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Research Article

Accommodative Insufficiency Induced Asthenopia

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Abstract

Purpose: The purpose of this study was to investigate accommodative insufficiency induced asthenopia among students using computer in MMUST.

Methods: This study used descriptive study with cross sectional approach. The subjects of the study comprised 78 students from the department of computer science, Masinde Muliro University. The inclusion criteria in the study was those willing to fill in the questionnaire and receive the optometric examination, normal visual acuity corresponding to 1.00 LogMar scale and those without ocular disorder capable of obstructing the visual axis.

Results: Among the computer using students the prevalence of asthenopia was 60.30%. The most frequent symptom that was reported was eye pain with a score of 126 among the whole population and 91 among the asthenopic population. The least reported symptom was diplopia with a score of 51 for the whole population and 41 among the asthenopic population. Out of the 60.3% of asthenopic population, 19.1% had accommodative insufficiency. Chi-square test showed association between asthenopia and accommodative insufficiency (p value 0.000).

Conclusion: Asthenopic symptoms were highly prevalent among computer using students in the university setting. There is significant association between asthenopia and accommodative insufficiency, thus there is need for more research to be carried out on this association and accommodation measurements should be performed more routinely and regularly, as screening, especially in computer users and those with asthenopic symptoms.

Keywords: *Accommodative Insufficiency, Asthenopia, Computer Using Students*

Operational Definitions

Accommodative insufficiency (AI): Refers to a reduced level of focus stamina required for accurate near binocular vision.

Asthenopia: Weakness or easy fatigue of the eye, with pain in the eyes, headache, dimness of vision.

Refractive error: It is a state of the eye whereby the rays of light from an object converge before the retina or behind the retina of the eye.

Convergence Insufficiency (CI): It is the inability to maintain binocular function while working at a near distant

Near point of accommodation (NPA): The point nearest the eye at which an object is clearly focused on the retina when accommodation of the eye is at a maximum.

Myopia: It is a state of the eye whereby close objects are seen clearly, the rays of light from an object converge before the retina, hence blurred vision for distant objects.

Hyperopia: It is a state of the eye whereby far objects are seen clearly, the rays of light from an object converge behind the retina, thus blurred vision.

Astigmatism: It is a defect in the eye caused by a deviation from spherical curvature, which results in distorted images.

Anisometropia: It is a condition in which the two eyes have unequal refractive power.

Introduction

The world has been changed to a global village with the help of computers. The use of computers and office automation like email, image processing with facsimile equipment, voice processing with teleconferencing enables people from different location to see and communicate with each other, share ideas and video without the need to travel Computer usage has increased work productivity leading to financial gains. It has been estimated that computer use is increasing exponentially worldwide and so have resultant health problems, especially ocular problems [2]. People using computers experience health problems, such as computer vision syndrome (CVS) - a combination of visual problems and poor ergonomics. According to Ihemedu., *et al.* [3]. CVS is common to millions of computer users around the world. CVS however, remain underestimated [4] and poorly understood condition at the work place. CVS is caused by the eye and the brain reacting differently to characters on a computer display than they do to a printed character. Characters on a visual display lacks contrast of well-defined edges than printed characters, therefore color intensity of digital characters diminish around the edges. The visual symptoms associated with CVS includes; headache, eye strain, blurry vision and dry eye syndrome.

Asthenopia has been associated with accommodative and convergence insufficiency [5]. Asthenopic symptoms have been shown [6] to increase with severe accommodative insufficiency. Accommodative insufficiency as an anomaly is characterized by inability to sustain focus at near [7]. It is often associated with insufficient amplitude of accommodation with regards to age. Thus, presenting with eyestrains and headache (asthenopia), double vision (diplopia) and difficulty with reading.

Background Information

As our dependence on computer continues to grow, an increasing number of people are seeking medical attention for eye strain, headache and blurry vision. Asthenopia was the most reported ocular symptom 62% [2]. Asthenopia is a term used to describe a sense of strain and weakness and/or ocular fatigue set up by the use of the eyes [8,9]. Symptoms associated with asthenopia are more common with near work because there is more strain on the accommodation and vergence systems for near work. Research studies report a prevalence of asthenopia as15.2% in 6 years old children (lp., *et al.* 2006) and 34.7% in school going children 6-10 years old [10].

Various risk factors for asthenopia have been studied [11,12] mainly in developing countries and these include; Age, sex, uncorrected refractive errors, prolonged close work, ergonomics, type of Visual Display Unit terminal activities and nature of work environment. Also found to be a significant risk factor is the characteristics of computer screen such as; resolution, viewing distance, and psychological [11,12]. To reduce asthenopia, findings [13] showed that environment modifications and adjustment of computer screen characteristics will be very useful.

Akinbinu [14] classified asthenopia into two main types: refractive and muscular asthenopia. Asthenopia due to disturbances of accommodation may be regarded as either refractive or muscular asthenopia [15], as shown in the table below [15].

Refractive asthenopia	Muscular asthenopia
Hypermetropia	Heterotropia / Heterophoria
Myopia	Convergence insufficiency
Astigmatism	Accommodative insufficiency
Anisometropia	

Table 1

Hypermetropia does not always require correction because young people can accommodate to overcome part of their refractive error, hence achieving good near and far vision (Khan 1999 and Jones 1997). Most young people especially children with asthenopic symptoms due to hypermetropia, the amplitude of accommodation is usually low in relation with the degree of hypermetropia. These people are not able to comfortably overcome their hypermetropia. As a result, they need correction with plus lenses, to reduce the accommodative demand resulting in a stable binocular vision and a decreased level of or elimination of the asthenopic symptoms [16].

In addition to blurry far vision, myopia also causes esophoria and accommodation fluctuations at near. The abnormal accommodative responses in young people can give rise to uncomfortable vision when doing near activities [15]. In case of high exophoria and intermittent exotropia at distance, a prescription for full time wear of the full refractive error is recommended. In case of esophoria at near or accommodative insufficiency, a plus lens addition for near can be appropriate.

All astigmatic refractive errors larger than 0.25D should be corrected if any asthenopic symptom is present. Correction of astigmatism in all patients including those with asthenopia improves visual acuity and stabilizes input into the accommodative systems, thus eliminating or reducing the symptoms of asthenopia [17]. When anisometropia is corrected using glasses, two problems may appear. That is, either prismatic effect of the glasses or aniseikonia - resulting from difference in magnification of the two lenses - which may lead to problems with binocular vision [16]. Young people with good accommodation can adapt to these effects of anisometropic correction and may not experience impaired binocular vision. The most frequent complains of accommodative insufficiency are inability to sustain focus on near target for a prolonged period - like reading, diplopia and asthenopic symptoms. Treatment of asthenopia should be directed to the cause and work-related environmental modifications effected. The inability to maintain convergence - inward vergence eye movement - for visual demand at near results in symptoms of asthenopia. According to Evans [16], fusional eye movements refers to the ability of the eyes to perform vergence eye movement until the object of regard falls on the corresponding retina areas. Decompensated heterophoria is associated with asthenopia.

Despite all these studies, no similar studies on awareness of computer vision effects and its corrective measures has been carried out in East Africa including Kenya despite most people in Kenya especially university students engaging in computer use for longer hours in their day to day activities.

Scope of Study

This study will show the relationship between accommodative insufficiency and asthenopia among computer using students. It will be carried out in Masinde Muliro University of Science and Technology (MMUST). The university is located in Kakamega town in Kenya. Study design applied will be descriptive cross-sectional whereby the etiology and prevalence of asthenopia due to accommodative insufficiency will be analyzed. The study will involve 84 subjects who will be selected from the 94 students pursuing computer science as well as information technology in the university. Random sampling technique will be used in the selection of the subjects by the use of computer software.

Statement of the Problem

Many computer users present with asthenopic symptoms such as; headache, ocular fatigue and straining. Asthenopia can impair one's ability to function efficiently at near work. Due to the significant effects of asthenopia there is a need to find out its because which has been widely overlooked by clinicians. Also, there is need to know the role of accommodative insufficiency in asthenopic symptoms.

With increased demand for computer usage, it becomes apparent why many users presenting with symptoms of headache, eye pain and visual fatigue have been related to refractive errors as the main cause. With close association between asthenopia and accommodation insufficiency, the need to investigate the relationship of asthenopia and Accommodative insufficiency among computer users becomes highly necessary. This study will highlight the role of Accommodative insufficiency in asthenopic complains presented by regular or prolonged computer users.

Study Rationale

Many computer users present with asthenopic symptoms such as; headache, ocular fatigue and straining. Our study is hoped to show the association between accommodative insufficiency and asthenopic symptoms among computer users. This finding will be relevant for diagnostic purposes and for clinical management of asthenopia due to accommodative insufficiency among prolonged computers users. Most importantly, the finding of our study will promote awareness both among clinicians and patients on the adoption of simple preventive approaches such as; elimination of root cause and adoption of healthy modifications of work-related environmental.

Purpose of the Study

Aim

The aim of this study was to investigate accommodative insufficiency induced asthenopia among students using computer in MMUST.

Specific Objectives

- To determine the prevalence of asthenopia among computer using students
- To determine the prevalence of accommodative insufficiency among computer using students
- To determine the relationship between accommodative insufficiency and asthenopia among computer using students

Literature Review

Introduction

There has been increased usage of computers worldwide and so therefore their resultant health and ocular problems associated with them. Health and ocular problems as a result of computers reduce quality of life and financial losses and so there is need to reduce them.

In this chapter, the literature on ethology of asthenopia, prevalence of asthenopia, and prevalence of accommodative insufficiency will be reviewed.

Causes of Asthenopia

Asthenopia can be caused or induced by each of the following distinct conditions: glare from lighting; anomalies of binocular vision such as convergence insufficiency and esophoria; accommodative dysfunction such as reduced amplitude and accommodative infacility; uncorrected refractive errors, including presbyopia; compromised quality of the viewed image such as poor contrast or legibility; less than optimal gaze angles; flickering stimulus such as CRT computer displays; and dry eyes [18]. The main cause of asthenopia is thought to be fatigue of the ciliary and extra ocular muscles due to prolonged accommodation and vergence required by near work [19] Another causative factor is dryness of the eyes resulting from increased exposed surface area of the cornea when focusing straight ahead and a decreased blink rate due to mental concentration [6]. Muscular asthenopia may be caused by heterophoria, intermittent heterotropia

and convergence insufficiency, whereas refractive asthenopia is due to ametropia and a combination of accommodative and convergence insufficiency [20]. Asthenopic symptoms include headache, eye ache, photophobia, lacrimation, diplopia and blurry vision [19].

According to Husnun., *et al.* [6] there are two major causes of asthenopia that is; refractive anomalies and muscular anomalies. In the study on accommodative insufficiency as a cause of asthenopia, a total of 99 subjects were studied whereby consisting of 61 males and 38 females of the age range of 16 - 26 years. Refractive anomalies accounted for majority of asthenopia causes (95.7%). The following table shows the distribution of the causes of asthenopia.

Refractive anomaly	No. of subjects	Percentage %
Myopia	15	21.7
Astigmatism	2	2.9
Compound myopic astigmatism	3	4.3
Combination of AI and CI	11	15.9
AI	35	50.7
Muscular Anomalies		
Heterophoria	0	0
Intermittent Heterotropia	0	0
Convergence insufficiency	3	4.3

Table 2

Saber., *et al.* [21], 2007, carried out a study with an aim of describing the orthoptic and ophthalmological findings in school children with asthenopia and to correlate them with asthenopia symptoms and to evaluate the effects of treatment. 120 school children with asthenopia aged 6 - 16 years were included in the study. Ophthalmological assessment was performed, and the diagnoses were; accommodative insufficiency (AI), refractive errors (RE), and latent strabismus. Reading glasses could help (98%) of the school children with accommodative insufficiency and (94%) of the children with refractive errors and heterophorias were helped with appropriate spherical, cylindrical and prism correction. Convergence exercises reduced the symptoms in all patients with Convergence Insufficiency. (93%) of all the 120 children were symptoms free after 3-6 months after treatment had started. By this ophthalmological and orthoptic examination, abnormalities in school children with asthenopic related to visual problems can be identified. Most of the children were relieved from their symptoms by giving glasses, convergence exercises and surgery.

Saber., *et al.* [21], carried out a study to determine the prevalence of refractive errors and binocular disorders in relation to asthenopia in a representative population of Swedish school children. The study population included 216 school children. The conclusion of this study was that asthenopia was significantly associated with uncorrected VA of 0.65Logmar, and with myopia equivalent of - 0.50D or less among Swedish school children.

In a study conducted by Husnun., *et al*. in 2010 [6] on accommodative insufficiency as a cause of asthenopia in computer using students, it was found that high prevalence of asthenopia was mostly caused by refractive asthenopia. The duration of use of computer per day was not significantly associated with asthenopia.

Prevalence of Asthenopia

Asthenopia also referred to as visual fatigue or eyestrain is a very common condition among computer users in every day practice but most go undiagnosed or inadequately managed (Iwakiri 2004).

In a study which aimed at determining asthenopic symptoms, a total of 308 computer users participated where 187(60.7%) were females. (87.6%) of study participants were aged between 20-39 years, with their mean age being 26.8 years. Prevalence of a single asthenopic symptoms among them ranged from (13.9% - 46.3%) whereas (63.0%) of them had at least two asthenopic symptoms. The study also found out that the higher the number of hours a person used the computer the more symptoms recorded. There was no significant relation between age, gender and asthenopia [22].

Dinesh., *et al.* [23]. conducted a study in India on prevalence of asthenopia among 419 computer operators and its risk factors. Results showed that among 419 subjects, 194 (46.3%) suffered from asthenopia. Marginally, higher proportion of asthenopia was noted in females compared to males. Occurrence of asthenopia was significantly associated with age of starting use of computers, presence of refractive error, viewing distance and use of anti-glare screen. Prevalence of asthenopia was noted to be quite high among computer operators especially those who started using it at an early age.

Husnun., *et al.* [6] in a study on accommodative insufficiency as a cause of asthenopia in computer using students, out of 99 computer science students who participated, 69.7% had asthenopia. The duration of use of computer per day was not significantly associated with asthenopia. The high prevalence of asthenopia was mostly caused by refractive asthenopia.

Cheng Cheng., *et al.* [24] conducted a study on Chinese college students to determine the prevalence of asthenopia and its risk factors. Out of 1469 subjects who participated, 58.7% were males with average age of 21.4 years, 839 (58.7%) had asthenopic symptoms and there were no significant differences between gender and asthenopia. It was observed that high asthenopic symptoms were probably related to psychological state, environmental health status and dietary and life style habits.

Jyothi., *et al.* [2] in a study on prevalence of ocular symptoms among computer professions in a university setting in South India, 385 subjects of mean age 36 years were used in the study where (43.6%) were males. The mean duration of computer use was 6.6 hours, prevalence of asthenopia among those who reported ocular symptoms were (76%) at the end of a typical working day. Eyestrains was the most reported ocular symptom (62%) in the study, eye fatigue (43%), irritating and burning eyes (39%), blurred vision (36%), dryness of eyes (27%) and eye redness (23%). There was no association found between age, gender and ocular symptoms in this study. There was no correlation between ocular symptoms with duration of computer use by day and work at visual display terminal.

Another study on determining photo stress among visual display terminal worker in certain company in Jarkata using 285 study participants found out that; the most frequent eye problem encountered were as follows- eye fatigue (65.3%), headache (45.7%), blurring of vision (26.6%) among the operators. Among the control group the results were as; eye fatigue (60.5%), headache (24.4%), watery eyes (30.2%) and blurry vision (27.9%) [25].

Association between accommodative insufficiency and asthenopia

In a study of patients diagnosed with AI with 96 participants, the incidence of blur was (56%), headache (56%), asthenopia (45%) and diplopia (45%). Those who had at least one subjective complaint had the prevalence being (42.4%) of 59 patients, headache (28.8%), asthenopia (23.7%), floating text 18.6% and facility problems (5.1%) (Scheiman., *et al*. 2006).

Pilar., *et al.* [26] carried a study to determine the scientific evidence of accommodative and non-strabismic binocular anomalies. They carried out a systematic review of studies published between 1986 and 2009, analyzing the Medline, Cinahl, Francis and Psycoinfo databases. In this study there was a wide range of prevalence, particularly of accommodative insufficiency (2 - 61.7%) and convergence insufficiency (2.25 - 33%).

Shin., *et al.* [27] studied the effectiveness of vision therapy in children. 57 children age 9 - 13 years were diagnosed with symptomatic convergence insufficiency (n = 27) or combined symptomatic convergence insufficiency and accommodative insufficiency (n = 30). They

were independently divided into a treatment and control group, matched by age and gender. A quality of life instrument documented the symptomatic patients and charted improvement in symptoms after therapy.

Marry., *et al*. [28], study on AI: A literature and Record Review fifty-four cases met the eligibility criteria for AI as defined in this paper. Myopia (56%) was most commonly found refractive condition in this group followed by emetropia (37%), and hyperopia (7%). The most frequently encountered chief complaint was distance blur (n = 20 subjects) followed by headaches (n = 8), both distance and near blur (n = 7) and near vision blur only (n = 5). Optometric vision therapy was prescribed in 27.8% of the cases, while plus at near was given in (74%) of the cases. Of 40 patients issued plus at near, bifocals (40.7%) were most commonly prescribed, followed by reading glasses (29.6%) and progressive addition lenses (3.7%).

Husnun., *et al*. [6] in a study on Accommodative Insufficiency as a cause of asthenopia in computer using students, 99 students participated until completion. Out of these 69(69.7%) had asthenopia. Accommodative insufficiency was observed to be the major cause of asthenopia [6] 35 (50.7%). The concurrence of refractive error leads to an increased probability of subjective complaints.

In study to find out the influence of AI on reading, AI was reported to be the common cause of asthenopia in school children between ages 8 - 15 years [29]. Asthenopia was significant handicap to learning as the symptoms were specifically related to near visual work. In the three-case report; one complains of difficulty while reading, the other, blurred vision and occasionally diplopia during reading followed by headache and the final case had reading problem and asthenopia. These cases were included in the study only when were thoroughly investigated to ensure that AI was the only underlying cause of asthenopic symptoms.

Materials and Method

Study area

The study was carried out in MMUST main campus. The university is a public university in Kenya and is located in Kakamega town in western Kenya. It is located 1 KM from Kakamega Central Business District on the Kakamega Webuye road.

The institution is located 42 KM from Webuye, and 58 KM from Kisumu city. Kakamega is a cosmopolitan town with an estimated population of 73607 [30]. Its main occupants are the Luhya community. The economic activities of the town are farming, fishing and trade.

MMUST has an estimated student population of 12000.It offers more than 156 programs and computer science is one of the major course, other renowned courses include engineering, health, business and education.

Study design

This study was on descriptive study with cross sectional approach. The study was conducted in August 2015 at the Department of Optometry (pre-eye clinic) Masinde Muliro University.

Study population

The subjects of the study comprised 84 students from the department of computer science, Masinde Muliro University. The inclusion criteria to participate were normal visual acuity corresponding to 1.00 LogMar scale, those without ocular disorder and willing to participate.

Sample Size Determination

The sample size for the study was determined by using the formula below;

$$\mathbf{n=}\ \frac{A}{[E2+(\frac{A}{N})}$$

n = Minimum sample size required (approximate)

P = Assumed population prevalence, in % = prevalence of asthenopia among computer users 76% [2].

Q = Proportion of students with asthenopia = (100 - P).

E = Degree of accuracy tolerable (5% precision) for this study (Margin of error acceptable due to random sampling in %).

W = Design Effect (change in design due to randomization by cluster) = 1.5

N = Population of computer science and IT students in MMUST= 94.

$Z_{(\alpha = 0.05)}$ = Standard normal deviate at 5% = 1.96 (corresponding to 95% confidence interval i.e. probability of not exceeding E).

A = PQW

P = 76% [2].

Q = 100 - 76

W = 1.5%

N = 94

E = 5%

A =x 76 x 24 x 1.5 = 10510.62

E^2 = 5 x 5 = 25

= 10510.62/94 = 111.82

n = 10510.62/(25+111.82) = 76.82

Contingency provision for non-response = 10%

Therefore, n = 76.82 + 7.6

Hence, our sample size was 84 subjects

Sampling Technique

We adopted the simple random sampling method in our study.

Selection of study participants

Using the computer generated random system (http://www.random.org/integers/); 84 participants were randomly selected from a population of 94 students on the enrolment register.

The procedure involved:

1. We obtained the total number of students and their contact details from the computer science department.
2. We coded the students from 001 - 94.
3. 84 participants were randomly selected from the coded students using computer generated random software.
4. We matched the selected codes with the names on the student register.
5. The selected students were contacted and then invited to the clinic.
6. Upon coming to the clinic, the procedure was explained to the subjects before they gave consent.
7. Preliminary examination was done for eligibility for those who gave consent before giving the questionnaire.
8. All 84 participants gave consent, but one did not meet the inclusion criteria.

Instruments for data collection

A structured questionnaire [13]

- Log MAR distance and near chart
- Penlight
- RAF rule
- Keeler retinoscope
- Trial set
- Occluder

Data Collection Procedure

Data collection was by means of a structured questionnaire and ophthalmological and optometric procedures.

The data collected by questionnaire comprised; demographic status, average hours of use of near work per day, total duration of computer use and 15 items on subjective complaints due to asthenopia. Response to the 15 items were scored as; 0, never; 1, infrequent; 2, occasionally; 3, relatively frequent; 4, frequent; 5, always. The subject that complained of more than or equal to 9 symptoms were assigned in a group labelled A (asthenopia) and those with less than 9 symptoms were placed in the group labelled B (no asthenopia). Those in group A received optometric examination comprising determination of visual acuity, refraction before test for amplitude of accommodation using RAF rule. The subjects were diagnosed having low amplitude of accommodation with reference to minimum Hofstetter's formula 15 - .25x age with respect to the age.

Data entry and analysis

Data was coded and entered into excel. The cleaned quality data was analyzed using SPSS V. 20; The study data was divided into a group of subjects with asthenopia and data with no asthenopia group subjects. The relation between variable of the asthenopia and no asthenopia groups and those diagnosed with accommodative insufficiency were analyzed using chi square test. A P-value of < 0.05 was considered significant. The data was analyzed using the SPSS program version 20.0.

Limitation of the Study

There were examiners biased results- this was managed by some doing the examination and the other examiners doing the analysis.

Ethical Issues

Ethical Approval was obtained from the MMUST Ethical Committee.

Risks to the Study Participants

The study was risk free.

Compensation / Reimbursement

There was no compensation except for convenience purposes.

Informed Consent

Consent was obtained from participants after explaining the aims of the study and any potential risks to them.

Confidentiality Assurances

All hard/soft data and information was safely stored on encrypted storage devices at the department of Optometry and Vision Sciences.

Results

Introduction

This chapter gives a brief preview on the results that we obtained during the data collection for the study.

Demographic characteristics of respondents

The total number of participants that were willing to participate in this study were 83, of whom 5 did not meet the inclusion criteria. One subject had ocular pathology and the other 4 did not complete the questionnaire. Out of the 78 who participated to the end 57 were male. The mean age of the subjects was 21.59 years ± 2.44. Age distribution of the respondents is as illustrated in the figure below.

Age

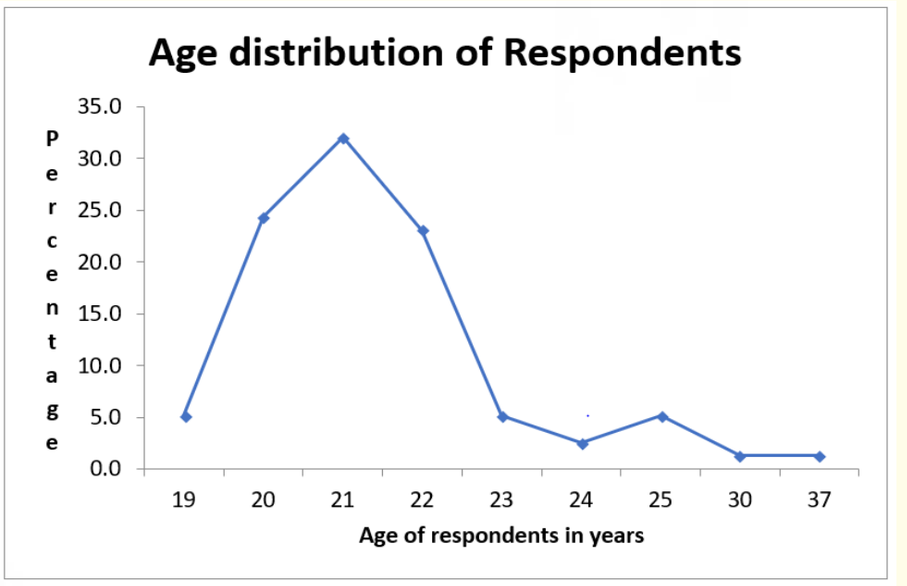

Figure 1: *Age distribution of respondents.*

The average computer usage per day in hours among the subjects was 7 hours 27 minutes with a minimum of 2 hours and a maximum of 16 hours as illustrated in the figure below.

Distribution of computer usage in hours per day

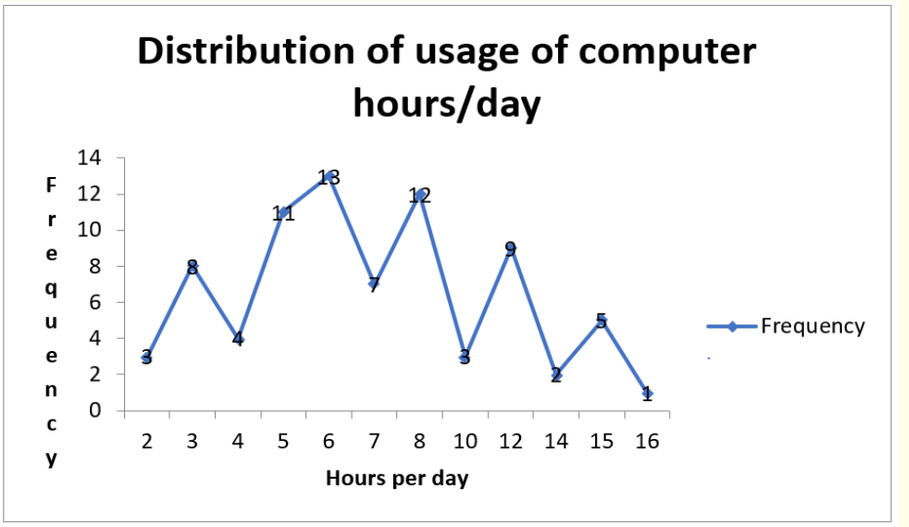

Figure 2: *Distribution of usage of computer hours/day.*

Duration of computer use in years

The majority of subjects had used the computer for a period of 2 - 4 years (46.2%),

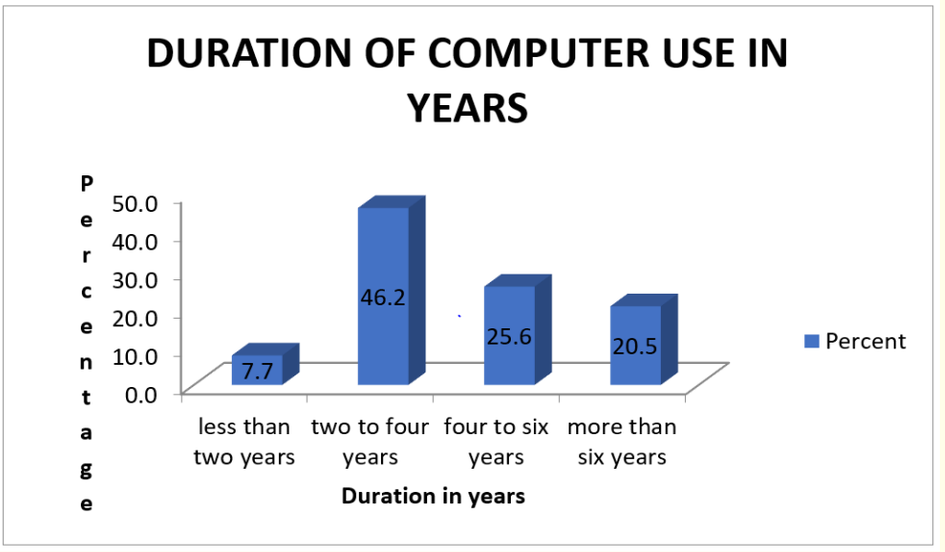

Figure 3: *Duration of computer use in years.*

Prevalence of Asthenopia

The prevalence of asthenopia was 60.30%.

Where prevalence = asthenopia respondents/ total respondents *100

P=47/78*100 = 60.30%

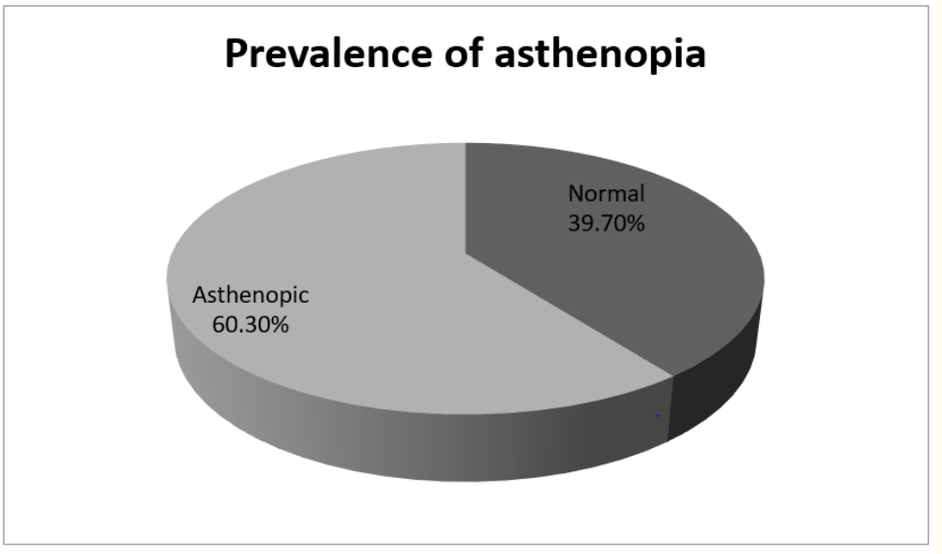

Figure 4: *Prevalence of asthenopia.*

Prevalence of asthenopic symptoms

The most common asthenopic symptoms were; eye pain with a score of 91, uncomfortable vision with a score of 85 and soreness with a score of 84.

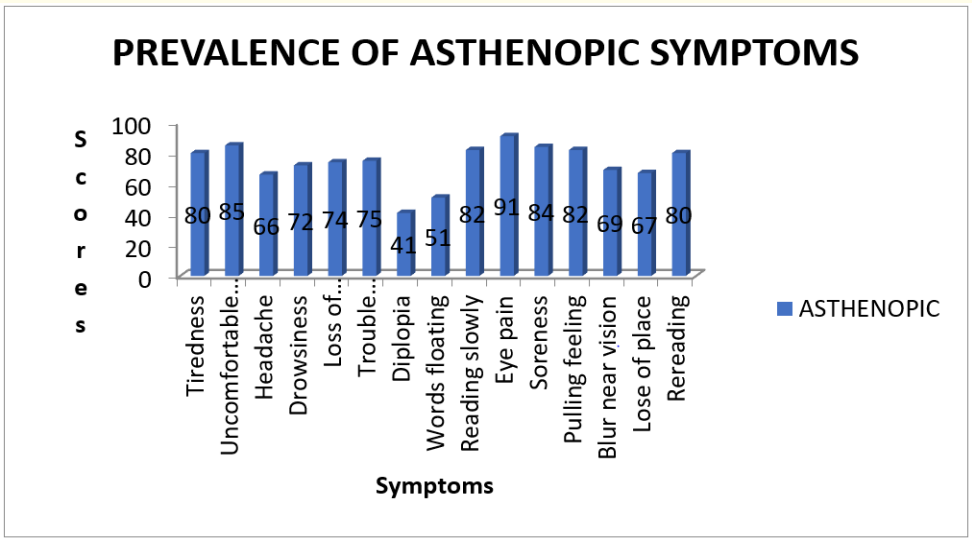

Figure 5: *Prevalence of asthenopic symptoms.*

Distribution of amplitude of accommodation

The distribution of amplitude of accommodation is as illustrated in the figure below, whereby, 19% of asthenopic participants had low amplitude of accommodation (AA) according to Hofstetter's formula 15 - .25x age with respect to the age.

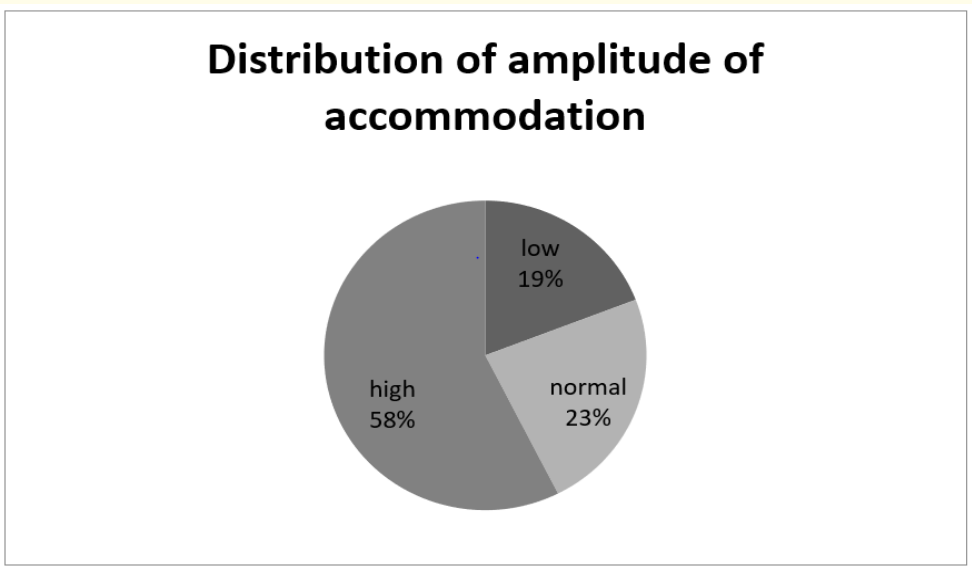

Figure 6: *Distribution of amplitude of accommodation.*

Prevalence of accommodative insufficiency

Accommodative insufficiency was 19% among the asthenopic participants.

Prevalence of AI = low amplitude/total asthenopic*100

Prevalence of AI = 9/47*100 = 19.1%

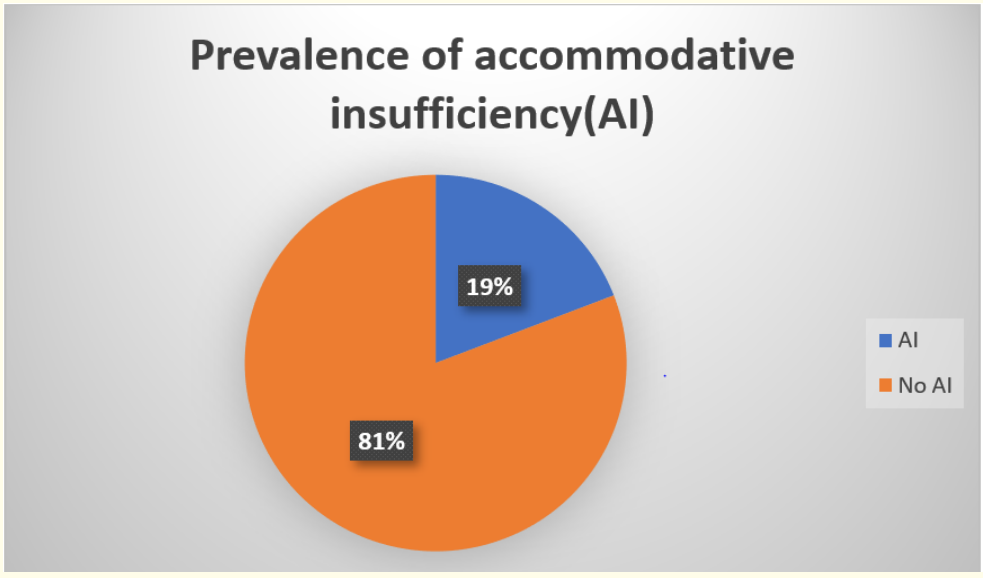

Figure 7: *Prevalence of Accommodative Insufficiency (AI).*

Relationship between Accommodative Insufficiency and Asthenopia

With a statistical P- value was 0.00 an indication of a strong relationship between accommodative insufficiency and asthenopia.

Chi-Square Tests			
	Chi-square Value	df	P value
Pearson Chi-Square	82.000[a]	6	0.000

Table 3

Discussion

In this age of high technology, about 70% of computer users worldwide report having vision problems and there is an alarming increase in the people affected (Blehm*., et al.* 2005). The present study on computer using students showed a high prevalence of asthenopia (60.30%). Previous studies have also shown a similar high prevalence of asthenopia in computer usersin a study on prevalence of ocular symptoms among computer professions in a university setting in South India was 76% [2]. In another study on Chinese college students with average age of 21.4 years, 58.7% had asthenopic symptoms [24]. Husnun., *et al.* [6] in a study on accommodative insufficiency as a cause of asthenopia in computer using students, out of 99 computer science students who participated, 69.7% had asthenopia.

Most subjects in the study reported uncomfortable, this was due to the characters on a computer screen are not as precise or sharply defined, the level of contrast of the characters to the background is reduced and the presence of glare and reflections on the screen makes viewing more difficult, hence uncomfortable vision leading to high prevalence of asthenopia. Visual work on a computer involves saccadic eye movements, accommodation and vergence movements which all involve continuous muscular movements [13]. With prolonged computer work the eye muscles get fatigue thus leading to asthenopic symptoms. There was no significant association between age, gender, hours per day and duration of computer use in years with the high prevalence of asthenopia in the present study. The duration of computer use in hours per day was similar to a study carried out by [6] that showed no significant association between duration of computer use and the occurrence of asthenopia. In contrast, a study in India found that mean computer use of 78 minutes duration was associated with occurrence of asthenopia [11]. This could be attributed to the fact that most respondents in our study adhered to visual hygiene practices while using the computer.

The prevalence of accommodative insufficiency in the asthenopic subjects in the present study was 19%, Which is similar to a study by Reindel. B (2010) which was 18% among asthenopic patients. Accommodative insufficiency is the major cause of asthenopia, because computer-related activities overburden the accommodation mechanism [6]. The association between accommodative insufficiency and asthenopia was proven to be significant (pearson chi-square P = 0.000) [31-41].

Conclusion

Asthenopia symptoms were highly prevalent among computer using students in the university setting. There is significant association between asthenopia and accommodative insufficiency, thus there is need for more research to be carried out on this relationship and accommodation measurements should be performed more routinely and regularly, as screening, especially in computer users and those with asthenopic symptoms.

Recommendation

Based on the observations made during the course of this study and analysis of findings, the following recommendations are made so as to enhance learning and reduce the prevalence of asthenopia among students:

- Eye care practitioner should endeavour to probe patients who attend eye clinic during consultations about the history of computer use and time spent to discuss with the patient about the visual effect of computer use.
- The clinicians should find out the root cause whenever the patient comes in with asthenopic symptoms and advice on modification of work-related environment.
- Regular screening of students in learning institution should be advocated.
- Visual hygiene in computer using professionals should be advised.

Conflict of Interest

There were no conflicts of interest among the investigators.

The research protocol adhered to the provision of the Declaration of Helsinki for research involving human subjects.

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