

### Section A

### 4.1 Introduction

The results are presented in three parts: The first part is the demography of the participants, the second part is the ergonomics and the last part is the responses of the participants towards the factors that are associated with computer vision syndrome.

### 4.2 Demographics

#### 4.2.1 Age

A total of 65 workers participated in the study. One participant did not indicate the age. The ages of the participants ranged from 20 to 59 years with a mean of 39.5 and standard deviation of ±13.1 years. Age group for 20 to 29 years was 20 (30.8%), 30 to 39 years was 28(43.1%) and 40 years and older was 16(24, 6%).

#### 4.2.2 Gender

The total number of participants was 65. The majority of the participants were females 47 (72.3%) as opposed to the male counter parts that were 17 (26.2%). One individual did not specify gender.

#### 4.2.3 Occupation

The occupations of the participants was divided into five categories, namely; those who do general work like security personnel were 7(10, 8%), 22(33.8%) were doing administration work,
11 (16, 9%) were the human resource staff, 14(21, 5%) were professionals like

engineers and 10(15.4%) management like supervisors. One participant did not indicate his or her occupation.

### 4.2.4 Symptoms for different age groups

#### 4.2.4.1 Visual symptoms for different age groups

Most of the participants (80.0%) between the ages of 20 to 29 years suffered from eye strain. Dry, irritated eyes and headaches, were symptoms affecting a small number of participants in this age group. The other age groups demonstrated varied eye strain symptom as shown in the graph. The highest (56.3%) age group that suffered from headache was participants that were 40 years and older while the lowest (46.4%) were between the ages of 30 to 39 years.

**Table 1: Showing the visual symptoms reported by the participants and the percentages of the different age groups.**

| Visual Symptoms | Age groups / Percentages of symptoms | | | |
|---|---|---|---|---|
| | 20- 29 (N=20) | 30 - 39 (N=26) | >40 (N=18) | Total (N= 64) |
| Slow refocus | 55.0 | 75.0 | 37.5 | 59.4 |
| Blurred near Vision | 10.0 | 7.1 | 12.5 | 9.40 |
| Blurred distance vision | 15.0 | 21.4 | 0.0 | 14.1 |
| Double vision | 40.0 | 39.3 | 31.3 | 37.5 |
| Colour Distortion | 20.0 | 0.0 | 6.3 | 7.8 |
| Light sensitivity | 45.0 | 39.3 | 25.0 | 37.5 |
| After images | 35.0 | 14.3 | 18.8 | 21.9 |

#### 4.2.4.2 Systemic symptoms for different age groups

Neck pain was reported the highest (45.0%) from the age group of 20 – 29 years followed by the age group of 40 and above (43.8%). Very few participants (3.6%) suffered from backache while more (12.5%) from the age group of 40 and above suffered from backache (see Table 2).

**Table 2: Showing the systemic symptoms reported by the participants and the percentages of the different age groups.**

| Systemic symptoms | Age groups (years)/ Percentages (%) of symptoms | | | |
|---|---|---|---|---|
| | 20 - 29 (N=20) | 30 - 39 (N=26) | >40 (N = 18) | Total (N = 64) |
| Neck pain | 45.0 | 32.1 | 43.8 | 39.1 |
| Shoulder pain | 15.0 | 7.1 | 12.5 | 10.1 |
| Wrist pain | 30.0 | 10.7 | 12.5 | 17.2 |
| Backache | 5.0 | 3.6 | 12.5 | 6.3 |

### 4.2.5 Symptoms reported by different gender

#### 4.2.5.1 Visual symptoms for different gender

Both sexes shared an average of 59% as far as slow refocusing. There were no males that reported any blurred distance or near vision. Females however, reported a 12.8%of blurred near vision and 19.1% of blurred distance vision (See Table 3).Eye strain was the symptom affecting majority of individuals in both sexes with only slight difference favoring females, 63.80% versus 58.80% in males.

**Table 3: Showing the visual symptoms reported by the participants and the percentages of the different genders.**

| Visual symptoms | Gender/percentages(%) of the symptoms | | |
|---|---|---|---|
| | Male (N=17) | Female (N=47) | Total (N=64) |
| Slow refocus | 58.8 | 59.6 | 59.4 |
| Blurred near vision | 0.0 | 12.8 | 9.4 |
| Blurred distance vision | 0.0 | 19.1 | 14.1 |
| Double vision | 29.4 | 42.6 | 39.1 |
| Colour distortion | 0.0 | 10.6 | 7.8 |
| Light sensitivity | 29.4 | 40.4 | 37.5 |
| After images | 17.6 | 25.5 | 23.4 |

### 4.2.5.2 Systemic symptoms reported by different gender

Neck pain affected most of the participants (40.6%), almost similar split between the sexes. The other systemic symptoms ranged between 6.3% and 17.2% for both males and females (See Table 4).

**Table 4: Showing the systemic symptoms reported by the participants and the percentages of the different genders.**

| Systemic symptoms | Gender/Percentages (%) of symptoms | | |
|---|---|---|---|
| | Male (N=17) | Female (N=47) | Total (N=64) |
| Neck pain | 41.2 | 40.4 | 40.6 |
| Shoulder pain | 11.8 | 10.6 | 10.9 |
| Wrist pain | 23.5 | 14.9 | 17.2 |
| Backache | 0.0 | 8.5 | 6.3 |

### 4.2.6 Symptoms for different occupation

#### 4.2.6.1 Visual symptoms for different occupations

The highest number of workers (77%) who suffered from slow refocusing was the administrators while the lowest (42.9%) were professionals and those who do general work (See Table 5).Eye strain was the highest symptom that was reported by the workers who do human resource (72.7%) while slow refocus is shown highest to workers who do administrative work (77.3%). Most of the professionals (71.4%) suffered from headaches. About half of the participants (51.6%) reported headaches. They included general staff (42.9%), Admin (54.5%) and managers (40%).

**Table 5: Showing visual symptoms reported by the participants and the percentages of occupational categories.**

| Visual symptoms | Occupational categories/ Percentages(%) of symptoms | | | | | |
|---|---|---|---|---|---|---|
| | General (N=7) | Admin (N = 22) | Human Resource (N = 11) | Professional (N = 14) | Management (N = 10) | Total (N = 64) |
| Double vision | 42.9 | 36.4 | 36.4 | 35.7 | 40.0 | 37.5 |
| Slow refocus | 42.9 | 77.3 | 63.6 | 42.9 | 50.0 | 59.4 |
| Blurred near vision | 14.3 | 4.5 | 0.0 | 14.3 | 20.0 | 9.4 |
| Blurred distance vision | 14.3 | 13.6 | 0.0 | 21.4 | 20.0 | 14.1 |
| After images | 28.6 | 18.2 | 9.1 | 35.7 | 20.0 | 21.9 |
| Colour distortion | 14.3 | 13.6 | 0.0 | 21.4 | 20.0 | 14.1 |
| Light sensitivity | 28.6 | 18.2 | 9.1 | 35.7 | 20.0 | 21.9 |

### 4.2.6.2 Systemic symptoms reported for different occupational categories

All the participants in the different categories suffered from neck pain which ranged from 30% for managers to 57% of the workers that do general work. Wrist pain was reported at the same percent (42.9) by general workers and the professionals. A low percentage of workers experienced backache ranging from 0% for general workers, human resource and professionals to 13.6% for the administrators. Shoulder pain was highest for the professionals at 28% (See Table 6).

**Table 6: Showing the systemic symptoms reported by the participants and the percentages of the occupational categories.**

| Systemic symptoms | Occupational categories/Percentages (%) of symptoms | | | | | |
|---|---|---|---|---|---|---|
| | General (N=7) | Admin (N = 22) | Human Resource (N = 11) | Professional (N = 14) | Management (N = 10) | Total (N = 64) |
| Wrist pain | 42.9 | 4.5 | 9.1 | 42.9 | 0.0 | 17.2 |
| Backache | 0.0 | 13.6 | 0.0 | 0.0 | 10.0 | 6.3 |
| Neck pain | 57.1 | 31.8 | 36.4 | 50.0 | 30.0 | 39.1 |
| Shoulder pain | 14.3 | 4.5 | 0.0 | 28.6 | 10.0 | 10.9 |

## SECTION B

### 4.3 The period spent using computers daily

### 4.3.1 Symptoms for years of using computer

#### 4.3.1.1 Visual symptoms reported for the number of years listed

Most of the workers who used computers for a period of 5 to 10 years reported a very high (65.0%) of light sensitivity. The workers who used computers for more than 10 years reported the highest percentage (66.7%) of slow refocusing (See Table 7).From the 20 participants who worked 5 to 10 years with computers, 60% suffered from eye strain while 65 % suffered from headaches. No worker who worked for less than 5 years suffered from dry and irritated eyes and only a few (15.8%) of those reported heaviness of the forehead (See Figure 1).

**Table 7: Showing reported visual symptoms and the percentages of the subjects who have been using computers for the years listed.**

| Visual symptoms | Numbers of years / Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | < 5 (N = 19) | 5-10 (N = 20) | >10 (N= 24) | Total (N= 63) |
| Blurred near vision | 10.5 | 15.0 | 4.2 | 9.5 |
| Blurred distance vision | 10.5 | 15.0 | 16.7 | 14.3 |
| Slow refocus | 52.6 | 60.0 | 66.7 | 60.3 |
| Double vision | 31.6 | 45.0 | 37.5 | 38.1 |
| Colour distortion | 10.5 | 10.0 | 4.2 | 7.9 |
| After images | 21.1 | 30.0 | 20.8 | 23.8 |
| Light sensitivity | 26.3 | 65.0 | 25.0 | 38.1 |

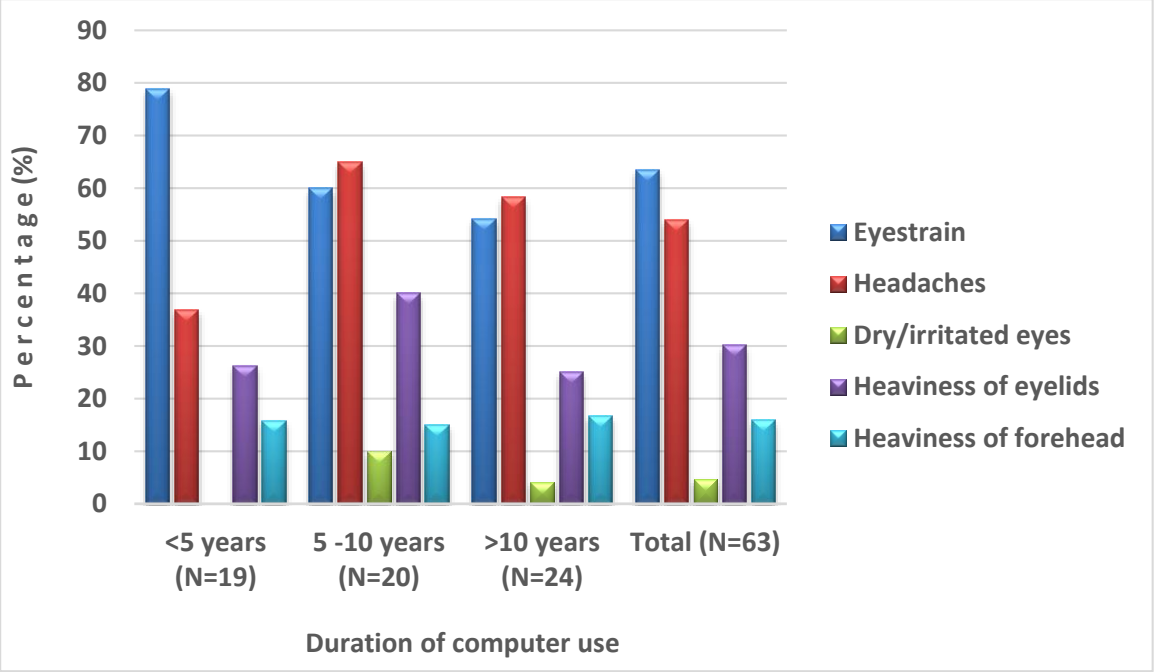


**Figure 1: A bar graph showing the visual symptoms and the percentages of the subjects who have been using computers for the years listed.**

**4.3.1.2 Systemic symptoms reported by the participants for the years listed**.

The subjects that worked for more than 10 years showed the highest (50%) percentage of neck pain and those who worked only for less than 5 years showed the lowest percentage (21.1%) of neck pain (See Table 8).

**Table 8: Showing the reported systemic symptoms and the percentages of subjects who have been using computers for the years listed.**

| Systemic symptoms | Numbers of years /Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | <5 (N= 19) | 5-10 (N = 20) | >10 (N =24) | Total (N= 63) |
| Shoulder pain | 15.8 | 20.0 | 0.0 | 11.1 |
| Wrist pain | 5.3 | 30.0 | 16.7 | 17.5 |
| Backache | 10.5 | 5.0 | 4.2 | 6.3 |
| Neck pain | 21.1 | 45.0 | 50.0 | 39.7 |

### 4.3.2 Symptoms for hours of using computers per day

#### 4.3.2.1 Visual symptoms for hours of using computers per day

The participants who used computers for only up to 4 hours reported a lower (37.5%) of double vision and slow refocus as compared to those who used it for up to 8 hours which was 41.9% and 62.8% respectively. Those who used the computer for 9 to 12 hours even showed the highest percentage (64.3%), (See Table 9).The longer the hours, the more headaches increased for the participants.

Those who used computers up to four hours 4 yours reported 25% of headache while participants who used it for 5to 8 hours reported 55.8% and those who used it for 9 to 12 hours reported 57.1% (See Figure 2).

**Table 9: Showing the visual symptoms reported by the participants and the percentages of the hours of working with computers per day.**

| Visual symptoms | Hours/ Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | up to 4 (N = 8) | 5 – 8 (N =43) | 9-12 (N= 14) | Total (N= 63) |
| Double vision | 37.5 | 41.9 | 28.6 | 38.5 |
| Slow refocus | 37.5 | 62.8 | 64.3 | 60.0 |
| Blurred distance vision | 12.5 | 14.0 | 14.3 | 13.8 |
| Blurred near vision | 37.5 | 7.0 | 0.0 | 9.2 |
| Colour distortion | 25.0 | 7.0 | 0.0 | 7.7 |
| Light sensitivity | 50.0 | 32.6 | 42.9 | 36.9 |
| After images | 37.5 | 16.3 | 35.7 | 23.1 |

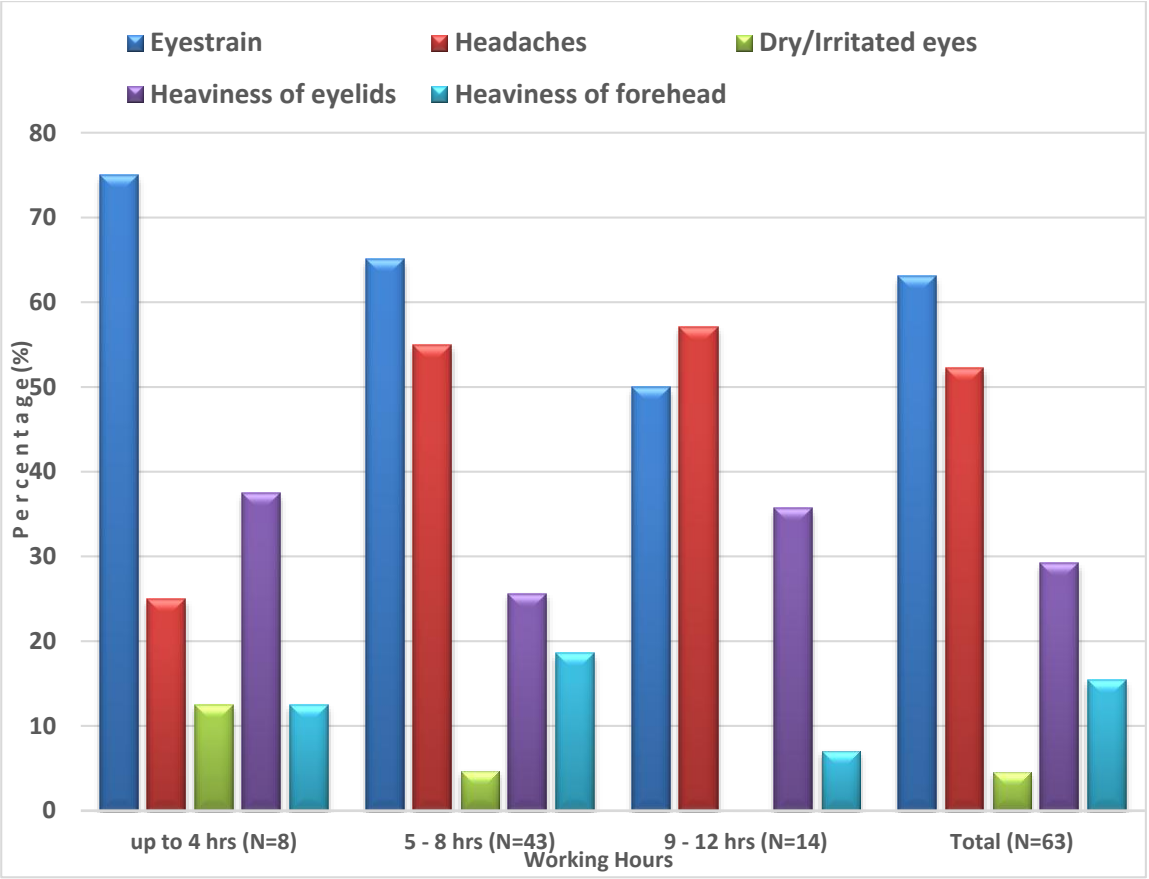


**Figure 2: A bar graph showing the visual symptoms reported by the participants and the percentages of the hours of working with computers per day.**

### 4.3.2.2 Systemic symptoms reported for the hours for working with computers

The systemic symptom that affected the majority of the participants was neck pain. The percentage thereof increased as the number of hours that one was using computer increased. Up to 4 hours the subjects reported 25.0% of neck pain, for 5 to 8 hours 37.2% was reported and 9 to 12 hours, 57.1% was reported (See Table 10).

**Table 10: Showing the systemic symptoms reported by the participants and the percentages of the hours of working with computers per day.**

| Systemic symptoms | Hours/ Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | up to 4(N = 8) | 5 – 8(N =43) | 9-12(N =14) | Total(N =63) |
| Neck pain | 25.0 | 37.2 | 57.1 | 40.0 |
| Shoulder pain | 12.5 | 11.6 | 7.1 | 10.8 |
| Wrist pain | 12.5 | 18.6 | 14.3 | 16.9 |
| Backache | 12.5 | 7.0 | 0.0 | 6.2 |

## SECTION C

### 4.4 THE WORKING/OFFICE ENVIRONMENT

#### 4.4.1 Symptoms for frequency of cleaning computer

#### 4.4.1.1Visual symptoms reported for the frequency of cleaning the computer

The highest symptom that was reported by the participants on their frequency of cleaning the computer was slow refocus at an average of 60% and the lowest symptom is colour distortion which has an average of 7.7%(See Table11).From the total of 65 subjects, (21.5%) of the participants reported that they never clean their computer screens. (16.9%) reported that they only clean their computers monthly.

Only (18.5%) of the participants were cleaning the computers weekly and (24.6%) daily. The highest symptom that was reported was eyestrain (63.1%) and the lowest was dry/irritated eyes (4.6%), (See Figure 3).

**Table 11: Showing the visual symptoms reported by the participants and the percentages of the frequency of cleaning of the computer screen.**

| Visual symptoms | Frequency /Percentages(%) of symptoms | | | | | |
|---|---|---|---|---|---|---|
| | Never (N= 14) | Occasionally (N = 12) | Monthly N= 11) | Weekly (N= 12) | Daily (N= 16) | Total (N= 65) |
| Slow refocus | 42.9 | 58.3 | 63.6 | 66.7 | 68.8 | 60.0 |
| Blurred near vision | 7.1 | 25.0 | 9.1 | 8.3 | 0.0 | 9.2 |
| Blurred distance vision | 14.3 | 33.3 | 9.1 | 16.7 | 0.0 | 13.8 |
| Double vision | 35.7 | 50.0 | 45.5 | 41.7 | 25.0 | 38.5 |
| Colour distortion | 14.3 | 8.3 | 9.1 | 0.0 | 6.3 | 7.7 |
| Light sensitiivity | 28.6 | 66.7 | 36.4 | 41.7 | 18.8 | 36.9 |
| After images | 28.6 | 25.0 | 27.3 | 25.0 | 12.5 | 23.1 |

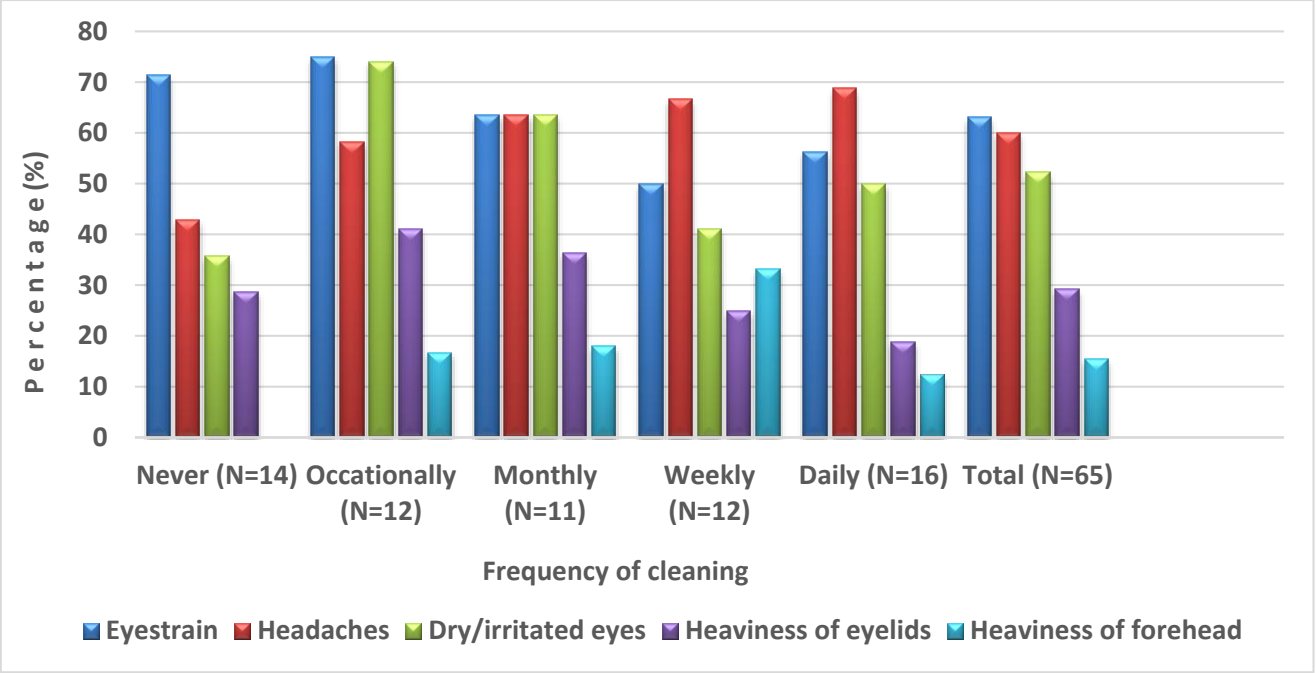


**Figure 3: Showing the visual symptoms reported by the participants and the percentages of the frequency of cleaning of the computer screen.**

#### 4.4.1.2 Systemic symptoms reported for the frequency of cleaning computers

Neck pain appeared to be affecting a significant number of participants from those who reported to be cleaning their computers daily (31%) to those who clean it occasionally (50%). Wrist pain was reported highest (45%) by those who indicated to be cleaning their screen monthly (See Table 12).

**Table 12: Showing the systemic symptoms reported by the participants and the percentages of the frequency of cleaning the computer screen.**

| Systemic symptoms | Frequency / Percentages(%) of symptoms | | | | | |
|---|---|---|---|---|---|---|
| | Never (N=4) | Occasionally (N=12) | Monthly (N= 11) | Weekly (N = 12) | Daily (N=16) | Total (N=65) |
| Neck pain | 35.7 | 50.0 | 45.5 | 41.7 | 31.3 | 40.0 |
| Shoulder pain | 0.0 | 8.3 | 18.2 | 25.0 | 6.3 | 10.8 |
| Wrist pain | 7.1 | 25.0 | 45.5 | 0.0 | 12.5 | 16.9 |
| Backache | 0.0 | 0.0 | 0.0 | 16.7 | 12.5 | 6.2 |

### 4.4.2 The type of light used in the work area

#### 4.4.2.1 Visual systems reported for the type of lights used

The majority (78.1%) of the participants were those who used fluorescent overhead only while very few (0.05%) used incandescent overhead only. Out of those who used fluorescent light only, the highest (58.1%) symptom that was reported was slow refocus and the lowest (9.3%) symptom was blurred near vision. 10 participants did not indicate type of light used in the work place and therefore the effective sample size is reduced to 55(See Table 13).Eyestrain was reported the highest with an average of (63.6%). When the participants were using incandescent lights eyestrain was the highest (100.0%) and lowest (58.1%) when the participants used fluorescent lights only. Headaches were reported the highest (77.8%) when the participants were using fluorescent and incandescent overhead (See Figure 4).

**Table 13: Showing the visual symptoms reported by the participants and the percentages for the type of lights that were used in the work area.**

| Visual symptoms | Type of lights / Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | Fluorescent overhead only (N =43) | Incandescent overhead only (N = 3) | Fluorescent & incandescent overhead (N - 9) | Total (N = 55) |
| Slow refocus | 58.1 | 100.0 | 33.3 | 56.4 |
| Blurred near vision | 9.3 | 0.0 | 0.0 | 7.0 |
| Blurred distance vision | 18.6 | 0.0 | 0.0 | 14.5 |
| Double vision | 30.2 | 66.7 | 55.6 | 36.4 |
| Colour distortion | 11.6 | 0.0 | 0.0 | 9.1 |
| Light sensitivity | 39.5 | 33.3 | 66.7 | 43.6 |
| After images | 20.9 | 33.3 | 22.2 | 21.8 |

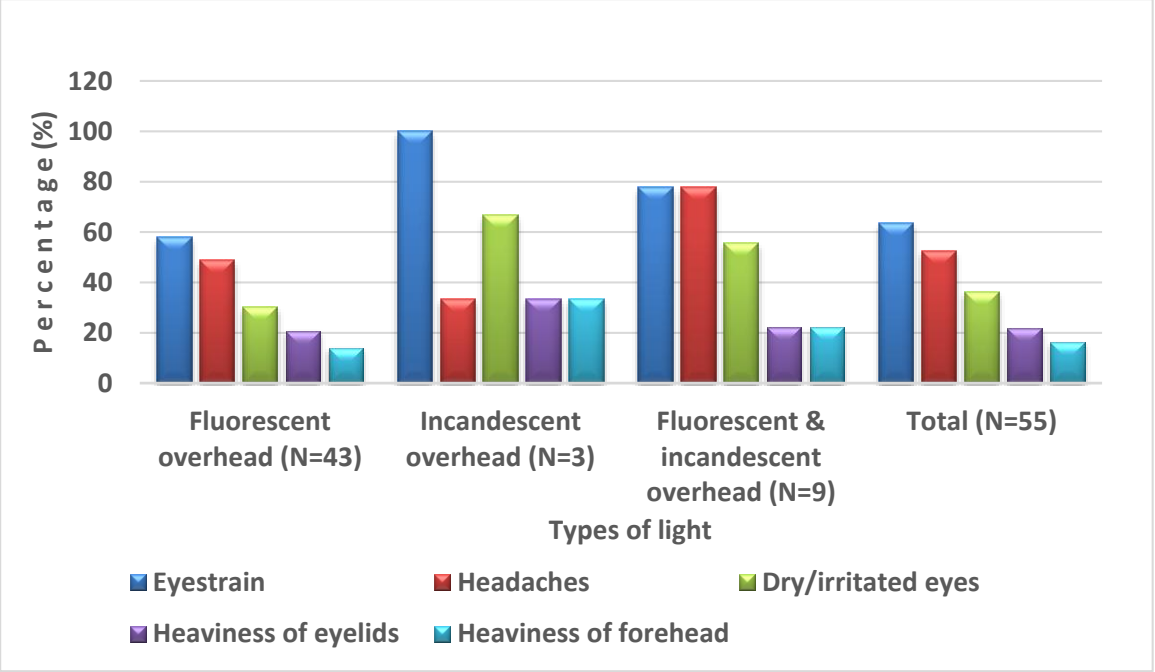


**Figure 4: Showing the visual symptoms reported by the participants and the percentages for the type of lights that were used in the work area**

### 4.4.2.2 Systemic symptoms reported for the type of lights used

All the subjects that reported to be using incandescent overhead only did not suffer from any of the systemic symptoms. Those who used both type of lights reported the highest (55.6%) percentage of neck pain and no backache was reported (0.0 %.)
(See table 14).

**Table 14: Showing the systemic symptoms reported by the participants and the type of lights that were used in the work area.**

| Systemic symptoms | Type of lights / Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | Fluorescent overhead only (N=43) | Incandescent overhead only (N = 3) | Fluorescent & incandescent overheads (N = 9) | Total(N=55) |
| Neck pain | 39.5 | 0.0 | 55.6 | 40.0 |
| Shoulder pain | 9.3 | 0.0 | 22.2 | 10.9 |
| Wrist pain | 18.6 | 0.0 | 33.3 | 20.0 |
| Backache | 7.0 | 0.0 | 0.0 | 5.5 |

### 4.4.3 Position of window light in relation to the screen

#### 4.4.3.1 Visual systems reported for the position of window light

Slow refocus was reported very high with an average of (72.0%) when the position of light was behind and in front of the screen and lower (41.4%) when the light was to the side of the screen. A significant (75.0%) of double vision symptom was reported as a result of light coming in front of the window and lower (27.6%) when light was reflecting to the side of the screen (See Table 15).Headache was reported the highest (75.0%) when the position of light was coming in front of the screen and lowest (44.8%) when it was coming to the side of the computer screen. Heaviness of the eyelids remained almost the same, about (27.0%) at all the three directions of light to the computer screen (See Figure 5).

**Table 15: Showing the visual symptoms reported by the participants and the percentages of the position of the window light in relation to computer screen.**

| Visual symptoms | Position of light /Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | Front (N= 8) | Behind (N= 25) | Side (N= 29) | Total (N= 62) |
| Slow refocus | 75.0 | 72.0 | 41.4 | 58.1 |
| Blurred near vision | 0.0 | 8.0 | 13.8 | 9.7 |
| Blurred distance vision | 12.5 | 20.0 | 10.3 | 14.5 |
| Double vision | 75.0 | 40.0 | 27.6 | 38.7 |
| Colour distortion | 0.0 | 8.0 | 10.3 | 8.1 |
| Light sensitivity | 62.5 | 28.0 | 41.4 | 38.7 |
| After images | 62.5 | 12.0 | 20.7 | 22.6 |

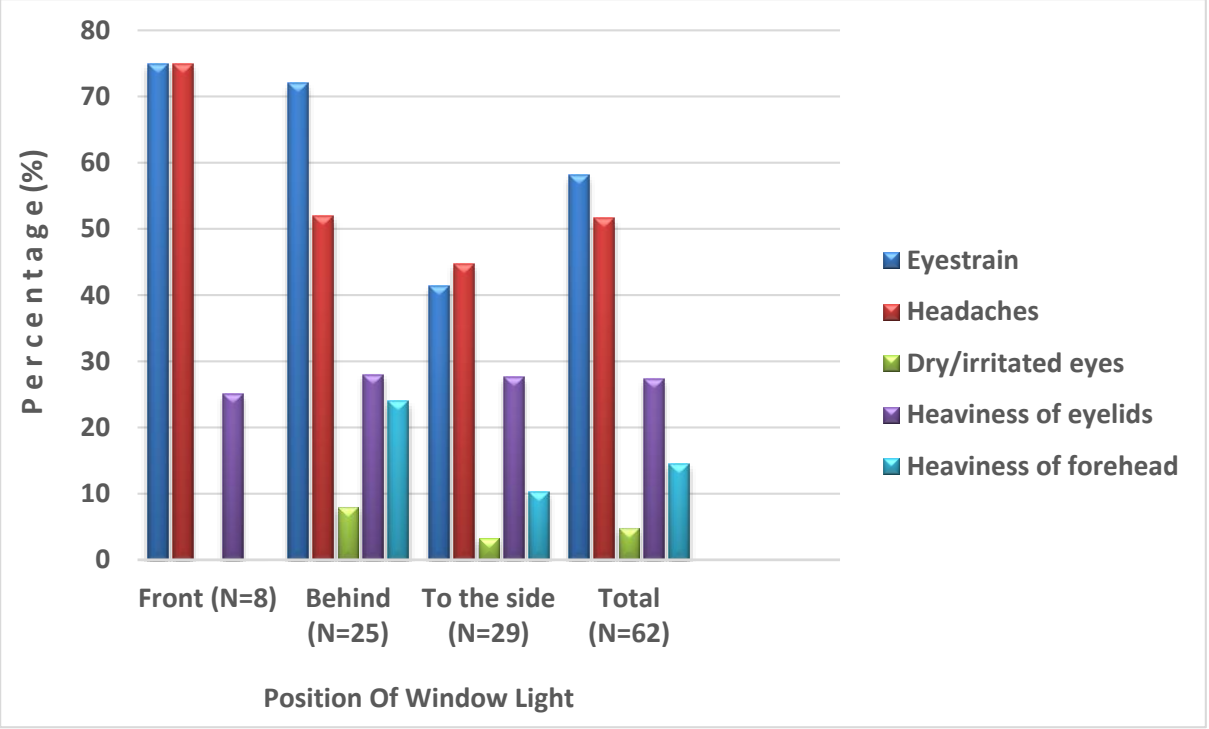


**Figure 5: A bar graph showing the result of the visual symptoms of participants and the percentages of the position of the window light in relation to screen of the computer.**

#### 4.4.3.2 Systemic systems reported for the position of window light

Neck pain was reported the lowest (24.1%) when the light was to the side of the computer screen and the highest (50.0%) when the light was in front of the screen. Shoulder pain was highest (17.2%) when the light was on the side and the lowest (4.0%) when the light was behind the screen. No subjects reported backache when the light was in front of the screen. Wrist pain was highest (20.0%) when the light was behind the screen and lowest (12.0%) when it was in front of the screen (See Table 16).

**Table 16: Showing systemic symptoms reported by the participants and the percentages of the position of the window light in relation to computer screen.**

| Systemic symptoms | Position of light/Percentages (%)of symptoms | | | |
|---|---|---|---|---|
| | Front (N = 8) | Behind (N=25) | Side (N=29) | Total (N=62) |
| Neck pain | 50.0 | 56.0 | 24.1 | 40.3 |
| Shoulder pain | 12.5 | 4.0 | 17.2 | 11.3 |
| Wrist pain | 12.5 | 20.0 | 17.2 | 17.7 |
| Backache | 0.0 | 8.0 | 6.9 | 6.5 |

### 4.4.4 Control of light entering the office

#### 4.4.4.1 Visual symptoms reported for the light controllers

There was a significant (50.0%) of light sensitivity when there was no control of light while lower (37.0%) sensitivity to light when it was controlled by either curtains or blinds (See Table 17).On average, about 61.5% of the participants that were using blinds still suffered from eye strain, slow refocus and headaches. Very few participants were using curtains as a measure of controlling the light in the working area. 62.5% had eye strain and 37.5% suffered from headache (See Figure 6)

**Table 17: Showing the visual symptoms reported by the participants and the percentages of the methods used to control the light in the work area.**

| Visual symptoms | Light controllers/Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | Curtains (N=8 ) | Blinds (N=25) | None (N=29) | Total (N=62) |
| Slow refocus | 37.5 | 63.6 | 50.0 | 60.0 |
| Blurred near vision | 0 .0 | 9.1 | 50.0 | 9.2 |
| Blurred distance vision | 0.0 | 16.4 | 0.0 | 13.8 |
| Double vision | 50.0 | 36.4 | 50.0 | 38.5 |
| Colour distortion | 12.5 | 7.3 | 0.0 | 7.7 |
| Light sensitivity | 37.5 | 36.4 | 50.0 | 36.9 |
| After images | 12.5 | 21.8 | 100.0 | 23.1 |

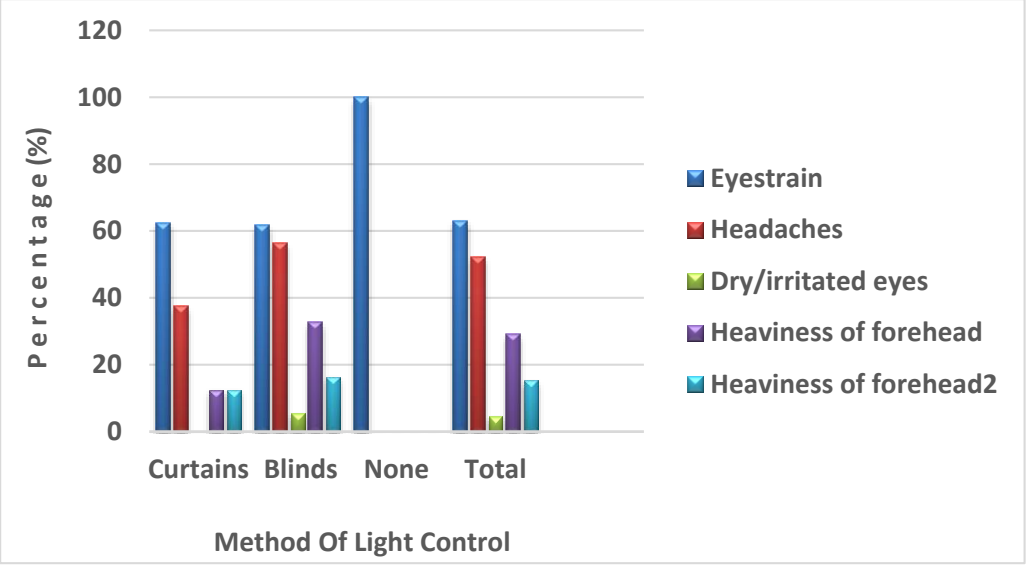


**Figure 6: Showing the visual symptoms reported by computer users and the percentages of the methods that were used to control the light that entered the work area.**

### 4.4.4.2 Systemic symptoms reported for the different light controllers

When the participants were using curtains, they did not report any shoulder or wrist pain. However, 37.5% suffered from neck pain and 12.5% suffered from backache. When they were using blinds, the participants reported all the systemic symptoms, the highest being neck pain at 41.8% and the lowest was backache at 3.6% (See Table 18).

**Table 18: Showing the systemic symptoms reported by the participants and the percentages of the methods that were used to control the light that entered the work area.**

| Systemic symptoms | Light controllers/Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | Curtains(N=8) | Blinds(N=25) | None(N=29) | Total(N=62) |
| Neck pain | 37.5 | 41.8 | 0.0 | 40.0 |
| Shoulder pain | 0.0 | 10.9 | 50.0 | 10.8 |
| Wrist pain | 0.0 | 20.0 | 0.0 | 16.9 |
| Backache | 12.5 | 3.6 | 50.0 | 6.2 |

### 4.4.5 The status of the inside walls of the work place

#### 4.4.5.1 Visual symptoms reported for the status of the walls

Slow refocus was reported the highest in both shinny (56.3%) and dull walls (60.4%). However, the lowest (6.3%) symptoms were blurred near vision in the shiny walls and colour distortion in the dull walls (See Table 19).There were 16(25.0%) of the participants that reported to have shinny walls and 18(28.1%) reported to be having dull walls. The participants that used shinny walls and those that used dull wall experienced the same or almost the same symptoms. For an example, 65.5% of the participants experienced eye strain whether the walls are shiny or dull (See Figure 7).

**Table 19: Showing visual symptoms reported by the participants and the percentages of the status of the walls (shiny/ dull).**

| Visual symptoms | Walls/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Shiny (N = 16) | Dull (N = 18) | Total (N= 64) |
| Slow refocus | 56.3 | 60.4 | 59.4 |
| Blurred near vision | 6.3 | 10.4 | 9.4 |
| Blurred distance vision | 12.5 | 14.6 | 14.1 |
| Double vision | 31.3 | 39.6 | 37.5 |
| Colour distortion | 12.5 | 6.3 | 7.8 |
| Light sensitivity | 25.0 | 39.6 | 35.9 |
| After images | 18.8 | 25.0 | 23.4 |

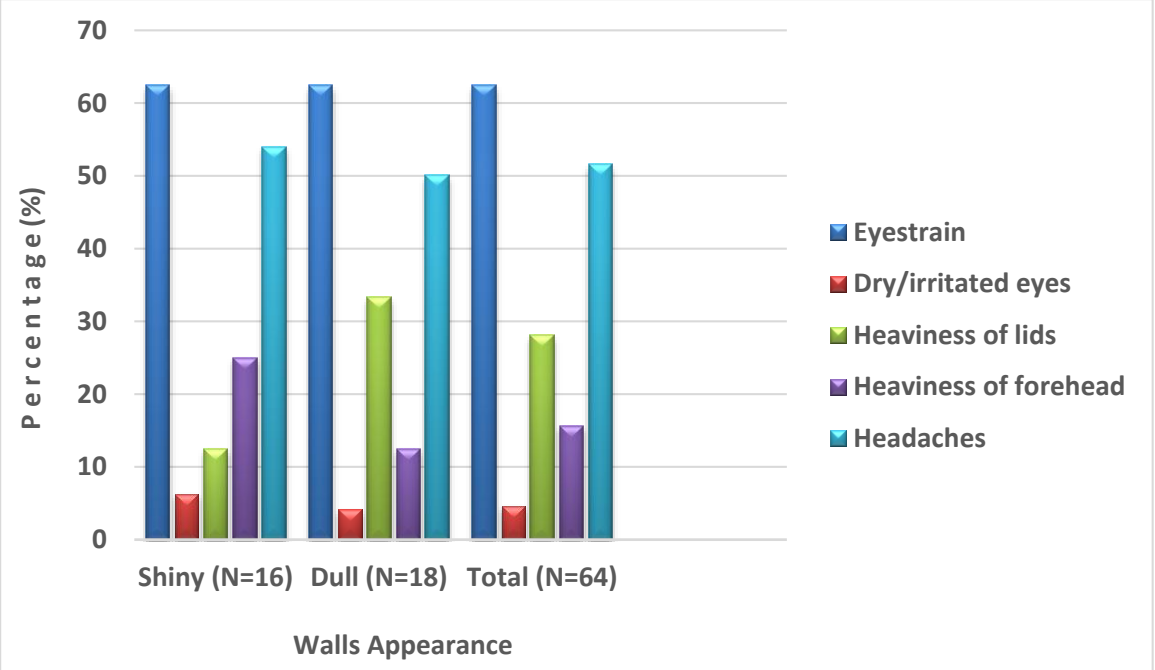


**Figure 7: Showing the visual symptoms reported by the participants and the percentages of the status of the walls (shinny/dull).**

### 4.4.5.2 Systemic symptoms reported for the status of the walls

The difference between the shiny walls and dull wall was not significant when looking at the systemic symptoms. When using shiny walls neck pain was at 43.8% and at 37.5% for dull walls. With regard to backache, whether the walls were shinny or dull, the percentage was the same both at 6.3% (See Table 20).

**Table 20: Showing the systemic symptoms reported by the participants and the percentages of the status of the walls (shiny/dull).**

| Systemic symptoms | Status of the walls/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Shiny(N = 16) | Dull(N = 18) | Total(N = 64) |
| Neck pain | 43.8 | 37.5 | 39.1 |
| Shoulder pain | 6.3 | 10.4 | 9.4 |
| Wrist pain | 12.5 | 16.7 | 15.6 |
| Backache | 6.3 | 6.3 | 6.3 |

### 4.4.6 Status of the desk surface

#### 4.4.6.1 Visual symptoms reported for the status of the desk surface

The participants reported a higher value (66.7%) of slow refocus when the desk surface was shiny and lower (57.9%) when it was dull. It was only after image that was reported high (26.3%) when the desk surface was dull and low (16.7%) when the desk was shiny (See Table 21). From a total of 62 participants, 24(38.7%) reported a shiny desk surface and 38(61.3%) reported a dull desk surface. Participants with a dull desk surface showed slightly lower visual symptoms than those that use a shiny surface. Eyestrain was reported the highest (66.7%) when the desk surface was shinny and the lowest (4.2%) symptom was dry/irritated eyes (See Figure 8).

**Table 21: Showing the visual symptoms reported by the participants and the percentages of desk status (shiny/dull).**

| Visual symptoms | Status of desk/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Shiny (N = 24) | Dull (N = 38) | Total (N = 62) |
| Slow refocus | 66.7 | 57.9 | 61.3 |
| Blurred near vision | 8.3 | 7.9 | 8.1 |
| Blurred distance vision | 16.7 | 13.2 | 14.5 |
| Double vision | 41.7 | 39.5 | 40.3 |
| Colour distortion | 8.3 | 7.9 | 8.1 |
| Light sensitivity | 41.7 | 36.8 | 38.7 |
| After images | 16.7 | 26.3 | 22.6 |

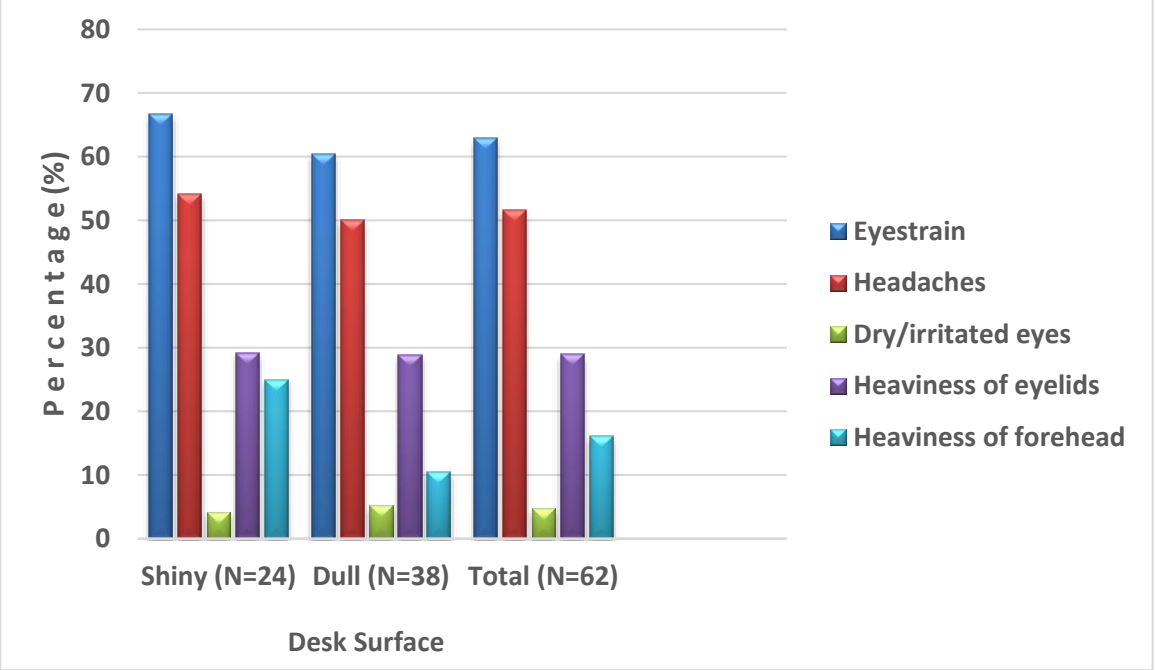


**Figure 8: A bar showing the visual symptoms reported by the participants and the percentages of the desk status (shiny/dull).**

#### 4.4.6.2 Systemic symptoms reported for the status of the desk

With the systemic symptoms, neck pain (45.8%) and shoulder pain (12.5%) were higher when using a shiny desk surface and lower when using a dull surface which was at 36.8% and 10.5% respectively. On the contrary, wrist pain (12.5%) and backache (4.2%) were lower when using shinny surface as opposed to a dull one which was 21.1% and 7.9% respectively (See Table 22).

**Table 22: Showing the systemic symptoms reported by the participants and percentages of the desk status (shiny/dull).**

| Systemic Symptoms | Status of desk /Percentages(%) of symptoms | | |
|---|---|---|---|
| | Shiny (N= 24) | Dull(N= 38) | Total(N = 62) |
| Neck pain | 45.8 | 36.8 | 40.3 |
| Shoulder pain | 12.5 | 10.5 | 11.3 |
| Wrist pain | 12.5 | 21.1 | 17.7 |
| Backache | 4.2 | 7.9 | 6.5 |

### 4.4.7 Status of the work place

#### 4.4.7.1 Visual symptoms reported for the brightness of the work area

A bright working area resulted in a higher (38.3%) light sensitivity than a dimmer working area which showed a lower (35.3%) sensitivity to light (See Table 23).Most of the participants (75.8%) reported a bright working area and very few (26.6%) reported a dim working place. Out of those who reported a bright area, (59.6%) suffered from eye strain and (46.8%) suffered from headaches. A higher (70.6%) of both eyestrain and headache was reported when the work area was dim (See Figure 9).

**Table 23: Showing the visual symptoms reported by the participants and the percentages of the status of work Place/area (Bright/dim)**

| Visual symptoms | Status of area/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Bright<br><br>(N = 47) | Dim<br><br>(N = 17) | Total<br><br>(N = 64) |
| Slow refocus | 57.4 | 70.6 | 60.9 |
| Blurred near vision | 8.5 | 11.8 | 9.4 |
| Blurred distance vision | 14.9 | 11.8 | 14.1 |
| Double vision | 34.0 | 47.1 | 37.5 |
| Colour distortion | 6.4 | 11.8 | 7.8 |
| Light sensitivity | 38.3 | 35.3 | 37.5 |
| After images | 23.4 | 23.5 | 23.4 |

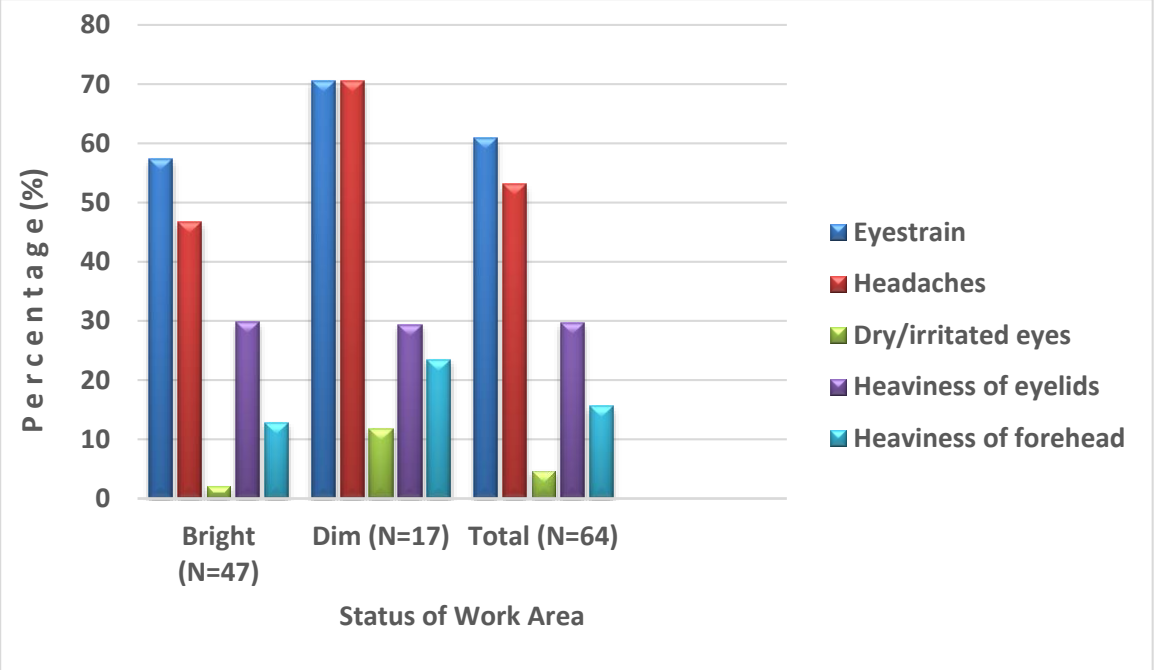


**Figure 9: A bar graph showing the visual symptoms reported by the participants and the percentages of the status of work area (bright/dim).**

### 4.4.7.2 Systemic symptoms reported for the brightness of the work area

Neck pain was the only systemic symptoms that was reported high (44.7%) when the appearance of the lights were dim than when they were dim (29.4%).The other symptoms like shoulder pain (10.6%), wrist pain (12.8%) and backache (2.1%) were lower at a bright appearance and higher (11.8%), 29.4%) and (17.6%) at a dim light appearance( See Table 24).

**Table 24: Showing the systemic symptoms reported by the participants and the percentages of the status of work area (bright/dim).**

| Systemic symptoms | Status of work area/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Bright (N= 47) | Dim (N = 17) | Total (N= 64) |
| Neck pain | 44.7 | 29.4 | 40.6 |
| Shoulder pain | 10.6 | 11.8 | 10.9 |
| Wrist pain | 12.8 | 29.4 | 17.2 |
| Backache | 2.1 | 17.6 | 6.3 |

### 4.4.8 Results of the air conditioner

#### 4.4.8.1 Visual symptoms reported for the availability of air conditioner

The highest (54.7%) symptom that was reported when the air conditioner is available was slow refocus and the lowest (5.7%) was colour distortion .In the absence of air conditioner the highest (60.3%) symptom was still slow refocus and the lowest (7.9%) symptom was also colour distortion. With regard to the visual symptoms, the results appeared to be almost the same in as far as the presence or absent of air conditioner (See Table 25).The results appeared to be almost the same in as far as the presence or absent of air conditioner. Most of the participants suffered from eyestrain and headaches of above 50% whether air conditioner was available or not. When air conditioner was available eye strain was 60.4%, and headache was 50.9%. When air conditioner was not available eye strain and headache were still high at (70.0%) and (60.0%) respectively (See Figure 10).

**Table 25: Showing visual symptoms reported by the participants and the percentages of availability of air conditioner in the work place.**

| Visual symptoms | Air conditioner/Percentages (%) of symptoms. | | |
|---|---|---|---|
| | Available (N = 53) | Not Available (N = 10) | Total (N= 63) |
| Slow refocus | 54.7 | 90.0 | 60.3 |
| Blurred near vision | 7.5 | 20.0 | 9.5 |
| Blurred distance vision | 13.2 | 20.0 | 14.3 |
| Double vision | 34.0 | 60.0 | 38.1 |
| Colour distortion | 5.7 | 20.0 | 7.9 |
| Light sensitivity | 39.6 | 20.0 | 36.5 |
| After images | 20.8 | 40.0 | 23.8 |

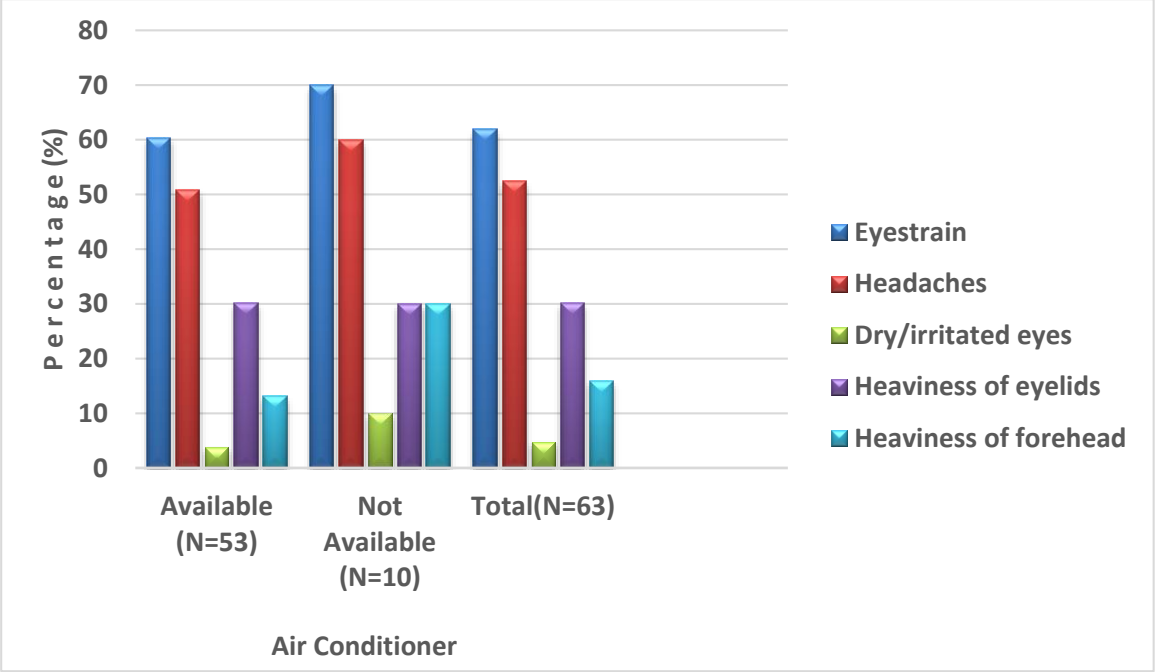


**Figure 10: A bar graph showing visual symptoms reported by the participants and the percentages of availability of air conditioner in the work place.**

### 4.4.8.2 Systemic symptoms reported for the availability of air conditioner

A total number of 63 participants responded to the question. Many (84.1%) reported to have an air conditioner in their work place and only a few (11.1%) did not have air conditioners. All the participants that reported to have an air conditioner also reported that they were not suffering from a backache (See Table 26).

**Table 26: Showing systemic symptoms reported by the participants and the percentages of availability of air conditioner in the work place.**

| Systemic symptoms | Air conditioner/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Available (N = 53) | Not Available (N = 10) | Total (N = 63) |
| Neck pain | 41.5 | 40.0 | 41.3 |
| Shoulder pain | 9.4 | 20.0 | 11.1 |
| Wrist pain | 17.0 | 20.0 | 17.5 |
| Backache | 0.0 | 30.0 | 4.8 |

## SECTION D

### 4.5 Appearance of colour and the distance of the screen to the eye.

### 4.5.1 The colour of the letters on the computer screen.

#### 4.5.1.1 Visual symptoms for the type of colour of the letters on the screen

The majority (70.9%) of the participants had black letters on the computer screen. Only (3.2%) workers reported blue letters and (11.1%) reported to be having white letters. Only (1.6%) participant indicated grey letters while (12.9%) of the workers reported to be having various colours on the computer screen. Most of the workers with black colours suffered from slow refocus (56.8%) (See Table 27).The participants reported the highest (71.4%) of headache when their letters on the screen was white and no dry/irritated eyes. Black letters resulted in a high (59.1%) of eyestrain and a low (4.5%) of dry and irritated eyes (See Figure 11).

**Table 27: Showing the visual symptoms reported by the participants and the percentages of the type of colour of the letters on the computer screen.**

| Visual symptoms | Types of colour/ Percentages(%) of symptoms | | | | | |
|---|---|---|---|---|---|---|
| | Black (N = 44) | Blue (N = 2) | White (N = 7) | Grey (N = 1) | Various colours (N = 8) | Total (N =62) |
| Slow refocus | 56.8 | 50.0 | 85.7 | 0.0 | 62.5 | 59.7 |
| Blurred near vision | 11.4 | 0.0 | 0.0 | 0.0 | 0.0 | 8.1 |
| Blurred Distance vision | 15.9 | 0.0 | 0.0 | 100.0 | 0.0 | 12.9 |
| Double vision | 31.8 | 100.0 | 57.1 | 0.0 | 62.5 | 40.3 |
| Colour distortion | 9.1 | 0.0 | 0.0 | 0.0 | 0.0 | 6.5 |
| Light sensitivity | 38.6 | 50.0 | 28.6 | 100.0 | 37.5 | 38.7 |
| After images | 20.5 | 0.0 | 42.9 | 0.0 | 37.5 | 24.2 |

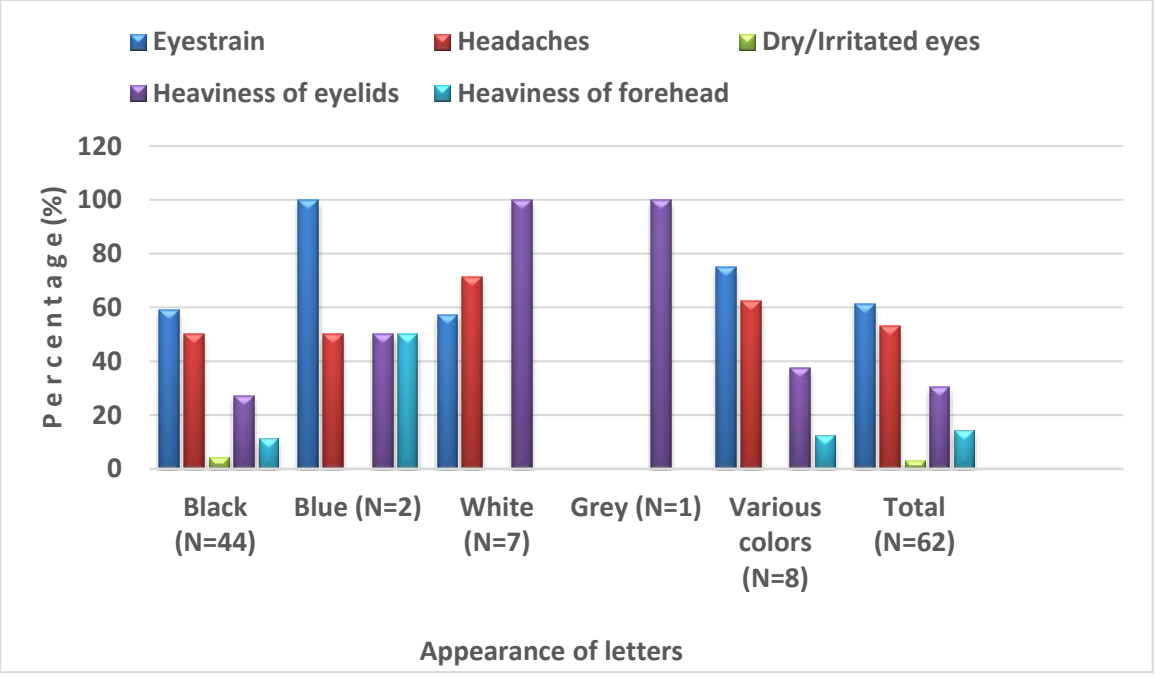


**Figure 11: A bar graph showing the visual symptoms reported by the participants and the percentages of the type colour of the letters on the computer screen.**

#### 4.5.1.2. Systemic symptoms reported for the colour of the letters on the computer

The participants that responded to have black letters, 40.9% reported to have suffered from neck pain which was the highest and the lowest symptom was backache at 9.1%. The subjects that had blue letters did not report any backache but all of them reported a 50.0% of the other three symptoms (See Table 28).

**Table 28: Showing the systemic symptoms reported by the participants and the percentages of the type of colour of the letters on the computer screen.**

| Systemic symptoms | Type of colour /Percentages (%) of symptoms. | | | | | |
|---|---|---|---|---|---|---|
| | Black (N=44) | Blue (N = 2) | White (N = 7) | Grey (N = 1) | Various colours (N = 8) | Total (N=62) |
| Neck pain | 40.9 | 50.0 | 42.9 | 100.0 | 37.5 | 41.9 |
| Shoulder pain | 13.6 | 50.0 | 0.0 | 0.0 | 0.0 | 11.3 |
| Wrist pain | 18.2 | 50.0 | 14.3 | 0.0 | 12.5 | 17.7 |
| Backache | 9.1 | 0.0 | 0.0 | 0.0 | 0.0 | 6.5 |

### 4.5.2 Background color of the screen

#### 4.5.2.1 Visual symptoms for the background of the screen

A significant percentage (38.7%) of the participants indicated a blue screen background while (27.4%) of the participants indicated a white background on the screen. The lowest background colour was black which was reported by only (4.8%) participants. The participants that reported to have various

colours on their screens were (11.9%) and 9.8% had a grey colour on the screen. From those who reported to have a white background, the majority (52.9%) suffered from light sensitivity and slow refocuses (See Table 29).Eye strain and headache was reported to be the highest (75.0%) symptoms when the background of the screen had various colours while dry and irritated eyes was the lowest (8.3%),(See Figure 12).

**Table 29: Showing the visual symptoms reported by the participants and the percentages of the background colours of the computer screen.**

| Systemic symptoms | Background colours / Percentages(%) of symptoms | | | | | |
|---|---|---|---|---|---|---|
| | White (N=17) | Grey (N=6) | Blue (N=24) | Black (N=3) | Various Colors (N=12) | Total (N=62) |
| Slow refocus | 52.9 | 66.7 | 54.2 | 66.7 | 66.7 | 58.1 |
| Blurred near vision | 5.9 | 0.0 | 8.3 | 0.0 | 16.7 | 8.1 |
| Blurred distance vision | 17.6 | 16.7 | 8.3 | 0.0 | 16.7 | 12.9 |
| Double vision | 35.3 | 50.0 | 45.8 | 33.3 | 33.3 | 40.3 |
| Colour distortion | 17.6 | 0.0 | 4.0 | 0.0 | 8.3 | 8.1 |
| Light sensitivity | 52.9 | 16.7 | 33.3 | 0.0 | 41.7 | 37.1 |
| After images | 29.4 | 33.3 | 12.5 | 33.3 | 25.0 | 22.6 |

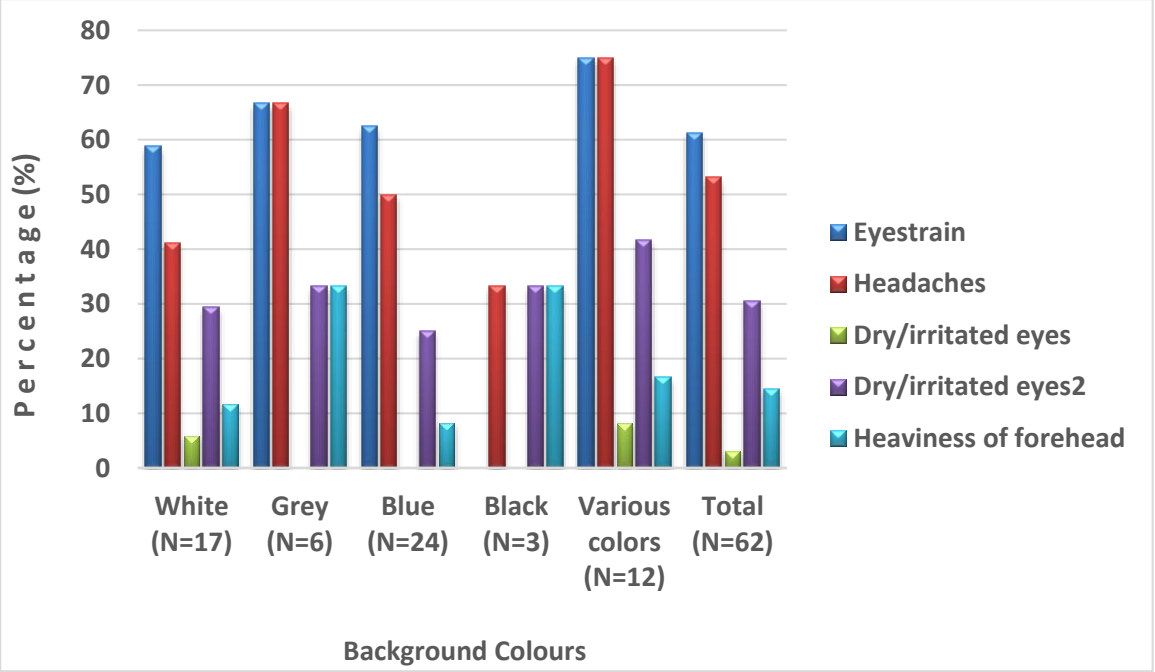


**Figure 12: A bar graph showing the visual symptoms reported by the participants and the percentages of the background colours of the computer screen.**

### 4.5.2.2 Systemic symptoms reported for the background of the screen

The highest symptom that was reported on the white background was neck pain (41.2%) and the lowest was backache (0.0%). A grey background had the same percentage (16.7%) for neck pain, shoulder pain and backache. The participants did not report any systemic symptoms for a black background except neck pain which was at 66.7% (See Table 30).

**Table 30: Showing the systemic symptoms reported by the participants and the percentages of the background colours of the computer screen.**

| Systemic symptoms | Background colours / Percentages(%) of symptoms | | | | | |
|---|---|---|---|---|---|---|
| | White( N=17) | Grey (N=6) | Blue (N=24) | Black (N=3) | Various colors (N=12) | Total (N=62) |
| Neck pain | 41.2 | 16.7 | 37.5 | 66.7 | 50.0 | 40.3 |
| Shoulder pain | 11.8 | 16.7 | 12.5 | 0.0 | 8.3 | 11.3 |
| Wrist pain | 23.5 | 0.0 | 16.7 | 0.0 | 25.0 | 17.7 |
| Backache | 0.0 | 16.7 | 12.5 | 0.0 | 0.0 | 6.5 |

### 4.5.3 Distance between the eyes and computer screen

#### 4.5.3.1 Visual symptoms reported for the mean distance

Only few participants (5) reported a blurred near vision when the mean distance was 40 cm. The majority (56) only experienced blurred vision when the mean distance was 49.86 cm (See Table 31).The above table shows the result of the mean distance and the standard deviation between the eyes and the screen of computer. Most participants (39) suffered from eyestrain when the mean distance was at 53.46 cm than when it was at 41.23cm (See Table 32).

**Table 31: Showing the visual symptoms reported by the participants and the mean distance between eyes and computer screen.**

| Visual symptoms | Mean distance (cm)/ standard deviation | | | |
|---|---|---|---|---|
| | Yes/No | N | Mean distance | Standard deviation |
| Slow refocus | Yes | 36 | 46.72 | 23.365 |
| | No | 25 | 52.40 | 17.416 |
| Blurred near vision | Yes | 5 | 40.00 | 7.906 |
| | No | 56 | 49.86 | 21.812 |
| Blurred distance vision | Yes | 8 | 45.13 | 18.075 |
| | No | 53 | 49.64 | 21.677 |
| Double vision | Yes | 24 | 52.29 | 26.743 |
| | No | 37 | 46.95 | 16.665 |
| Colour distortion | Yes | 5 | 42.20 | 9.471 |
| | No | 56 | 49.66 | 21.846 |
| Light sensitivity | Yes | 23 | 53.00 | 23.917 |
| | No | 38 | 46.66 | 19.244 |
| After images | Yes | 14 | 40.14 | 18.317 |
| | No | 47 | 51.70 | 21.397 |

**Table 32: Showing the visual symptoms reported by the participants and the mean distance between the eyes and computer screen.**

| Visual symptoms | Mean distance (cm)/ standard deviation | | | |
|---|---|---|---|---|
| | Yes/No | N | Mean distance | Std. deviation |
| Eye strain | Yes | 39 | 53.46 | 21.839 |
| | No | 22 | 41.23 | 17.774 |
| Headaches | Yes | 33 | 49.97 | 24.076 |
| | no | 28 | 47.96 | 17.483 |
| Dry/irritated eyes | Yes | 2 | 40.00 | 7.071 |
| | No | 59 | 49.36 | 21.433 |
| Heaviness of eyelids | Yes | 18 | 57.33 | 24.686 |
| | No | 43 | 45.58 | 18.740 |
| Heaviness of forehead | Yes | 10 | 36.40 | 10.977 |
| | No | 51 | 51.53 | 21.847 |

#### 4.5.3.2 Systemic symptoms reported for the mean distance

The participants showed that when the mean distance between the eyes and screen is shorter (42.4cm), the more they reported neck pain than when the distance is further (53.64cm). However, with regards to the other systemic symptoms; shoulder pain (53.86cm), wrist pain (55.55cm) and backache (50.57cm), when the distance between the eyes and screen was above 50cm the subjects reported to experience those symptoms (See Table 33).

**Table 33: Showing the systemic symptoms reported by the participants and the mean distance between eyes and computer screen.**

| Systemic symptoms | Mean distance (cm)/ standard deviation | | | |
|---|---|---|---|---|
| | Yes/No | N | Mean distance | Standard Deviation |
| Neck pain | Yes | 25 | 42.44 | 20.378 |
| | No | 36 | 53.64 | 20.734 |
| Shoulder pain | Yes | 7 | 53.86 | 32.544 |
| | No | 54 | 48.43 | 19.583 |
| Wrist pain | Yes | 11 | 55.55 | 24.271 |
| | No | 50 | 47.62 | 20.407 |
| Backache | Yes | 4 | 50.75 | 34.287 |
| | No | 57 | 48.93 | 20.408 |

### 4.5.4 Tilting of the monitor

#### 4.5.4.1 Visual symptoms reported for monitor movements

Most of the symptoms that were experienced by the participants were higher when the monitor could not be tilted and low when it could be tilted. Slow refocus was high (71.4%) when the computer could not be tilted and low (56.4%) when it could be. The same with other symptoms like light sensitivity, after image and double vision. No adjustment to e.g. light could be made (See Table 34).The highest symptom that was experienced by the participants when the monitor could be tilted was is eyestrain (69.1%) and the lowest was dry/irritated eyes (5.5%). Headache was at an average of (53.2%) whether the monitor could be tilted or not. At the same time, eye strain was reported higher (69.1%) when the monitor could be tilted and lower (28.6%) when it could not be tilted (See Figure 13).

**Table 34: Showing the visual symptoms reported by the participants and the percentages of monitor movements (could be tilted/could not be tilted).**

| Visual symptoms | Monitor movements/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Yes (N = 55) | No (N = 7) | Total (N = 62) |
| Slow refocus | 56.4 | 71.4 | 58.1 |
| Blurred near vision | 10.9 | 0.0 | 9.7 |
| Blurred distance vision | 14.5 | 14.3 | 14.5 |
| Double vision | 36.4 | 57.1 | 38.7 |
| Colour distortion | 9.1 | 0.0 | 8.1 |
| Light sensitivity | 38.2 | 42.9 | 38.7 |
| After images | 21.8 | 42.9 | 24.2 |

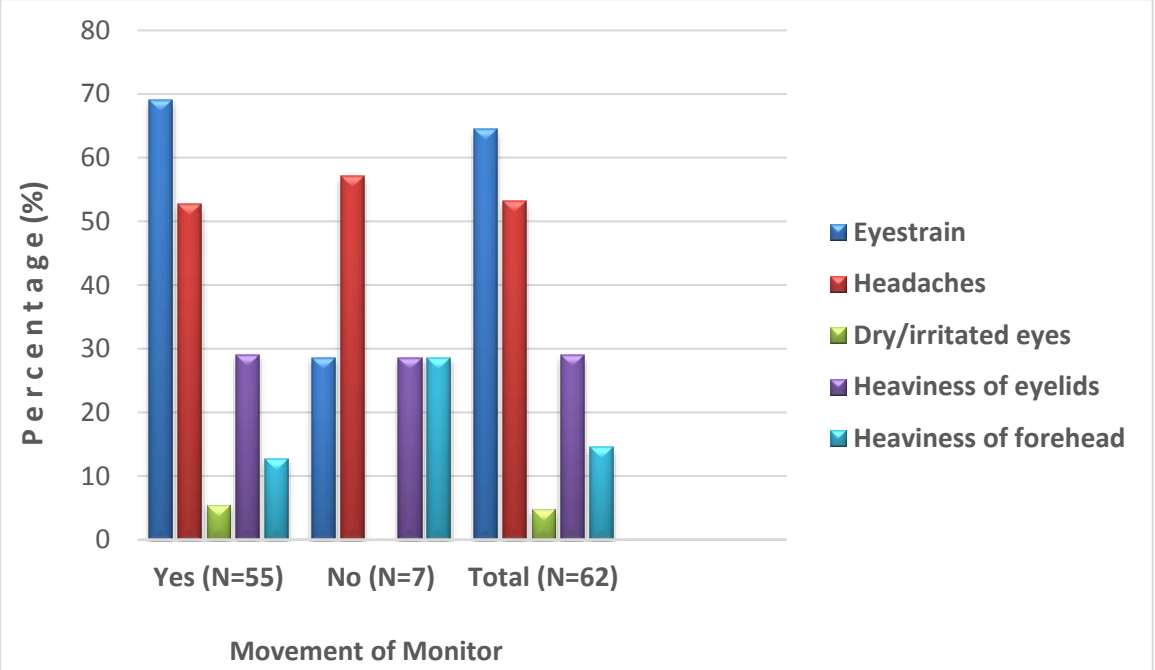


**Figure 13: A bar graph showing the visual symptoms reported by the participants and the percentages of monitor movements (could be tilted/ could not be tilted).**

### 4.5.4.2 Systemic symptoms reported for monitor movements.

The participants did not report any shoulder pain, wrist pain or backache when the monitor could not be tilted but only neck pain (57.1%). The highest symptom that was reported by the subjects when the monitor could be tilted was neck pain (36.4%) and the lowest was backache (7.3%), (See Table 35).

**Table 35: Showing the systemic symptoms reported by the participants and the percentages of the monitor movements (could be tilted/ could not be tilted).**

| Systemic symptoms | Monitor movements/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Yes (N = 55) | No (N = 7) | Total (N = 62) |
| Neck pain | 36.4 | 57.1 | 38.7 |
| Shoulder pain | 12.7 | 0.0 | 11.3 |
| Wrist pain | 20.0 | 0.0 | 17.7 |
| Backache | 7.3 | 0.0 | 6.5 |

### 4.5.5 Movement of the monitor by been raised or lowered

#### 4.5.5.1 Visual symptoms reported for lowering and raising monitor

The participants showed a high (62.3%) slow refocus when the monitor could be raised and lower (45.5%) when it could not. However, light sensitivity was lower (32.1%) when the monitor could be raised and higher (63.6%) when it could not (See Table 36).The highest symptom that was reported by the participants when the monitor could be tilted was eye strain (64.2%) and the lowest was dry/irritated eyes (5.7%). Headaches were reported high (63.6%) when the monitor could not be raised and lower (49.1%) when it could be raised (See Figure 14).

**Table 36: Showing the visual symptoms reported by the participants and the percentages of the monitor movements (could be raised/ could not be raised).**

| Visual symptoms | Monitor movements/Percentages(%) of the symptoms | | |
|---|---|---|---|
| | Yes (N= 53) | No (N=11) | Total (N = 64) |
| Slow refocus | 62.3 | 45.5 | 59.4 |
| Blurred near vision | 9.4 | 9.1 | 9.4 |
| Blurred distance vision | 11.3 | 27.3 | 14.1 |
| Double vision | 35.8 | 54.5 | 39.1 |
| Colour distortion | 9.4 | 0.0 | 7.8 |
| Light sensitivity | 32.1 | 63.6 | 37.5 |
| After images | 18.9 | 36.4 | 21.9 |

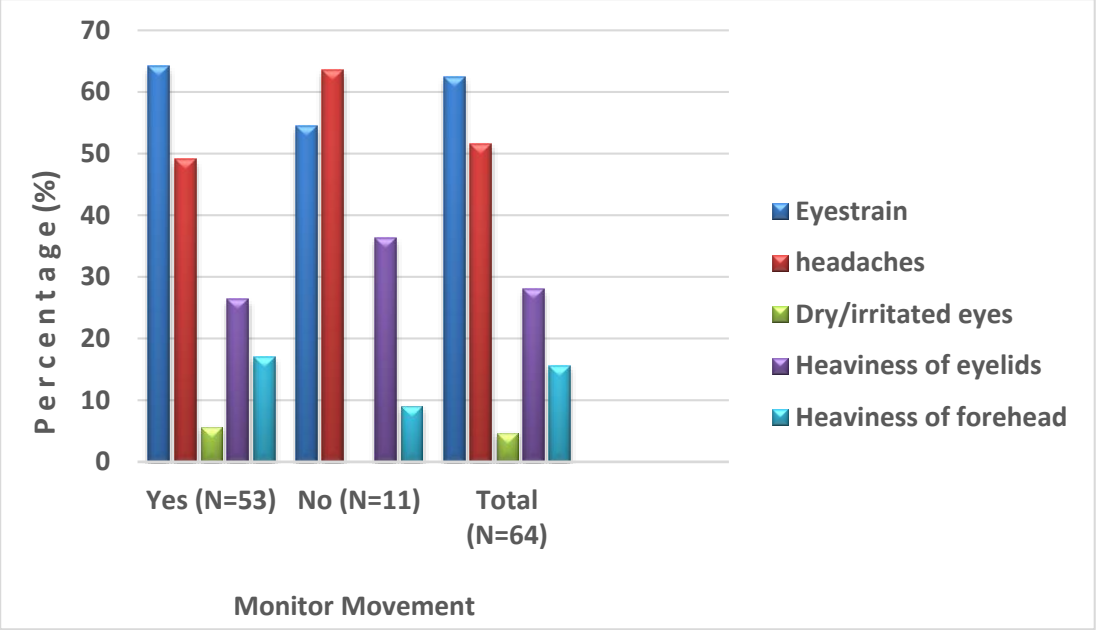


**Figure 14: A bar graph showing visual symptoms reported by the participants and the percentages of monitor movements (could be raised or could not be raised).**

### 4.5.5.2 Systemic symptoms reported for lowering and raising monitor

The highest symptom that most of the participants suffered when the monitor could be raised was neck pain (39.6%) and the lowest symptom was backache (7.5%). Still, when the monitor could not be raised the highest symptom was neck pain and the lowest was backache and wrist pain (0.0%), (See Table 37).

**Table 37: Showing the systemic symptoms reported by the participants and percentages of monitor movements (could be raised/ could not be raised).**

| Systemic symptoms | Monitor movements/Percentages(%) of the symptoms | | |
|---|---|---|---|
| | Yes (N=53) | No (N=11) | Total (N (N=64) |
| Neck pain | 39.6 | 45.5 | 40.6 |
| Shoulder pain | 11.3 | 9.1 | 10.9 |
| Wrist pain | 20.8 | 0.0 | 17.2 |
| Backache | 7.5 | 0.0 | 6.3 |

### 4.5.6 The presence of flickers on the screen

#### 4.5.6.1 Visual symptoms reported for showing flickers

From a total of 55 participants 19(34.5%) reported to have flickers on their screens while 30(54.5%) reported that they did not experience flickers on their computer screen. The symptoms that were experienced the highest (63.2%) by the participants was slow refocus. The lowest (5.3%) symptom when the screen had flickers was blurred distance vision (See Table 38).Eye strain and heaviness of the eye lids showed almost similar results. Without flickers eye strain was (61.1%) and with flickers it was (63.2%). Heaviness of the eye lids was (25.0%) without flickers and (26.3%) with them (See Figure 15).

**Table 38: Showing the visual symptoms reported by the participants and the percentages when the computer screen showed flickers and when it did not show flickers.**

| Visual symptoms | Flickers/ Percentages (%) of the symptoms | | |
|---|---|---|---|
| | Yes (N = 19) | No (N = 36) | Total (N = 55) |
| Slow refocus | 63.2 | 55.6 | 58.2 |
| Blurred near vision | 10.5 | 5.6 | 7.3 |
| Blurred distance | 5.3 | 19.4 | 14.5 |
| Double vision | 42.1 | 33.3 | 36.4 |
| Colour distortion | 10.5 | 8.3 | 9.1 |
| Light sensitivity | 26.3 | 41.7 | 36.4 |
| After images | 26.3 | 27.8 | 27.3 |

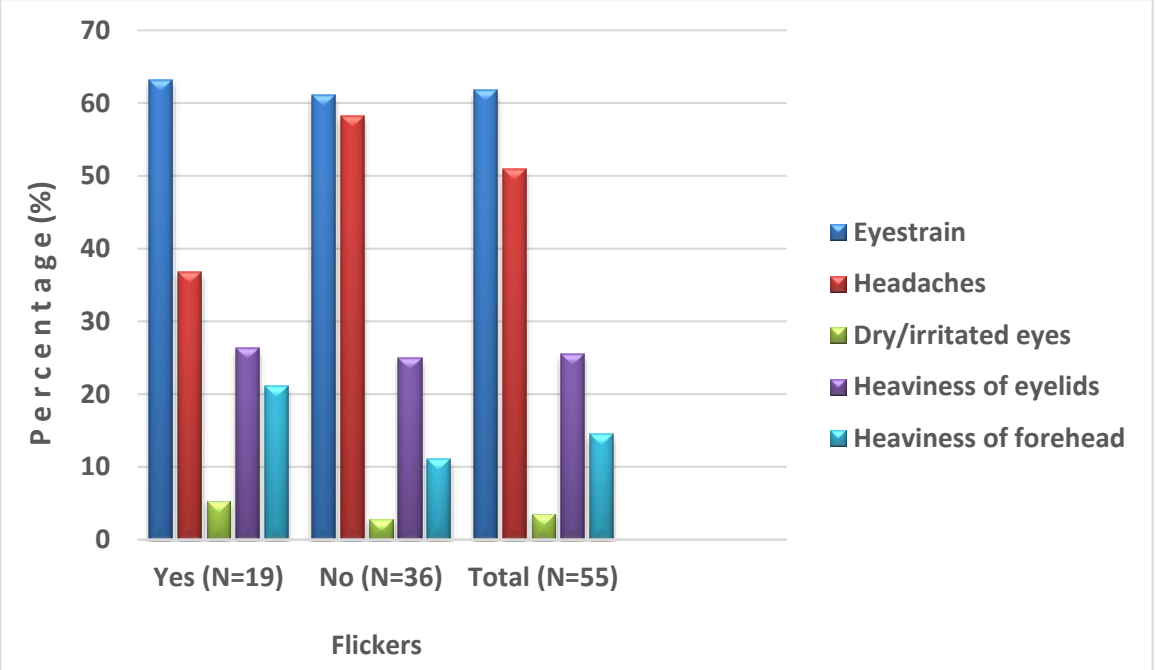


**Figure 15: A bar graph showing the visual symptoms reported by the participants and the percentages when the computer screen showed flickers and when it did not show flickers.**

### 4.5.6.2 Systemic symptoms reported for showing flickers

The majority of the participants reported a high (42.1%) of neck pain when the screen had flickers and a low (5.3%) of backache. The screen that had no flickers showed a high (38.9%) of neck pain and a low (8.3%) percentage of backache and shoulder pain (See Table 39).

**Table 39: Showing the systemic symptoms reported by the participants and the percentages when the computer screen showed flickers and when it did not show flickers.**

| Systemic symptoms | Flickers/ Percentages(%) of the symptoms | | |
|---|---|---|---|
| | Yes(N = 19) | No(N = 36) | Total(N= 55) |
| Neck pain | 42.1 | 38.9 | 40.0 |
| Shoulder pain | 10.5 | 8.3 | 9.1 |
| Wrist pain | 21.1 | 13.9 | 16.4 |
| Backache | 5.3 | 8.3 | 7.3 |

### 4.5.7 Glare on the computer screen

#### 4.5.7.1 Visual systems reported for computer screens that showed glare

Most of the participants with glare filter (23.5%) had shoulder pain whilst only 4.5% of those without glare filter had shoulder pain. Many (82.4%) participants still suffered from slow refocus (70.6%). Very few (5.9%) had blurred vision when there was a glare filter (See Table 40).The participants showed a lower (11.8%) of heaviness of the eyelids when the screen had flickers and a higher (15.9%) when it was absent. However, eyestrain was very high (82.4%) when there was a glare filter and lower (52.3%) when it was not there. Headache was also high (52.9%) with the presence of a glare filter and low (47.7%) without it (See Figure 16).

**Table 40: Showing the visual symptoms reported by the participants and the percentages of computer screen that had a glare filter and had no glare filter.**

| Visual symptoms | Glare filter/Percentages(%) of the symptoms | | |
|---|---|---|---|
| | Yes(N= 17) | No(N= 17) | Total(N= 61) |
| Slow refocus | 70.6 | 56.8 | 60.7 |
| Blurred near vision | 5.9 | 6.8 | 6.6 |
| Blurred distance vision | 11.8 | 11.4 | 11.5 |
| Double vision | 52.9 | 34.1 | 39.3 |
| Colour distortion | 11.8 | 6.8 | 8.2 |
| Light sensitivity | 47.1 | 34.1 | 37.7 |
| After images | 23.5 | 22.7 | 23.0 |
| | | | |

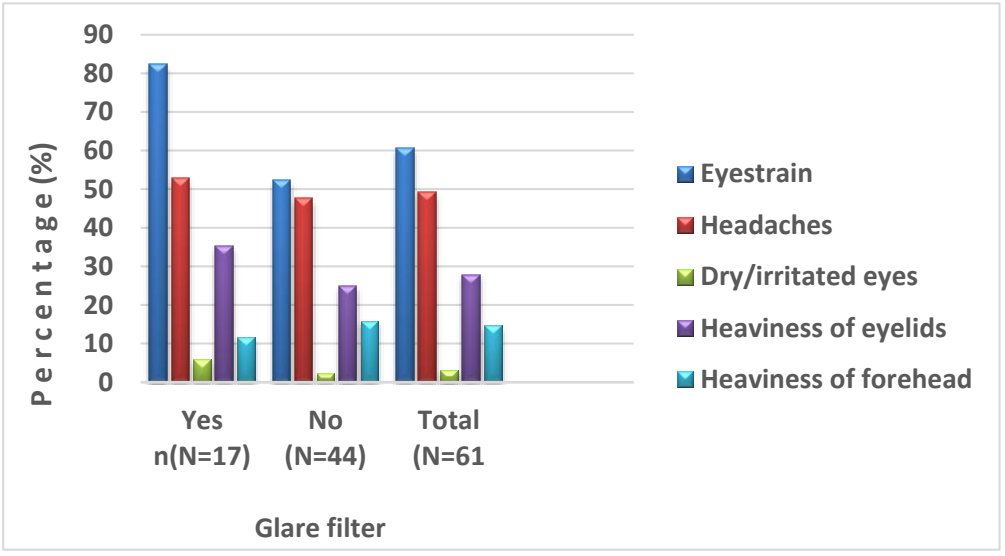


**Figure 16: A bar graph showing the visual symptoms and the percentages of computer screen that had a glare filter and had no glare filter.**

#### 4.5.7.2 Systemic symptoms reported screens that showed glare

The majority of the participants reported a high (52.9%) of neck pain when the screen had glare filter and a low (5.9%) of backache. The screen that had no glare filter also showed a high (34.1%) of neck pain and a low (4.5%) percentage shoulder pain (See Table 41).

**Table 41: Showing the systemic symptoms reported by the participants and the percentages of computer screen that had a glare filter and had no glare filter.**

| Systemic symptoms | Glare filter/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Yes (N= 17) | No (N= 44) | Total (N= 61) |
| Neck pain | 52.9 | 34.1 | 39.3 |
| Shoulder pain | 23.5 | 4.5 | 9.8 |
| Wrist pain | 35.3 | 11.4 | 18.0 |
| Backache | 5.9 | 6.8 | 6.6 |

### 4.5.8 Levels of the eye in relation to the screen

#### 4.5.8.1 Visual symptoms reported for different eye levels

From a total of 63 participants, the majority (77.7%) had their computer screen at eye level while only (9.5%) had it at above eye level and just (12.7%) below eye level. Eye strain was the highest symptom at eye level (67.3%) and lower at below and above eye level (50%). 28(57.1%) of participants reported a slow refocus at eye level as compared to 5(83.3%) above eye level and 4(50.0%) below eye level, (See Table 42).The participants reported no (0.0%) dry/irritated eyes when the screen level was below the eyes.

When the screen level was at eye level, dry/irritated eyes was lower (4.1%) and it was very high (16.7%) when it was above eye level (See Figure 17).

**Table 42: Showing the visual symptoms reported by the participants and the percentages of the different eye levels in relation to the computer screen.**

| Visual symptoms | Eye levels / Percentages(%) of the symptoms | | | |
|---|---|---|---|---|
| | Above (N=6) | Eye level (N=49) | Below (N=8) | Total (N = 63) |
| Slow refocus | 83.3 | 57.1 | 50.0 | 58.7 |
| Blurred near vision | 16.7 | 10.2 | 0.0 | 9.5 |
| Blurred distance vision | 16.7 | 16.3 | 0.0 | 14.3 |
| Double vision | 66.7 | 36.7 | 25.0 | 38.1 |
| Colour distortion | 16.7 | 8.2 | 0.0 | 7.9 |
| Light sensitivity | 33.3 | 40.8 | 25.0 | 38.1 |
| After images | 33.3 | 24.5 | 12.5 | 23.8 |

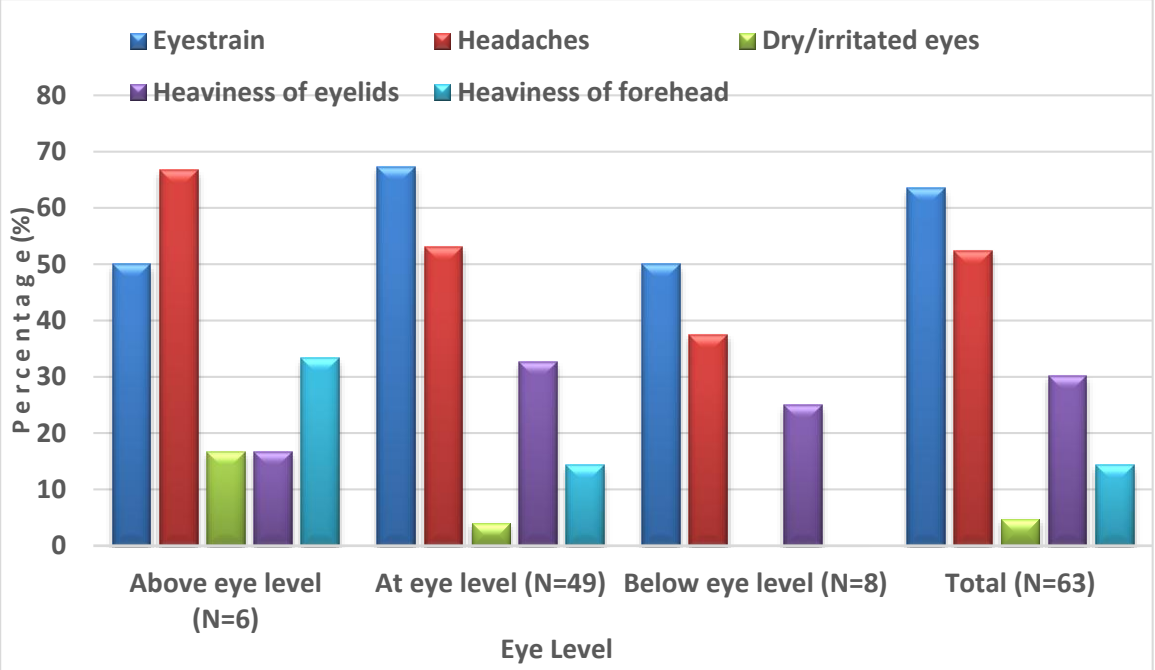


**Figure 17: A bar graph showing the visual symptoms reported by the participants and the percentages of the different eye levels in relation to the computer screen.**

### 4.5.8.2 Systemic symptoms reported for different eye levels

The participants who looked at the computer screen above eye level reported a high (33.3%) of neck pain and a lower (16.7%) of wrist pain with no (0.0%) shoulder pain or any backache. Those who reported to be looking at the screen at eye level showed a high (42.9%) of neck pain and a low (8.2%) of backache. The last group was participants that reported to look at the screen below eye level, neck pain and wrist pain was experienced the same (25.0%) and there was no (0.0%) shoulder or backache that was reported (See Table 43).

**Table 43: Showing the systemic symptoms of the participants and the percentages of the different eye levels that the respondents looked at the computer screen.**

| Systemic symptoms | Eye levels/Percentages(%) of symptoms | | | |
|---|---|---|---|---|
| | Above (N=6) | Eye level (N=49) | Below (N=8) | Total (N=63) |
| Neck pain | 33.3 | 42.9 | 25.0 | 39.7 |
| Shoulder pain | 0.0 | 14.3 | 0.0 | 11.1 |
| Wrist pain | 16.7 | 16.3 | 25.0 | 17.5 |
| Backache | 0.0 | 8.2 | 0.0 | 6.3 |

## SECTION E

## 4.6 THE WORKING STATION OF THE PARTICIPANTS

### 4.6.1 Position of hard copy material

#### 4.6.1.1 Visual symptoms reported for hard copy position

The majority (74.6%) of the participants placed their hard copy to the side of the screen and few (6.3%) placed it below the level of the screen. Slow refocus was higher (81.3%) when the hard copy was below eye level and lower (53.3%) to the side of the screen (See Table 44).The participants reported a high (63.8%) of eye strain when the hard copy was to the side of the screen and a lower (56.3%) eye strain when the hard copy was below the screen. There was no (0.0%) report of dry/irritated eyes when the hard copy was to the side of the screen and a slightly higher (6.4%) when the hard copy was on the side of the screen (See Figure 18).

**Table 44: Showing the visual symptoms of the participants and the percentages of the position of the hard copy while working on computer.**

| Visual symptoms | Hard copy position/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Side (N=47) | Below (N=16) | Total (N=63) |
| Slow refocus | 55.3 | 81.3 | 61.9 |
| Blurred near vision | 10.6 | 6.3 | 9.5 |
| Blurred distance | 10.6 | 25.0 | 14.6 |
| Double vision | 40.4 | 31.3 | 38.1 |
| Colour distortion | 8.5 | 6.3 | 7.9 |
| Light sensitivity | 34.0 | 43.8 | 36.5 |
| After images | 23.4 | 25.0 | 23.8 |

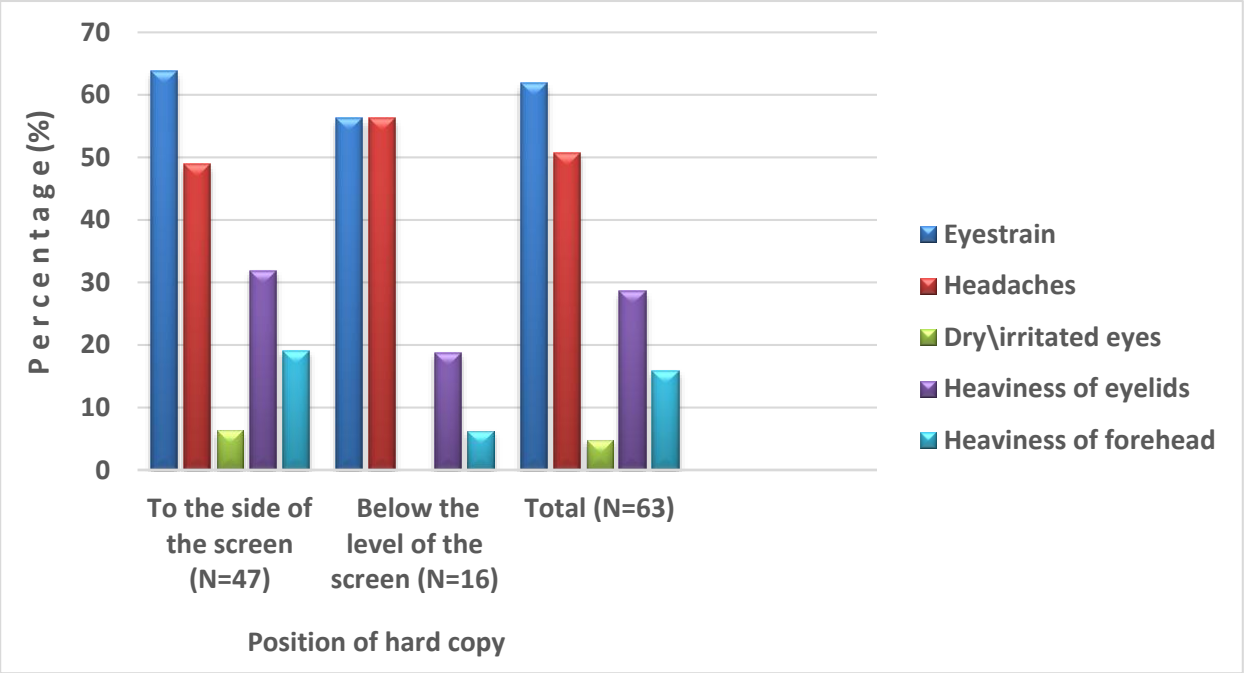


**Figure 18: A bar graph showing the visual symptoms reported by the participants and the percentages of the position of the hard copy.**

### 4.6.1.2 Systemic symptoms reported for hard copy position

The majority of the participants reported a high (44.7 %) of neck pain when the hard copy was to the side of the screen and a low (8.5%) of backache. The participants also showed a high (31.3%) of neck pain and a low (12.5%) wrist pain with no (0.0%) shoulder pain or backache when the hard copy was below eye level (See Table 45).

**Table 45: Showing the systemic symptoms of the participants and the percentages of the position of the hard copy while the participant is working on computer.**

| Systemic symptoms | Hard copy position/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Side (N=47) | Below (N=16) | Total (N=63) |
| Neck pain | 44.7 | 31.3 | 41.3 |
| Shoulder pain | 14.9 | 0.0 | 11.1 |
| Wrist pain | 17.0 | 12.5 | 15.9 |
| Backache | 8.5 | 0.0 | 6.3 |

### 4.6.2 Visibility of hard copy

#### 4.6.2.1 Visual symptoms reported for visibility of hard copy

Most of the participants experienced lower (55.6%) symptoms when using computers like slow refocus when the hard copy could be seen without moving the head and higher (62.5%) symptoms when the hard copy could not be seen without moving the head. Blurred distance and near vision was also lower (7.5%) when the hard copy could be seen without moving the head and higher (21.9%) when it could not be seen without moving the head (See Table 46).Visibility of hard copy without moving the head resulted in a lower (37.0%) of headache while hardcopy visibility that required movement of head caused (65.6%) of headache. There were no (0.0%) dry/irritated eyes when hardcopy was visible without head movement and lower (9.4%) when it could not be seen without head movement (See Figure 19).

**Table 46: Showing visual symptoms reported by the participants and the percentages of visibility of the hard copy without moving the head.**

| Systemic systems | Hard copy visibility/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Yes (N=27) | No (N=32) | Total (N=59) |
| Slow refocus | 55.6 | 62.5 | 59.3 |
| Blurred near vision | 7.4 | 12.5 | 10.2 |
| Blurred distance vision | 7.4 | 21.9 | 15.3 |
| Double vision | 40.7 | 37.5 | 39.0 |
| Colour distortion | 7.4 | 9.4 | 8.5 |
| Light sensitivity | 37.0 | 43.8 | 40.7 |
| After images | 25.9 | 18.8 | 22.0 |

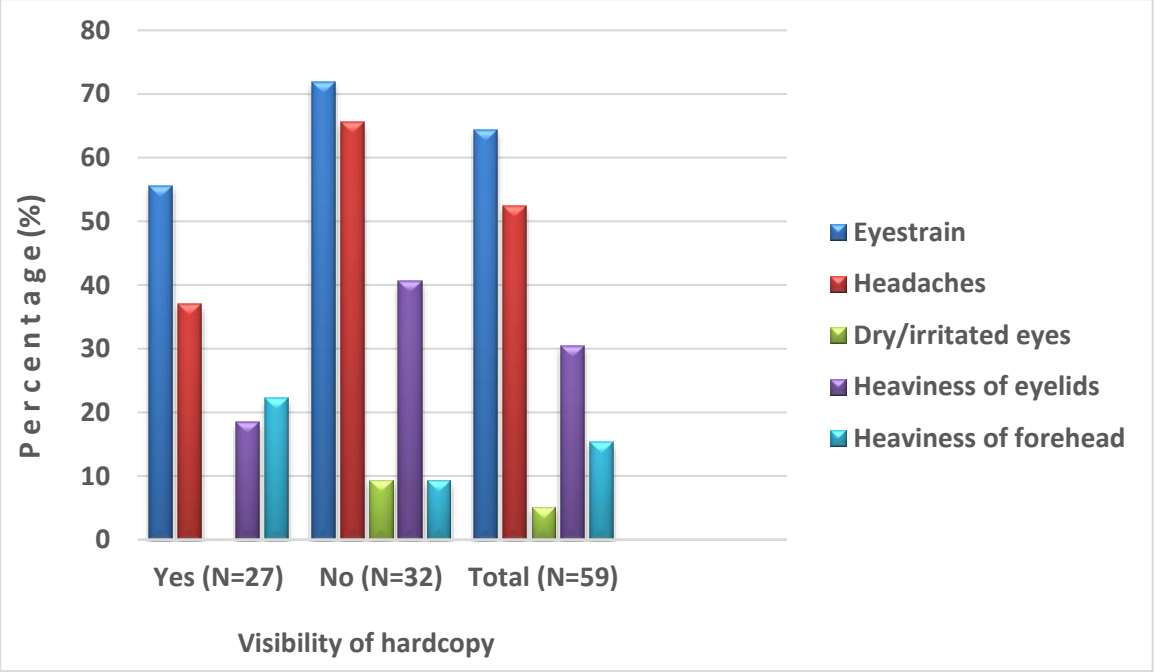


**Figure 19: A bar graph showing visual symptoms reported by the participants and the percentages of the visibility of the hard copy without moving the head.**

### 4.6.2.2 Systemic symptoms reported for visibility of hard copy

The participants reported neck pain as high (43.8%) when hard copy could not be seen without moving the head and low a (37.0%) when hard copy could be seen without moving the head. Other symptoms were also lower when hard copy could be seen without moving the head except backache (See Table 47).

**Table 47: Showing systemic symptoms reported by the participants and the percentages of the visibility of the hard copy without moving the head.**

| Systemic symptoms | Hard copy visibility/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Yes (N=27) | No (N=32) | Total (N=59) |
| Neck pain | 37.0 | 43.8 | 40.7 |
| Shoulder pain | 11.1 | 12.5 | 11.9 |
| Wrist pain | 14.8 | 18.8 | 16.9 |
| Backache | 7.4 | 6.3 | 6.8 |

## SECTION F

## 4.7 THE VISUAL AIDS

### 4.7.1 Participants using glasses

#### 4.7.1.1 Visual symptoms reported for participants wearing glasses

From a total of 64 subjects, 34 participants reported to be wearing glasses while working at the computer and 30 reported that they were not wearing glasses. The results showed a high percentage of slow refocus (67.6%) when the participants were wearing glasses and a lower (50%) when they were not wearing glasses. The lowest symptom that was reported when glasses were worn was blurred near vision (9%).However, when glasses were not worn the lowest symptom was colour distortion (3.3%) (See Table 48).The participants showed an average of (64.1%) of eye strain when wearing glasses and not wearing glasses. The lowest symptom that was reported when glasses were worn was dry and irritated eyes (2.9%), (See Figure 20).

**Table 48: Showing the visual symptoms and the percentages of the participants that wore glasses and those that did not.**

| Systemic symptoms | Glasses/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Yes (N=34) | No (N=30) | Total (N=64) |
| Slow refocus | 67.6 | 50.0 | 59.4 |
| Blurred near vision | 5.9 | 13.3 | 9.4 |
| Blurred distance vision | 8.8 | 20.0 | 14.1 |
| Double vision | 38.2 | 36.7 | 37.5 |
| Colour distortion | 11.8 | 3.3 | 7.8 |
| Light sensitivity | 35.3 | 40.0 | 37.5 |
| After images | 26.5 | 20.0 | 23.4 |

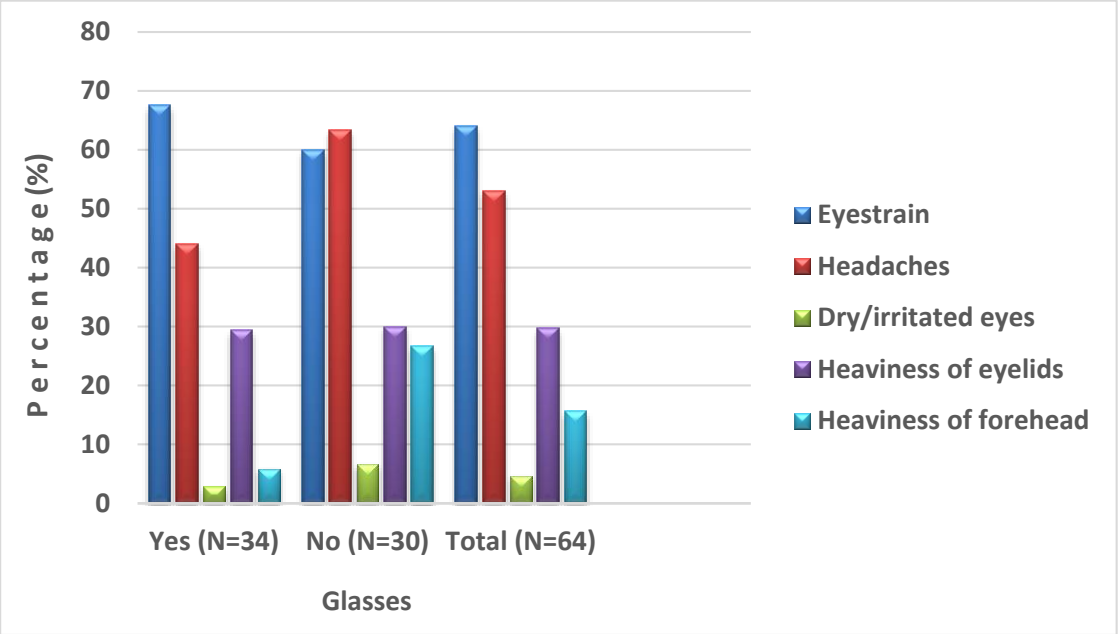


**Figure 20: A bar graph showing the visual symptoms reported by the participants and the percentages of the participants wore glasses and those that did not wear glasses while working at the computer.**

### 4.7.1.2 Systemic symptoms reported for participants who wore glasses

The majority of the participants reported a high (44.1 %) of neck pain when wearing glasses while working at the computer and a low (8.8%) of backache and shoulder pain. The participants also showed a high (36.7%) of neck pain and a low (3.3%) backache when not wearing glasses. All the systemic symptoms were high when subjects were wearing glasses than not wearing glasses except for shoulder pain (See Table 49).

**Table 49: Showing the systemic symptoms reported by the participants and the percentages of the participants that wore glasses and those that did not wear glasses while working at the computer.**

| Systemic symptoms | Glasses/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Yes (N=34) | No (N=30) | Total (N=64) |
| Neck pain | 44.1 | 36.7 | 40.6 |
| Shoulder pain | 8.8 | 13.3 | 10.9 |
| Wrist pain | 20.6 | 13.3 | 17.2 |
| Backache | 8.8 | 3.3 | 6.3 |

### 4.7.2 Participants that had an eye test in the last two years

#### 4.7.2.1 Visual symptoms reported for participants who had an eye test

Most 49(81.7%) of the participants had an eye test in the last two years. The participants that never had an eye test in the last two years showed more symptoms of using computers than those who were tested. For an example, double vision was higher (54.5%) to those who never had an eye test in the last two years and lower (34.7%) to those who were tested (See Table 50).From a total of 60participants, the majority 49(81.7 %) indicated that they had an eye test in the last two years and 11(18.3%) never had an eye test. 5 participants did not indicate if they ever had an eye test or not. The highest (61.2%) symptom that was experienced by the subjects that had an eye test in the last two years was eye strain and the lowest (4.1%) was dry/irritated eyes (See Figure 24).

**Table 50: Showing the visual symptoms reported by the participants and the percentages of the participants that had an eye test and those who did not have an eye test in the last two years.**

| Visual symptoms | Eye test/Percentages(%) of symptoms | | |
|---|---|---|---|
| | Yes (N=49) | No (N=11) | Total (N=60) |
| Slow refocus | 57.1 | 63.6 | 58.3 |
| Blurred near vision | 6.1 | 0.0 | 5.0 |
| Blurred distance | 10.2 | 27.3 | 13.3 |
| Double vision | 34.7 | 54.5 | 38.3 |
| Colour distortion | 10.2 | 0.0 | 8.3 |
| Light sensitivity | 38.8 | 45.5 | 40.0 |
| After images | 20.4 | 36.4 | 23.3 |

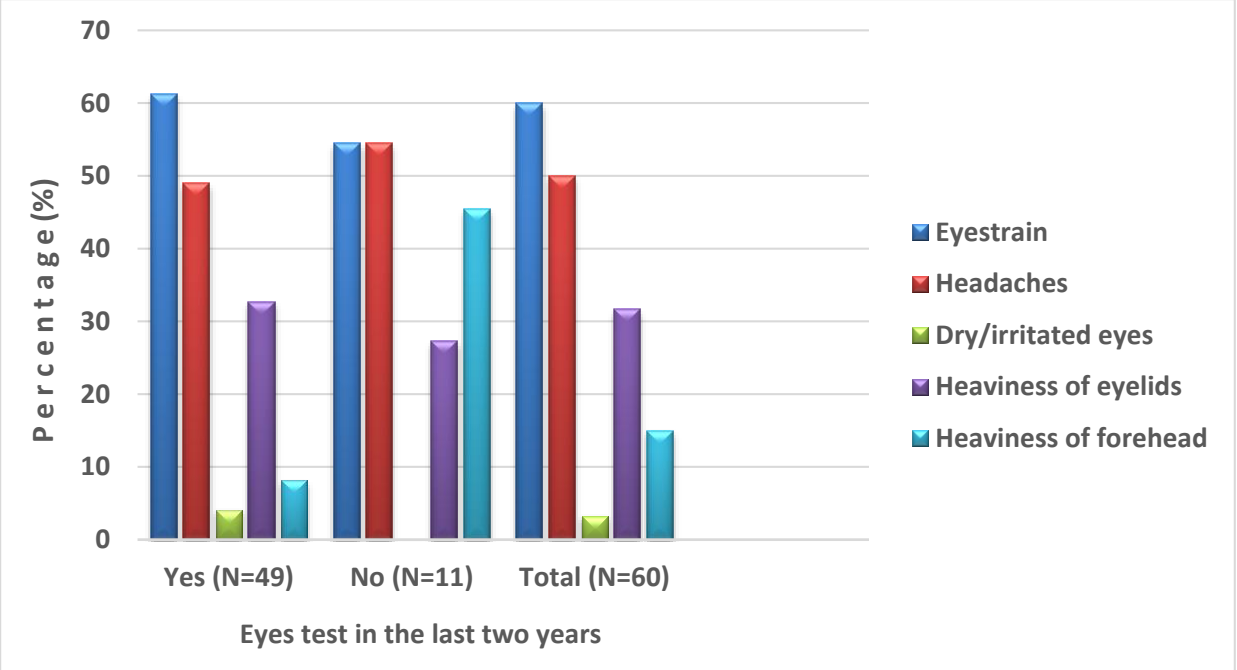


**Figure 21: A bar graph showing the visual symptoms reported by the Participants and the percentages of participants that had an eye test and those who did not have an eye test in the last two years.**

### 4.7.2.2 Systemic symptoms reported by participants that had an eye test

The participants reported a high (72.2%) of neck pain for those who never had an eye test and a low (36.7%) of neck pain for the subjects that had an eye test in the last two years. Shoulder pain was also higher (9.1%) to the subjects that never had an eye test and lower (8.2%) to those who did (See Table 51).

**Table 51: Showing the systemic symptoms reported by the participants and the percentages of participants that had an eye test and those who did not have an eye test in the last two years.**

| Systemic symptoms | Eye test/Percentages(%) of the symptoms | | |
|---|---|---|---|
| | Yes (N=49) | No (N=11) | Total (N=60) |
| Neck pain | 36.7 | 72.7 | 43.3 |
| Shoulder pain | 8.2 | 9.1 | 8.3 |
| Wrist pain | 18.4 | 18.2 | 18.3 |
| Backache | 2.0 | 0.0 | 1.7 |

## SECTION G

## 4.8 FACTORS ASSOCIATED WITH THE LONG USE OF COMPUTERS.

### 4.8.1 Visual factors associated with the use of computers

There were 65 participants who responded to the question about eye strain. Many, 41(63.1%) responded that they suffer from eye strain after using computers and 24(36.9%) did not experience any eye strain. Almost half the number of the subjects 34(52.3%) reported to have suffered from headache after computer use and the other half 31(47.7%) did not suffer from headaches. Very few participants 6(9.2%) experienced blurred near vision and opposed to the majority 59(90.8%) that never reported any blurred near vision. The lowest symptom was dry and irritated eyes which were reported by only 3(4.6%), (See Table 52).

**Table 52: Showing the visual symptoms and responses (number and the percentages) that were experienced by the participants *(*N = 65)**

| Visual symptoms | 'Yes' Response | | 'No' Response | |
|---|---|---|---|---|
| | N | % | N | % |
| Eyestrain | 41 | 63.1 | 24 | 36.9 |
| Slow refocus | 39 | 60.0 | 26 | 40.0 |
| Headache | 34 | 52.3 | 31 | 47.7 |
| Blurred near vision | 6 | 9.2 | 59 | 90.8 |
| Blurred distance vision | 9 | 13.8 | 56 | 86.2 |
| Double vision | 25 | 38.5 | 40 | 61.5 |
| Colour distortion | 5 | 7.7 | 60 | 92.3 |
| Dry/irritated eyes | 3 | 4.6 | 62 | 95.4 |
| Light sensitivity | 24 | 36.9 | 41 | 63.1 |
| Heaviness of eyelids | 19 | 29.2 | 46 | 70.8 |
| After images | 15 | 23.1 | 50 | 76.9 |
| Heaviness of forehead | 10 | 15.4 | 55 | 84.6 |
| Total | 19 | 29 | 45 | 76 |

### 4.8.2 Systemic factors associated with computer use of computers

From a total of 65 participants, 26 (40%) experienced neck pain while 39 (60%) did not report to be having a neck problem after using computer. The participants that experienced shoulder pain were less 7 (10.8%) than those that experienced

shoulder pain 58 (89.2%). Wrist pain was reported by only 11 (16.9%) out of 65participants and 54 (83.1%) reported no wrist pain (See Table 53).

**Table 53: Showing the systemic symptoms and responses (number and the percentages) that were experienced by the participants (*N* = 65)**

| **Systemic symptoms** | **'Yes' Response** | | **`No' Response** | |
|---|---|---|---|---|
| | N | % | N | % |
| Neck pain | 26 | 40.0 | 39 | 60.0 |
| Shoulder pain | 7 | 10.8 | 58 | 89.2 |
| Wrist pain | 11 | 16.9 | 54 | 83.1 |
| Backache | 4 | 6.2 | 61 | 93.8 |

### 4.9 Conclusion

Referring to the visual factors, the participants experienced a high percentage of eye strain, slow refocus and headaches as opposed to the other symptoms. On the systemic factors, fewer participants experienced the symptoms as opposed to those who did not.

# CHAPTER 5

# 5. DISCUSSION

## 5.1 Introduction

The purpose of the study was to investigate the visual and systemic symptoms among the computer users in the two selected companies in Gauteng Province, South Africa. The results of this study will assist in educating the workers and employers on the effects of computer use on the individual's health and work productivity, also the prevention and treatment methods of the symptoms that are associated with the long term use of computers.

## 5.2 Demography

Just like any other developing countries, South African companies rely on computers to perform daily tasks in the work area. The use of computers has been one of the most effective methods thus far. The research included both males and females from the two selected companies in Gauteng.

### 5.2.1 Age

According to Butzon *et al*., (2002), most of the workers who are older and are presbyopes are at a greater risk of developing the symptoms that are associated with long term use of computers even when they wear glasses. In presbyopes, the crystalline lens loses is flexibility resulting in a slow refocus. This is in agreement with the results that were found in this study. Older participants showed a slow refocus as compared to participants of younger ages. Therefore, there was one significant association between age and slow refocus in this study.

### 5.2.2 Gender

In this study, more females participated than the males. The reason for these may be that the two companies had more female employees than the males. Both genders seem to suffer from almost similar symptoms like eye strain. However, a previous study by Sheedy (2008) has shown that more females suffered more from dry eyes than the male counter parts.

### 5.2.3 Occupation

By virtue of the use of computers, all workers were affected by the systemic and visual symptoms that are associated with the use of computers. However, these symptoms were higher in one category than the other. The majority of the participants that were affected were those who did administrative work in terms of the numbers. These results could be attributed to the fact that administrative work requires full time working with computer unlike other categories. Eye strain was highest to the workers who worked under human resource while slow refocus is shown highest to workers who do administrative work. The reason could be that most of the administrative workers could be older age wise as the study has proven that slow refocus is associated with age. Most of the workers that were classified under professionals like the engineers suffered from headaches. According to Anshel (2005), most of the researchers have indicated that visual symptoms occur in 70% to 90% of computer workers. These are however in contrast with a survey that was conducted by the National Institutes for Occupational Safety and Health (NIOSH) that showed that only 22% of computer workers had musculoskeletal disorders. A survey of optometrists (Sheedy, 1992) has proven that about 10 million primary care eye examinations that are done every year are as a result of visual problems that are related to computer work.

## 5.3 The period spent by the participants using computers

### 5.3.1 Number of years

Symptoms such as light sensitivity were associated with the number of years of computer use. The participants who were using computers from 5 -10 years had a higher percentage of light sensitivity. According to Taineo *et al*., (2006), asthenopia, commonly called eyestrain is one of the most common symptoms of exposure to Visual Display Terminal work. It results from prolonged, fixed and closely oriented vision. A result of ophthalmologic medical examination for the participants was taken into consideration and the findings revealed that the intensity of eyestrain was related to the duration of weekly VDT use as opposed to the number of years that an individual was working at the same company.

### 5.3.2 Hours of working with computers per day

The results of this study showed that the participants who used computers from five hours and above per day were suffering a high percentage of eye strain and headaches as compared to the participants who uses it for four hours and less. These results are in line with the findings of Taineo *et al.,*(2006) that the intensity of eyestrain is related to the number of hours that a person take on a computer as opposed to the number of years that an individual has been working with computers.

## 5.4 The working/office environment

### 5.4.1 Frequency of cleaning of the computer screen

This study did not show any association between the frequency of cleaning the computer screen and the symptoms that are associated with computer use. Whether participants were cleaning the computer screen daily, weekly or monthly did not seem to affect the intensity of such symptoms. Other studies recorded that the dust that accumulates on the computer screen may affect an individual who works on the computer. However, such studies did not show how the dust on the screen may affect a computer user (Vision Rx, 2002).

### 5.4.2 Type of lights used in the work area.

The study did not show any association about the type of lights that were used in the office. These results are contrary to those of Anshel (2007) that showed that environmental factors in the work area like the type of lights that are used, play a major role in increasing the symptoms that are related to the long term use of computers. According to Smith *et al.,* (1981), the lighting in the majority of offices is designed for reading paper documents; twice that was needed for computer work. The resident's photons from the overhead lights in the work area often compete with those from the monitor, which, with sunlight thrown in the mix can produce a highly distracting glare.

### 5.4.3 The position of window light in relation to the computer screen

In this study, the only significant association was between after images and position of window light, significant at alpha = 0.05. The large glass windows increase the sensitivity to light for workers who uses computers as shown by Sheedy and coworkers (1992).The majority of the respondents were using blinds while only few were using curtains. This means that blinds were preferred more than curtains in order to limit the light that enters the work area.

### 5.4.4 The status of the inside walls of work place/area

The study shows that the participants that worked in the rooms with shiny walls and those that worked in rooms with dull walls experienced the same effects that are related to the use of computers. On the contrary, other studies showed that shinny wall contributes to the glare which is one of the major causes of eye strain (Sheedy, 2007).

### 5.4.5 The status of the desk surface

The subjects that had a dull desk surface showed slightly lower symptoms than those that used a shiny surface. This is in line with the study that was conducted by Lutron (1998) about the shiny surfaces like desk that result in reflections which in turn

causes strain to the eyes.

### 5.4.6 The status of the work place/area

The study did not show any effect of brightness of workplace. However, previous studies has shown that too much brightness can result into glare which needs to be minimized by using shades, blinds or drapes. According to Lutron (1998), work place lighting correlates to the increased symptoms of the use of computers. Glare from the lighting affects the eyes. The author calls it washout glare and explained it as the glare that falls from the computer screen and lights up the whole screen.

## 5.5 Appearance and the distance of the computer screen to the eye.

### 5.5.1 The colour of letters and the background on the computer screen.

The majority of the participants had black letters on the screen, while others had a white background and some a blue background. This is in agreement with what Sheedy (2007) recommended, a black text on a white background has been proven as the best colour combination for the eyes. Other dark-on- light contrast are also acceptable. Gazing at the images on the screen requires the muscles of the eyes to constantly focus and refocus. When the definition of the screen is poor, the more the eye muscles have to refocus. This will therefore contribute to eye strain (Wahlstrom, 2005). According to Blehm (2005), high levels of contrast and brightness that are known to increase the blurring of characters must be avoided.

### 5.5.2 The mean distance between eyes and computer screen

The study showed that most of the participants suffered from eye strain when the mean distance was long at 53.46 cm than when it was short at 41.23cm. A study by Sheedy *et al.,* (2007) showed that there was less near blurred vision display viewing distance was closer. However, in the same study he recommended a farther viewing distance of 70 to 100cm in order to avoid neck and visual discomfort. This is in agreement with the study that was done by Blem *et al.,* (2005). Initially, the recommended distance between the monitor and the eyes was at 40 to 76cm but

the same researchers conducted a new study and realized that the best distance between computer screen and the eyes must be 89cm to 102cm.

### 5.5.3 Symptoms experienced when the monitor could be tilted or not.

When the monitor could be tilted, eye strain was the highest symptom that was experienced by most of the participants and the lowest symptom was dry/irritated eyes. When the monitor could not be tilted, the highest symptom was slow refocus and the lowest was a blurred distance vision. A study by Sheedy (2007) has shown the importance of the monitor that could be tilted so that it is always positioned in a straight ahead position for proper alignment with the eyes.

### 5.5.4 Symptoms experienced when the monitor could be raised /not

The highest symptom that most people suffered when the monitor could be lowered was eye strain and if it could not be lowered, the percentage for eye strain was lower. The reason for a high percentage of eye strain could be that the monitor was not in a straight ahead and slightly lowered position as shown by Sheedy (2007).

### 5.5.5 The symptoms experienced when the computer screen showed flickers.

Eye strain still appeared to be the highest symptom that was experienced whether the screen was showing any flickers or not. Previous studies however showed that the participants suffered more symptoms when there were flickers on the computer screen (Watt, 2004).

### 5.5.6 Computer screen that had a glare filter

The study showed that there was a significant associations between eyestrain and shoulder pain with a screen that had glare filter at alpha = 0.05. Most of the participants with a glare filter experienced eyestrain whilst only less of those without glare filter had no eyestrain. Again, the majority of the participants with glare filter had shoulder pain whilst fewer of those without glare filter had shoulder pain. The results of this study were in contrast with what was found in previous

studies. The presence of a glare filter should minimize the symptoms of computer use as shown by Watt (2004). In another study that was conducted by Cole (2003), it was shown that if there was no glare filter, the computer worker will try and adjust his or her posture by leaning forward in order to refocus on the letters on the screen. This bodily adjustment resulted in neck or shoulder pain.

### 5.5.7 Screen levels

In this study the level of the screen did not have any effect on the visual symptoms. This was in contrast with what was found in previous studies. Looking below eyelevel reduces the distance between the upper and lower lid and result in less exposure to environmental factors (Redmond, 2008). Blehm *et a*/., (2005) also recommended that the monitor should be at the height that has the middle of the screen at 13cm to 15cm below the level in order to reduce the exposure of the eye ball.

### 5.5.8 The position of the hard copy

The result of the study did not establish any significance association about placement of a hard copy at alpha = 0.05. However, eye strain remained high as showed by this study. Instead, other studies were researching the reason why participants preferred a shorter working distance when using a hard copy than a desktop computer display. The results revealed that the external symptoms associated with the use of computers like tearing, dry eyes and irritation were worse when using a desk top and hand held displays than hard copy. There were fewer symptoms that were experienced by the participants when the hard copy was below the level of the screen as opposed to above the (Kundart *et al.,* 2009).Another study that was conducted by Richmond (2001) revealed that the document should be in front of the worker at the same height and distance as the screen for easy visibility, not to the side.

### 5.5.9 The visibility of the hard copy

The results of this study indicated that there was a significant associations at alpha = 0.05 between headaches and hard copy that was visible without moving the head. The reason for this could be the extra pulling of the eye muscles when a subject is looking between the hardcopy and the computer screen. The majority of the subjects that suffered from headaches were those who could not see their hard copies without moving their heads. The reason for the headache in this instance could be due to the muscle trying to focus and refocus from one area to the other. The ideal position of the hardcopy should be above the keyboard for an easier visibility as recommended by the American Optometric Association (AOA, 2006).

## 5.6 The visual aids

### 5.6.1 Participants who wore glasses while working at the computer.

In this study, almost half of the workers (34%) were wearing glasses while working at the computer and the others did not wear them. The result indicated a significant association at alpha = 0.05 between heaviness of forehead and wearing of glasses while working at the computer. Fewer (14.5%) participants that wore glasses reported heaviness of the forehead as opposed to those who did not wear them. The majority of the participants still experienced most of the symptoms like eyestrain and headache even when wearing glasses. The reason for experiencing such symptoms even when wearing glasses could be that most glasses were not designed specifically for computer use. Most of the glasses either correct distance or reading difficulty but not intermediate like computer distance. Butzon *et al*., (2002) also found the same results when he was researching for the efficacy of computer glasses in the reduction the symptoms as opposed to conventional glasses. Kent (2008) has shown that increasing number of workers who wear spectacles require an extra pair of glasses in order to deal with the symptoms of computer vision syndrome.

### 5.6.2 Participants who had an eye test in the last two years.

The study found out that most of the workers had an eye test in the last two years and only a few never had an eye test. In this study, the results indicated a significant association at alpha = 0.05 between neck pain and had an eye test in last 2 years. The reason for this was because neck pain is caused by poor posture when the subjects are trying to focus on the computer screen. That is why, even when the participants had an eye test, may still suffer from neck pain. There was also a significant association at alpha = 0.05 between heaviness of forehead and had an eye test in last 2 years. A small percentage of the participants that had an eye test reported heaviness of forehead while a significant number of those who did not have an eye test reported heaviness of forehead. Heaviness of the forehead results from over working of the frontal muscles due to long period of working on the computer. According to the South African Optometric Association (SAOA), every individual should have their eyes tested at least once every two years.

## 5.7 Factors associated with the long use of computers

The study has shown that most the participants have experienced two or more of the symptoms that are associated with the use of computers. The factors that may result from a long term use of computers may be environmental, personal or a combination of both (Anshel, 2007). The environmental factors can be the angle of gaze to the computer screen or the illumination of the working area while personal factors include amongst others; uncorrected refractive error, age and working for prolonged time looking at the computer monitor. These factors may then leads to symptoms such as eye strain, slow refocus, blurred vision, headaches, dry eyes and neck pain.

## 5.8 Conclusion

The results show that the majority of the participants suffered from eye strain, slow refocus and headache. Even though other visual related symptoms are not experienced by the majority of participants, such symptoms are noted. According to Blehm *et al.,* (2005), it is the collective symptoms of both the visual and ophthalmic conditions. Therefore this study supports and reinforce that the long term use of computers,

inappropriate ergonomics and other factors such as refractive errors contribute to visual and systemic symptoms.

# CHAPTER 6

# 6. CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

## 6.1 INTRODUCTION

The study will be significant in educating the workers and employers about adverse effects of long term use of computers on individual's health and work productivity. Also on the ways of preventing, treating and managing the symptoms for better health and productivity.

## 6.2 CONCLUSION

Computer Vision Syndrome**,** the collective word for the visual and ophthalmic disorders that is related mostly to fatigue; like eye strain and blurred vision (Natalio, 2008).It is clear from the study that majority of the workers suffered from visual and systemic symptoms relating to the long term use of computers and those probably due to refractive as well as other visual anomalies. According to Thomson (1998), the prevalence of ocular symptoms in computer users is a function of the adverse effects that computer has on individuals. Both workers and employers should take it upon themselves to prevent and manage the symptoms.

Education and awareness about the risk factors associated with the use of computers should be made part of the health and safety standard in the work places. However, the findings of this study were not exclusive in the sense that some of the symptoms may not be due to the long use of computers only. For example, headache may be a symptom or a sign of other underlying factors of a participants' general and ocular health were not investigated in this study. This study could not establish association between the long term use of computers and symptoms such as neck pain and shoulder pain. Such factors may be due to the ergonomics of a particular working area and therefore may have nothing to do with the use of computers. In view of these findings, computer users should be aware of the consequences of computer use and how to prevent associated symptoms. Also, workers should have their eyes examined regularly to prevent visual symptoms, which may contribute to the computer use symptoms. Further, workers should know the appropriate posture

to maintain when working on the computer.

## 6.3 LIMITATIONS OF THE STUDY

1. A comprehensive eye test was not performed on the participants in order to rule out and correct any refractive error that could be present. May be some of the participants had dry eyes that could be determined by Schimer test.
2. The study could have been limited also by the fact that the researcher relied only on the responses from the questionnaire, may be a one on one interview could give different results on the manner which participants responded.
3. In this study, the angle of gaze was not measured as previous studies suggested that it has a major contributing factor as shown by Izquierdo *et al.,* (2004).
4. General health of the participants was not known by the researcher; therefore the study could not prove that experiencing these symptoms was only due to the use of computers.
5.Measurements of the work station such as lighting, posture, viewing angle and distance from the horizontal to the bottom of the computer screen were not done as such might have limited the study.

## 6.4 RECOMMENDATIONS

1. To prevent the symptoms that are related to long term use of computers, proper ergonomics should be in place in the work places.
2. Employees should be given an eye test every two years and if possible, the companies should provide employee with computer glasses that will serve as Personal Protective Equipment (PPE). In order to avoid dry eyes, workers must be discouraged to use medications that may worsen dry eyes. Avoidance of using contact lenses will relieve the symptoms (Natalio *et al*., 2008); therefore, eye care practitioners should advice their clients against the use of such lenses.
3. The companies that have clinics or health centers, should provide appropriate eye drops that would help to lubricate the anterior surface of the eye and prevent symptoms that may be related to dry eyes that might be caused by the use of the computers.
4. Appropriate engineers should be consulted in order to evaluate and set up a desirable work station including evaluation of the lighting in the work area.
5. More research should be conducted in other to establish the various factors that are related symptoms associated with the use of the computers.
6. Computer users should have about 15 minutes breaks in after two hours of computer work.

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## APPENDICES

### APPENDIX A:

**QUESTIONNAIRE**

Socio-Demographic Information

**NUMBER** | | | |

1. Age | | |

2. Gender | Male | Female |

3. Occupation | |

4. How many years have you been working with the computer? | | |

**Work Practices**

7. How many hours do you work on the computer per day? | | |

8. How often do you take breaks during work? | | |

9. How often do you clean your computer screen?

| Daily | Weekly | Monthly | Never |
|---|---|---|---|

| Other…… |
|---|

**Environment**

9. What type of lights is used in your work area? (Tick all that apply)

| | |
|---|---|
| Florescent overhead only | Incandescent overhead only |
| Both Florescent & incandescent overhead | Both Florescent & incandescent direct |

10. Where is the window light in relation to your screen?

| | | |
|---|---|---|
| In front | Behind | To the side |

11. What is your window light control?

| | | |
|---|---|---|
| Curtains | Blinds | None |

12. How is the inside walls of your work place/area?

| | |
|---|---|
| Shiny | Dull |

13. How is your desk surface?

| | |
|---|---|
| Shiny | Dull |

14. What is the brightness of your work place?

| | |
|---|---|
| Bright | Dim |

15. Air Conditioner?

| | |
|---|---|
| Available | Not Available |

**Computer Screen (Video Display Monitor)**

16. What color are the letters on your screen? _____

17. What color is the background of your screen? _____

18. What is the distance between your eyes to the computer screen? …..cm

19. Can you monitor be tilted?

| | |
|---|---|
| Yes | No |

20. Can your monitor be raised or lowered?

| | |
|---|---|
| Yes | No |

21. Does your screen have flicker?

| | |
|---|---|
| Yes | No |

22. Does your screen have glare filter?

| | |
|---|---|
| Yes | No |

a. If Yes, is it Glass? or Mesh

23. At what level is the screen? (Choose 1)

a. Above eye level ☐

b. At eye level ☐

c. Below eye level ☐

**Work Station**

24. Where do you normally place the hard copy material? (Choose 1)

a. To the side of the screen ☐

b. Below the level of screen ☐

25. Is all your hard copy material visible without you moving your head?

**Visual & Associated Factors**

26. Do you wear glasses while working at the computer? Yes | No

27. If you wear glasses what type are they (Choose 1)

a. Single vision ☐

b. Bifocal ☐

c. Multifocal ☐

d. Contact lenses ☐

e. Do not know ☐

28. Have you ever had eye test in the past 2 years?

| Yes | No |
|---|---|

29. Have you experienced any of the following? (Tick all that apply)

| | | | |
|---|---|---|---|
| Eyestrain | ☐ | Slow refocus | ☐ |
| Headaches | ☐ | Blurred near vision | ☐ |
| Neck pain | ☐ | Blurred distance vision | ☐ |
| Double vision | ☐ | Dry/irritated eyes | ☐ |
| Shoulder pain | ☐ | Color distortion | ☐ |
| Wrist pain | ☐ | Light sensitivity | ☐ |
| Backache | ☐ | Heaviness of eyelids | ☐ |
| After images | ☐ | Heaviness of forehead | ☐ |

## APPENDIX B

### Voluntary consent concerning questionnaire and information leaflet

**Researcher's name:** Joyce Pheladi Mogane
**Student number:** 9006906
**Course:** Master of Public Health
**Institution:** University of Limpopo

**Title of the study:** An investigation of the visual and systemic symptoms among workers at the National Home Builders Registration Council (NHBRC) and British Petroleum (BP) in Johannesburg, Gauteng Province, South Africa.

### Dear Participant

I am a MPH student at the University of Limpopo. You are invited to volunteer to participate in my research project on an investigation of the visual and systemic symptoms among the workers at your company.

This letter is to help you understand what is involved by giving you important information on the study. If you have questions or queries, do not hesitate to ask the researcher.

### Purpose of the study

The aim of the study is to investigate the adverse effects which may results due to the use of computers. The visual and systemic symptoms like eye strain, blurred vision, slow refocus and headache may be experienced. Using computer for most part of your day, you are at risk of these symptoms and that makes you a very important source of information regarding this.

**Procedure to be followed**

You will be required to complete a questionnaire which will take about 10 minutes of your time. This questionnaire will be kept at a safe place to ensure confidentiality and you need not disclose your name or any information that may identify you.

**Risk and discomfort involved**

There are no risks involved in this study. You are only requested to complete the questionnaire and answer all the questions.

**Possible benefits of the study**

Any participants may be given free advice on these symptoms from the researcher. The results of the study will be made available to your company with suggestions on how to reduce the risk of the long term effects of using computers; the findings may also help the company ensuring a worker friendlier and safe environment.

**The rights of the participants**

Your participation in this study is voluntary and you may refuse to participate or stop your participation at any time without giving any reason. Your withdrawal will not affect you in any way.

**Ethical approval**

The study has received written approval from the Research Ethic Committee of the University of Limpopo. A copy of this approval is available if you wish to have one.

**Confidentiality**

The study may be published in a scientific journal but confidentiality of the participants will be maintained.

**Consent**

By completing this questionnaire the participant implies that he/she is giving consent.

**Compensation**

Your participation is voluntary and no compensation will be given; however information relating to the study that can benefit you may be obtained without cost from the researcher.

**Information and contact person**

If you have any questions or queries, please do not hesitate to contact me, Joyce (researcher) at 0745843233 or Mr. Kekana P (co-supervisor) at 0152683404.

I sincerely appreciate your kind participation in this study

Yours truly
Mogane JP