JAMBI MEDICAL JOURNAL
Jurnal Kedokteran dan Kesehatan
Vol. 12, No. 2, November 2024
DOI: 10.22437/jmj.v12i2.31573
Journal homepage: https://online-journal.unja.ac.id/kedokteran
p-Issn : 2339-269x
e-Issn : 2580-6874

Original Article

Relationship Between Accommodation Insufficiency, Screen Time, and Asthenopia Symptoms in Young Adult Patients

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Article History:

Submited Oct 23, 2023
Review Dec 14, 2023
Accepted Sep 10, 2024

Keyword:
Amplitude of accommodation;
Screen time;
Asthenopia

ABSTRACT

Background: Asthenopia, characterized by symptoms following near visual activity, often affects individuals with accommodative insufficiency and prolonged screen time. This study aims to investigate the correlation between demographic, refractive status, accommodative insufficiency, screen time, and asthenopia symptoms among patients at the Indonesia National Eye Centre, Cicendo Eye Hospital Bandung, Indonesia.

Method: In this cross-sectional study, consecutive sampling was conducted to obtain subjects. Ocular examinations were performed to determine refractive status, amplitude of accommodation, accommodative insufficiency, symptoms of asthenopia, and screen time.

Result: *A total of 105 subjects were included in the study, with a median age of 25 years (IQR: 3). The median amplitude of accommodation was 9.09 D (IQR: 0.7), which was found to be lower than normative data. Asthenopia was observed in 47 subjects (44.7%), and accommodative insufficiency was present in 37 subjects (35.2%). Male gender and screen time > 8 hours per day were significantly correlated with asthenopia (p=0.048 and p<0.001, respectively), while refractive status and accommodative insufficiency showed no significant correlation*

Conclusion: this study demonstrates a relatively similar prevalence of asthenopia. Additionally, male gender and excessive screen time were identified as risk factors for asthenopia.

INTRODUCTION

International Commission on Occupational Health (ICOH) Scientific Committee on "Work and Vision" in 2003 stated that there is a high prevalence of visual impairments and discomfort among workers engaged in near-distance activities. Objects placed at a distance of one meter for extended periods activate excessive accommodation and cause discomfort in the eyes, a condition known as Asthenopia. Asthenopia is a collection of symptoms experienced by

patients after engaging in activities such as screen time, reading, and other near-distance activities. Symptoms such as headaches, dry eyes, double vision, glare, and a sensation of foreign objects on eyes are symptoms of asthenopia. These symptoms can lead individuals to cease near-distance activities.[1–4]

Accommodation itself is the process of increasing the dioptric power of the eye, aiding in focusing images on the retina if the images behind the retina. Total dioptric power of the eye increases due to the increased dioptric power of the lens. The eye's maximum ability to increase the dioptric power of the lens is referred to as the amplitude of accommodation. Accommodative insufficiency is one of the accommodation disorders that can prevent patients from focusing on near objects and may lead to symptoms of asthenopia. prolonged screen time is a risk factor for asthenopia, causing discomfort during near-distance activities in addition to accommodative insufficiency. [2,5,6]

This study aims to describe the demographic characteristics, amplitude of accommodation, and the relationship between accommodative insufficiency, screen time, and symptoms of asthenopia among patients in the refractive clinic at the Indonesia National Eye Center, Cicendo Eye Hospital, Bandung, Indonesia.

METHOD

This study is a prospective analytical observational study using a cross-sectional method with primary data collected from patients attending the Refractive Clinic at Indonesia National Eye Center, Cicendo Eye Hospital, Bandung, Indonesia during the period of June to October 2022. Inclusion criteria were all patients aged 18 to 35 years who attended the Refractive Clinic and underwent amplitude of accommodation examination. Exclusion criteria were patients with incomplete data and corrected visual acuity below 1.0.

Prevalence study formula was used to determine the required sample size. Calculation using a 95% Confidence Interval resulted in a sample size of 96 patients. Consevutive sampling method was done to collect research subject.[7]

Data collected included demographic characteristics such as gender, age, and occupation of the patients. Amplitude of accommodation was measured using the Royal Air Force (RAF) Rule examination repeated three times, obtaining the average from the nearest distance at which the eyes could see clearly. This average value was then divided to determine the amplitude of accommodation in diopters (D). Normal amplitude of accommodation was obtained using the Hofstetter Expected Amplitude Accommodation formula, which is 18.5 - (0.3 x Age).[8] Subject with amplitude of accommodation less than 2 D compared to the normal age group were classified into the accommodative insufficiency group. Screen time data were collected, calculated in hours, and grouped into 4 categories: <4 hours, 4-6 hours, 6-8 hours, and >8 hours per day. Refractive abnormalities were categorized based on the eye with the greatest deviation, with myopia defined as Spherical Equivalent (SE) ≤ -0.50, hyperopia as ≥ 0.50, and emmetropia as ≥ -0.50 to ≤ 0.50. Symptoms of asthenopia were considered present if the patient experienced at least 1 of the following symptoms only present during near visual work: blurred vision, eye pain, dry eyes, difficulty focusing, double vision, sensation of foreign objects, tearing, photophobia, and eye swellin. Data were analyzed using Microsoft Excel 2019® and analytical data with SPSS® version 25. Numerical data with non-normal distribution were descriptively presented with median (interquartile range IQR). The relationship between numerical data was analyzed using Spearman's correlation test. Chi-square test was used for proportion tests. Statistically significant results. indicated with $p<0.05$.

RESULT

Data were collected from 170 patients who attended the Refractive Clinic undergoing

amplitude of accommodation examination. Out of these, 53 patients were over 35 years old and 2 patients were under 18 years old, thus they were excluded. Additionally 10 patients were excluded because they could not achieve visual acuity of 1.0. The total sample obtained for this study was 105 patients who met the inclusion and exclusion criteria.

Table 1. Demographic characteristic

Respondent Characteristic Variables	Frequency (n)	Percentage (%)
Gender		
Male	28	26.7
Female	77	73.3
Occupation		
Student	31	29.5
Employee	48	45.7
Unemployed	22	21.7
Self-employed	4	3.8
Myopia		
Mild	57	54.3
Moderate	35	33.3
High	7	6.7
Emmetropia	3	2.9
Hypermetropia	3	2.9

The median age of the study subjects was 25 (IQR: 3) years. The majority of participants in this study were female, with 77 (73.3%) patients being women. The most common occupation among the participants was students (29.5%). The most prevalent refractive abnormality was mild myopia (54.3%). The demographic characteristics and refractive abnormalities are presented in Table 1.

Table 1. Characteristic of Asthenopia, Accommodation Insufficiency and Screen Time

Characteristic	Frequency (n)	Percentage (%)
Asthenopia Symptoms		
Yes	47	44.8
No	58	55.2
Accommodation Insufficiency		
Yes	37	35.2
No	68	64.8
Screen Time		
< 4 hour	3	2.9
4-6 hour	31	29.5
6-8 hour	45	42.9
> 8 hour	26	24.8

Symptoms of asthenopia were found in 47 subjects (44.8%) with accommodative insufficiency present in 47 (35.2%). The majority of screen time fell within the 6-8 hours range (42.9%). The proportions of asthenopia, accommodative insufficiency, and screen time are presented in Table 2.

The median amplitude of accommodation in this study was 9.09 D (IQR: 0.7). This significantly negatively correlates

with the subjects' age, as indicated by Spearman's correlation test (r: -0.699, p<0.001). The median Hofstetter expected amplitude of accommodation was 11 D (IQR: 0.9). The most common symptom of asthenopia was blurry vision when reading at near distance (85.1%), followed by eye pain when reading at near distance (72.3%). Other symptoms of asthenopia are presented in Figure 1.

Analysis of the proportion of the gender variable with the occurrence of asthenopia shows that males have a higher risk compared to females (RR = 1.56) and is statistically significant (p = 0.047). The variable of accommodative insufficiency has a higher risk of developing asthenopia (RR = 1.25) but is not statistically significant (p = 0.31). Further details of the analysis are provided in Table 3.

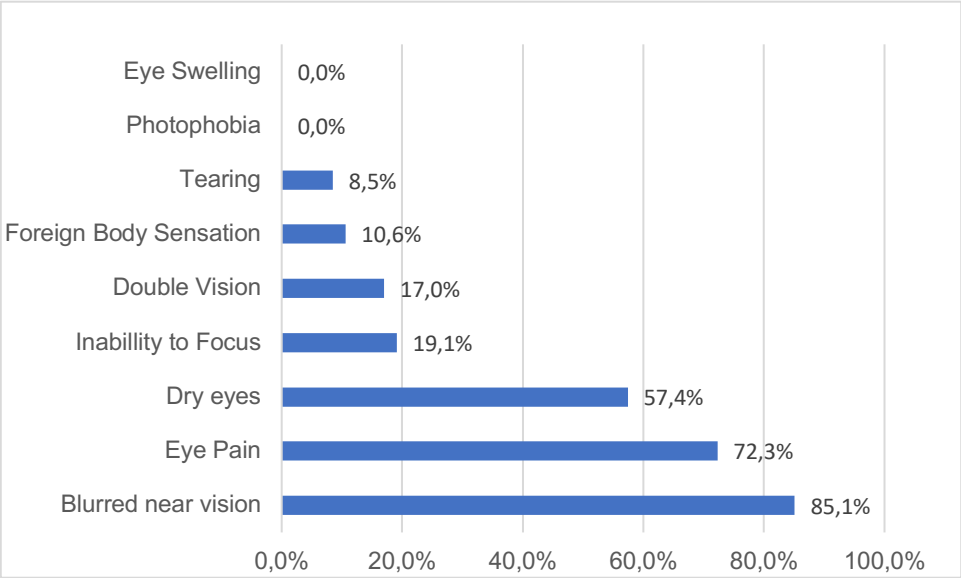

Figure 1. Prevalence symptoms in Aesthenopia

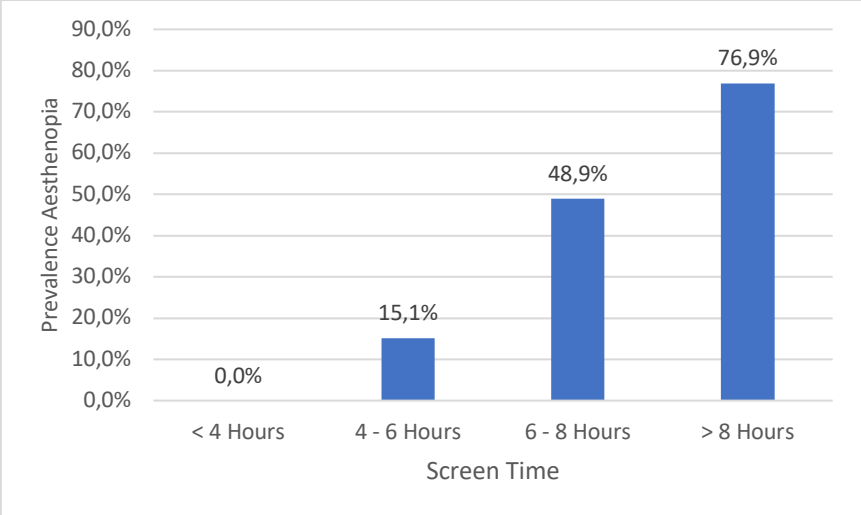

Figure 2. Proportion Comparison Screen Time to Prevalence Of Asthenopia

Table 3. Proportion table compared to Asthenopia Occurrence

Variabel	Asthenopia Occurrence		PR* (95% CI)	P value
	Yes n=47 (%)	No n=58 (%)		
Gender				
Male	17 (36.2%)	11 (23.4%)	1.56 (1.04 –	0.047*
Female	30 (63.8%)	47 (81.0%)	2.34)	
Accommodation Inssuficiency				
Yes	19 (40.4%)	18 (31.0 %)	1.25 (0.81 –	0.317*
No	28 (59.6%)	40 (69.0 %)	1.9)	

Chi-Square test. with p value <0,05. asterisk* mark shown p<0,05 statistically significant. CI : *Confidence Interval*

Analysis of the proportion of screen time on the occurrence of asthenopia indicates that longer screen time is associated with a higher occurrence of asthenopia compared to shorter screen time. Among subjects with >8 hours of screen time, asthenopia occurred in 76.9% of cases. The Chi-Square test yielded statistically significant results (p=0.00). Other characteristics are explained in Graph 2. Analysis of the proportion of refractive status shows that the highest prevalence of asthenopia occurs in mild myopia at 49.1%, but this result is not statistically significant according to the Chi-Square test (p=0.81). Other refractive statuses with asthenopia are presented in Figure 3.

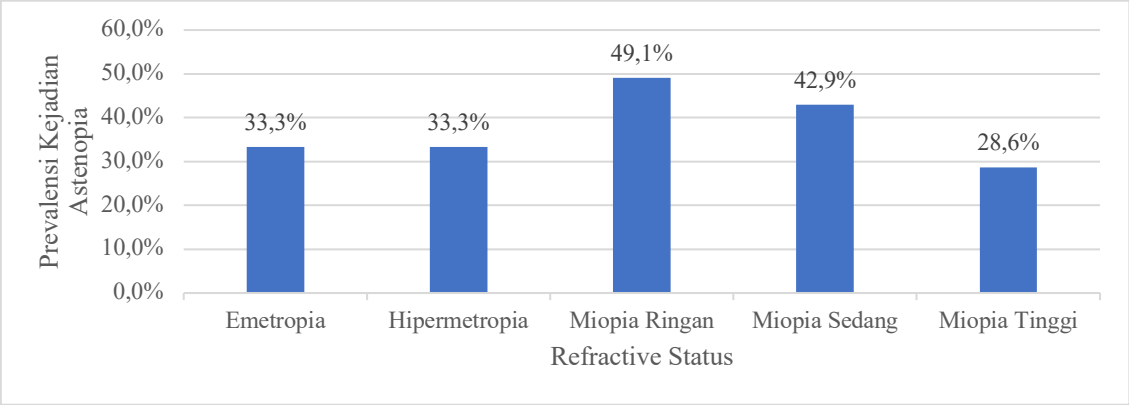

Figure 3. Propotion Comparison Refractive Status and Prevalence of Asthenopia
Chi square test P value = 0.81

DISCUSSION

The proportion of asthenopia in this study was found to be 44.8% with a median population age of 25 years. Other studies have found higher values, such as Bhanderi et al. with 46% at a mean age of 25 years and Kaya with 53.3% at a mean age of 20.4 years. The highest prevalence was found by Han et al. at up to 71% in the age range of 18–30 years. [9–11]

There is a significant correlation between reduced amplitude of accommodation found in this study, consistent with the known fact that age is a factor that can reduce amplitude of accommodation. A similar finding was reported by Nikolay et al. with a difference of about 2 D from normative data. Accommodative insufficiency itself has a prevalence ranging from <1.00% to 61.6%, with hyperopia having the highest prevalence. This study found a proportion of accommodative insufficiency of 35.2%. [3,12,13]

Unlike the results of Han and Agarwal, no significant difference in gender was found.

Bhanderi et al. and Hashiemi et al. found that females had a higher prevalence of asthenopia compared to males. This study found that males have a higher risk of developing asthenopia compared to females.[9,14] Hashemi et al. found that the most common symptom of asthenopia was glare at 48%.[2] This study found that the most common symptom was blurry vision when reading at near distance at 85.1% and eye pain at 72.3%. This may be due to accommodative insufficiency, leading to blurry vision, although it was not statistically significant.

Studies by Medelin et al. and Simarmata et al. found similar non-significant results for screen time above 4 hours. This study found that increased screen time can increase the occurrence of asthenopia, with >8 hours reaching 76.9%. Similar results were found by Mehra et al. with screen time >8 hours increasing the risk of asthenopia (odds ratio 1.94). Refractive status in this study was not found to be significantly associated with asthenopia.[5,15,16]

Afzal et al. and Shakeel et al. found a weak correlation with myopic refractive abnormalities. Prabhu et al. found that hyperopia was one of the main risk factors for asthenopia.[17–20] The difference in these results may be due to the small number of subjects with refractive abnormalities other than myopia in the study.

CONCLUSION

The characteristics of amplitude of accommodation in patients attending the refractive clinic at Cicendo Eye Hospital National Eye Center were found to be lower than normative data. Similar results were found from previous data. Male gender and longer screen time are associated with a risk of asthenopia, while refractive status and accommodative insufficiency do not have a significant relationship.

SUGGESION

Limitations of this study include a small sample size, especially for refractive statuses other than myopia, recall bias that may arise from screen time, and near point convergence status. Suggestions from this study include a larger study sample with variation in patient refractive statuses.

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