ACTA MEDICA BULGARICA

Vol. LII 2/2025

CENTRAL MEDICAL LIBRARY MEDICAL UNIVERSITY – SOFIA

CONTENT

Vol. 52 No. 2 (2025): Acta Medica Bulgarica
Acta Medica Bulgarica
Published: 13.06.2025

ORIGINAL ARTICLES

CASE REPORT

SCIENTIFIC REVIEW

SHORT COMMUNICATION

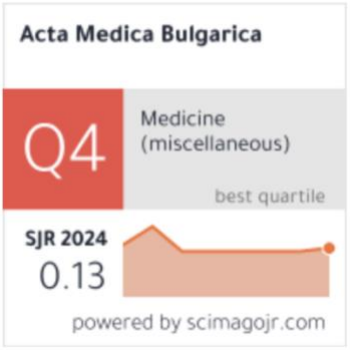
Scimago Journal & Country Rank (SJR) Rank
Laman : https://www.scimagojr.com/journalsearch.php?q=26759&tip=sid&clean=0

Acta Medica Bulgarica

COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	SJR 2024
Germany Universities and research institutions in Germany Media Ranking in Germany	Medicine Medicine (miscellaneous)	Walter de Gruyter GmbH	0.132 Q4 H-INDEX 7

PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
Journals	03241750	1975-1976, 1978-1987, 2001-2024	Homepage How to publish in this journal miravankova@abv.bg

Journal Metrics



sciendo
10.2478/AMB-2025-0038

ORIGINAL ARTICLE

CONTRAST SENSITIVITY AND ASTHENOPIA ANALYSIS IN WORKERS

H. Amalia[1], A. Adiwardhani[1], A. Devita[2], M. Pratiwi[3], R. Witjaksana[1], A. Dewi[4], E. Yousif[5]

[1]Department of Ophthalmology, Faculty of Medicine, Universitas Trisakti – Jakarta, Indonesia
[2]Department of Microbiology, Faculty of Medicine, Universitas Trisakti – Jakarta, Indonesia
[3]Medical Professional Education Program, Faculty of Medicine, Universitas Trisakti – Jakarta, Indonesia
[4]Department of Ophthalmology, Faculty of Medicine, Universitas Islam Malang – Malang, Indonesia
[5]Department of Chemistry, Al-Nahrain University – Bagdad, Iraq

Abstract. *In the digital age, complaints of eyestrain, or asthenopia, have become increasingly common. This condition is often associated with prolonged near-work activities, such as extended use of computers or digital devices, with reported prevalence rates ranging from 40% to 90%. Eye fatigue is influenced by a decline in the eye's accommodative capacity. Optimal visual function and acuity contribute to reducing visual discomfort by enhancing contrast sensitivity – the ability to clearly and precisely discern the boundaries of microscopic or fine-detail objects.* ***Materials and Methods:*** *The study design was observational analytics and a cross-sectional approach. The number of patients was 94 people aged 18-60 years, without having anatomical abnormalities of the eye in the form of corneal opacities, cataracts, turbidity of refractive media, and retinal abnormalities. Research instruments in the form of asthenopia questionnaires and Pelli Robson charts were used to examine eye contrast sensitivity. Results*: *84% of respondents in this study were aged > 25 years, 72.4% had worked for > 2 years, and 34% did close viewing activities for 2-5 hours/day. The incidence of asthenopia was 76.6%, and 96.8% had normal eye contrast sensitivity ability. Analysis using the chi-square test showed no significant relationship (p = 1,000) between contrast sensitivity and asthenopia.* ***Conclusion:*** *There was no significant relationship between contrast sensitivity and asthenopia.*

Key words: *contrast sensitivity, asthenopia, length of work, near vision activities*

Corresponding author: *Husnun Amalia, Department of Ophthalmology, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia, email: husnun_a@trisakti.ac.id*

ORCID: *0000-0001-9727-8874*

Received: *14 July 2024;* ***Accepted:*** *07 January 2025*

INTRODUCTION

In accordance with the Regulation of the Minister of Health of the Republic of Indonesia (PERMENKES) in 2016, the vulnerable adult age is 19-44 years [1]. Generally, those in the adult age category are already active in activities using electronic devices daily. During this pandemic, the use of electronic devices has increased, and people who are used to doing activities directly but switch to online work are required to continuously stare at the screen. This, of course, endangers human health, especially eye health [2]. Asthenopia is one of the impacts that can occur in eye health problems [3].

Asthenopia or tired eyes is a condition characterized by non-specific symptoms such as eye strain, tired eyes, eye discomfort, eye irritation, hot sensation, and headaches [4]. The main cause of asthenopia is fatigue of the ciliary and extraocular muscles due to prolonged accommodation and excessive accommodation work to see at close range. Other causative factors that can have implications for asthenopia are staring at the screen for too long and reduced blinking frequency, which causes the eyes to experience excessive evaporation so that the eyes become dry [5].

The World Health Organization (WHO) found that the incidence of eye fatigue globally reached 40% to 90% [6]. The high prevalence of eye fatigue was also found in students in various countries such as China (53.5%), Malaysia (89.9%), and Egypt (86%) [7]. According to research conducted by Fernanda in 2018, the incidence of asthenopia in Indonesia is quite high, reaching 69.7% [8].

Contrast sensitivity (CS) is the ability to see the boundaries of small objects clearly and distinctly. CS testing uses a Pelli-Robson chart to measure visual sensitivity at various levels of contrast and can assess early visual impairment [9]. Several studies have shown that CS provides useful information about everyday visual function that is not reflected in visual acuity and visual field test results. CS affects various aspects of vision, especially motion detection, visual fields, dark adaptation, and visual acuity [10].

Research on the difference in eye sensitivity to asthenopia in adults has never been done. CS can affect visual acuity so that it can overcome eye fatigue or asthenopia. Based on this, researchers aim to identify the relationship between contrast sensitivity and asthenopia in adults.

MATERIALS AND METHODS

The study was conducted using an analytical observational design and a cross-sectional approach in Jakarta, Indonesia, in 2024. The total study sample was 94 workers collected using consecutive non-random sampling. The inclusion criteria in this study were 18-60 years old and willing to take part in the study, while the exclusion criteria were having a history of eye anatomical abnormalities (corneal opacities, cataracts, and retinal abnormalities).

The research instrument utilized was the asthenopia questionnaire on Google Forms. This questionnaire comprises 15 questions concerning subjective complaints related to asthenopia. Each response is scored as follows: a score of 0 is assigned for "never"; 1 for "rarely"; 2 for "sometimes"; 3 for "quite often"; 4 for "often"; and 5 for "always". The total score for the 15 questions ranges from 0 to 75. Subjects are deemed at risk of asthenopia if their total score exceeds 9. Those with a total score lower than 9 are categorized in the negative symptom group, while those with a total score greater than 9 are placed in the positive symptom group [11].

Contrast assessment of eye sensitivity was carried out using a Pelli Robson card placed at a distance of 1 meter in front of the respondent. Respondents were asked to read the letters listed on the card. The results of the contrast sensitivity response ability in the right eye, left eye, and both eyes (Binocular) were recorded, with normal values being log > 1.80 and less if < log 1.80.

Data analysis used the SPSS (Statistical Package for Social Science) program. This study has obtained research ethics approval from the Research Ethics Committee of the Faculty of Medicine, Trisakti University, with the number 003/KER/FK/I/2024.

RESULTS

Univariate analysis in this study assessed the frequency distribution of respondents.

Table 1. Characteristics of respondents

Variable	Frequency	Percentage (%)
Age		
< 25 years old	15	16
> 25 years old	79	84
Gender		
Man	29	30.9
Woman	65	69.1
Duration of Work		
< 2 years	13	13.8
> 2 years	68	72.4
Not Working	13	13.8
Near Vision Activities		
< 2 hours	22	23.4
2-< 5 hours	32	34.0
hour	29	30.9
> 8 hours	11	11.7
Asthenopia		
Yes	72	76.6
No	22	23.4
Contrast Sensitivity		
Normal	91	96.8
Less	3	3.2

The age of respondents was between 19-59 years with an average of 37.98+10.774, with the most common age being 43 years (8 people). The duration

of work is between 0-39 years with an average of 10.61+10.159.

Table 2. Relationship of Contrast Sensitivity with Asthenopia and Risk Factors

Variable	Contrast Sensitivity		p	Asthenopia		p
	Normal	Less		Yes	No	
Age						
< 25 years old	15	0	1.000*	11	4	0.745§
> 25 years old	76	3		61	18	
Gender						
Man	28	1	1.000*	17	12	0.006§
Woman	63	2		55	10	
Duration of Work						
< 2 years	13	0	0.553§	9	4	0.581§
> 2 years	63	3		54	14	
Not Working	13	0		9	4	
Near Vision Activities						
< 2 hours	21	1	0.418§	14	8	0.175§
2-< 5 hours	32	0		24	8	
5-8 hours	27	2		26	3	
> 8 hours	11	0		8	2	

*Fisher exact test; §Chi Square test

Table 3. Relationship between the Asthenopia Questionnaire and the Incidence of Asthenopia

Questionnaire	Relationship with Asthenopia (p)
Eye fatigue	0.000
Red eye	0.131
Heavy sensation in the eyes	0.000
Dry eye	0.018
Sleepy	0.000
Difficult to remember what just read	0.000
Pain around the eyes	0.001
Headache around the forehead or back of the head	0.001
Blurry vision	0.000
Sometimes double eye vision at near sight	0.000
Some lines are missed when reading	0.001
When I read, I was confused about how to read it	0.000
Difficulty focusing/losing concentration when reading/writing/working	0.000
Must squint your eyes to focus your vision when reading/writing/working	0.006
Seeing words/letters jumping/moving	0.097

Table 2 shows a significant relationship between gender and asthenopia (p = 0.006). Table 3 shows that the Pearson Chi-Square test on all asthenopia questionnaires was associated (p < 0.05) with asthenopia except for complaints of red eyes (p = 0.131) and seeing words/letters jumping/moving (p = 0.097). Table 4 shows no relationship between contrast sensitivity and asthenopia (p = 1.000).

Table 4. Relationship of Contrast Sensitivity with Asthenopia

Variable	Asthenopia		p
	Yes	No	
Contrast Sensitivity			
Normal	69	3	1.000*
Less	22	0	

*Fisher exact test

DISCUSSION

Out of all of the respondents in this study, 84% were aged > 25 years, 72.4% had worked for > 2 years, and 34% did near-vision activities for 2-5 hours/day. The data were tested for normality using the Kolmogorov–Smirnov test and showed that the distribution was not normal. This is because this study used a data collection design with consecutive non-random sampling, making it difficult to obtain data with a normal distribution.

Our study shows that 96.8% of respondents have normal contrast sensitivity abilities. Killeen et al. [12] reported a similar finding and found that 10% of the population had CS impairment. This statement shows that 90% of the population has normal CS abilities. CS is an eye health screening examination as important as visual acuity, which is currently considered an additional examination only. As it reflects the quality of vision and in many cases declines earlier, while visual acuity remains normal (6/6 or better) [13], many conditions (age, myopia, etc.) and eye diseases (diabetes, cataracts, glaucoma, etc.) affect contrast sensitivity just before any change in visual acuity is detected [14]. Zheng et al. state that contrast sensitivity will be impaired in people with vision disorders such as myopia, asthenopia, foggy vision, and ocular hypertension [15]. Various studies on changes in contrast sensitivity depending on the case and the impact of these changes on the patient's daily life have been conducted worldwide by various researchers. As we age, body functions begin to decline, and so does contrast sensitivity. However, neurological changes that cause loss of contrast sensitivity with age have not been generally established by studies

in patients with good visual acuity. The frequency of those initially affected is the lowest and begins to occur after the age of 40 [14].

Our research shows that there is no significant difference between age and CS (p = 1.000), while a different finding was reported by Killeen et al. [12], with p ≤ 0.001. This difference can be caused by the large number of samples. Killeen et al. [12] had a total sample of 3817, while our study had only 94 samples. Apart from that, there are differences in age groups: our study used an employee age group of 19-59 years, while Killeen et al. [12] had respondents in the age group > 71 years. In our study, gender and CS do not have a significant relationship (p = 1000). A similar finding was reported by Killeen et al. [12] who reported no relationship between gender and CS, with p = 0.39.

The prevalence of asthenopia was found to be quite large in employees, namely 76.6%, which is also confirmed by the studies by Amalia H. et al. [16], who found the prevalence of 69.7%, and Fernanda N. et al. [8] (prevalence of 83.7%). Table 2 shows that there is a relationship between asthenopia and gender risk factors with p = 0.006, while other risk factors, namely age, length of work, and the length of near vision activity do not show a relationship (p > 0.05). This could be because the data distribution in this study was not normal, as seen by the amount of asthenopia reaching 76.6% and normal contrast sensitivity of 96.8%.

Research by Singh H. et al. [17] states that there is a relationship between gender and the severity of asthenopia with p = 0.019. This is confirmed by our research, which shows that more women suffer from asthenopia than men. Korpole NR et al. [18] stated that women have a higher risk factor for eye diseases or complaints due to the lack of awareness of regular check-ups after the age of 40 years, early menopause, childhood malnutrition, hormonal imbalance, inappropriate drug usage causing ocular side effects, hormonal changes after menopause, which increase the risk, environmental exposure such as smoke and dry air, etc. Fernanda N. et al. [8] stated that there was an influence of accommodation insufficiency with asthenopia, but our study did not assess the respondent's accommodation ability.

Our study shows that there is no relationship between the length of close viewing activity (p = 0.418) and asthenopia; this follows the results of research by Amalia H. et al. [16], with p = 0.700. The highest prevalence was reported by Singh H. et al. [17] who found asthenopia in 96% of students in India.

Our study did not show a significant relationship between length of work and asthenopia (p = 0.581). A different finding was reported by Zayed HAM et al. [19] who stated that there was a relationship between the duration of computer use and Digital Eye Strain (DES) (p = 0.000). Zayed HAM's research did not analyze asthenopia, but DES here is eye fatigue due to close viewing activities.

Asthenopia is a type of computer vision syndrome that manifests clinically with various complaints such as visual disturbances, dry, red, and watery eyes, gritty itching, disturbances when reading, diplopia, and headaches [20]. These symptoms often occur associatively with doing close work to read and write, where eye accommodative processes and vergence movements are more intense [17]. This is a significant problem for public health in the era of modern technological life [21]. The use of electronic devices is widespread and has become an indispensable part of life. Adults and children alike use computers and other electronic devices for both vocational and recreational purposes. These devices purportedly make life easier but can also cause harm if used improperly [22]. Symptoms of asthenopia can be severe if individuals do not limit their near-vision activities. This can result in the development of age-related eye diseases [17].

The incidence of asthenopia was 76.6%, and 96.8% had normal eye contrast sensitivity ability. Analysis using the chi-square test showed no relationship (p = 1000) between CS and asthenopia. Research regarding the relationship between CS and asthenopia has never been conducted before. Based on research, it is stated that CS can affect visual acuity. In addition, significantly decreased CS is related to the meibomian gland obstruction and the degree of abnormality in the meibomian gland secretion, which can cause dry eye symptoms. These dry eye symptoms will affect asthenopia. The tear film in individuals with worsening CS will be more unstable compared to individuals with poor visual acuity, as measured by meibomian gland blockage and tear film breakdown time [23].

CONCLUSION

This study found that contrast sensitivity was not significantly different from asthenopia, and gender was a risk factor associated with asthenopia. Further research can be done by increasing the number of samples and using stratified random sampling for the contrast sensitivity group so that it is expected to obtain data with a normal distribution.

Acknowledgment Statement: *The authors are grateful to the Nutrition Study Center, Faculty of Medicine, Universitas Trisakti.*

Funding Statement: *The study was supported by the Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia.*

Author Contribution Statement:

HA, AA, AD: *Study conception and design, data collection, results analysis, reviewing, and approving the final results and manuscripts;*

MYVP, RW: *Data collection, drafted and wrote the manuscript;*

ARD, EY: *reviewed and approved the final version of the manuscript.*

Conflict of Interest Statement: *The authors declare no conflicts of interest.*

Ethics Approval Statement: *Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Trisakti University, with number 003/KER/FK/I/2024.*

REFERENCES

1. Peraturan Menteri Kesehatan Republik Indonesia Nomor 25 Tahun 2016 Tentang Rencana Aksi Nasional Kesehatan Lanjut Usia Tahun 2016-2019 [Internet], Available from: http://hukor.kemkes.go.id/uploads/produk_hukum/PMK_No._25_ttg_Rencana_Aksi_Nasional_Kesehatan_Lanjut_Usia_Tahun_2016-2019_.pdf.
2. Firdani F, Sari PN, Alfian AR. Study Of Visual Fatigue Due To Extended Gadget Use During The Covid-19 Pandemic. ijph, 2023,18(2), 219-229. DOI:https://doi.org/10.20473/ijph.v18i2.2023.219-229.
3. Sawaya RIT, Meski NEI, Saba JB, et al. Asthenopia Among University Students: The Eye of the Digital Generation. J Family Med Prim Care, 2020, 9(8), 3921-3932. doi: 10.4103/jfmpc.jfmpc_340_20.
4. Han CC, Liu R, Liu RR, et al. Prevalence of asthenopia and its risk factors in Chinese college students. Int J Ophthalmol, 2013, 6(5), 718-722.
5. Chandra J, Kartadinata E. Hubungan antara durasi aktivitas membaca dengan astenopia pada mahasiswa. J Biomedika dan Kesehat, 2018, 1(3), 185-190.
6. Gumunggilung D, Doda DVD, Mantjoro EM. Hubungan Jarak Dan Durasi Pemakaian Smartphone Dengan Keluhan Kelelahan Mata Pada Mahasiswa Fakultas Kesehatan Masyarakat Unsrat Di Era Pandemi Covid-19. J Kesmas, 2021, 10(2), 12.
7. Pane JP, Saragih IS, Laoli TL. Hubungan lama penggunaan gadget dengan kejadian astenopia pada mahasiswa program studi ners. J Penelit Perawat Prof, 2022,4(3), 947-954. Available from: http://jurnal.globalhealthsciencegroup.com/index.php/JPPP
8. Fernanda N, Amalia H. Hubungan akomodasi insufisiensi dan astenopia pada remaja di Jakarta Barat. J Biomedika dan Kesehat, 2018, 1(1),10-17.
9. Kaur K, Gurnani B. Contrast Sensitivity. 2023 Jun 11. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing, 2024 Jan–, Available from: https://pubmed.ncbi.nlm.nih.gov/35593849/
10. Ichhpujani P, Thakur S. An Overview of Spaeth/Richman Contrast Sensitivity (SPARCS): A Web-based, Contrast Sensitivity Testing Tool. TouchREVIEWS in Opthalmology, 2024, 18(1), 18-24.
11. Pratama PPAI, Setiawan KH, Purnomo KI. Asthenopia: Diagnosis, Tatalaksana, Terapi. Ganesha Med, 2021, 1(2), 97-102.
12. Killeen OJ, De Lott LB, Zhou Y, et al. Population Prevalence of Vision Impairment in US Adults 71 Years and Older: The National Health and Aging Trends Study. JAMA Ophthalmol, 2023,141(2), 197-204. doi:10.1001/jamaophthalmol.2022.5840
13. Pateras E, Karioti M. Contrast Sensitivity Studies and Test-Review. Biomed J Sci & Tech Res, 27(1)-2020. BJSTR. MS.ID.004439
14. Mc Kendrick AM, Sampson GP, Walland MJ, Badcock DR. Contrast sensitivity changes due to glaucoma and normal aging: low spatial frequency losses in both magnocellular and parvocellular pathways, Investigative Ophthalmology & Visual Science, 2007;48(5), 2115-2122.
15. Zheng F, Hou F, Chen Ret al. Investigation of the Relationship Between Subjective Symptoms of Visual Fatigue and Visual Functions. Front Neurosci, 2021,15,1-11.
16. Amalia H, Suardana GG, Artini W. Accommodative insufficiency as a cause of asthenopia in computer-using students. Universa Medicina, 2010, 29(2), 78-83. https://doi.org/10.18051/UnivMed.2010.v29.78-83.
17. Singh H, Tigga MJ, Laad S, et al. Prevention Of Ocular Morbidity Among Medical Students By Prevalence Assessment Of Asthenopia And Its Risk Factors. J. Evid. Based Med. Health, 2016, 3(15), 532-536. doi: 10.18410/jebmh/2016/122
18. Korpole NR, Kurada P, Korpole MR. Gender difference in ocular diseases, risk factors and management with specific reference to role of sex steroid hormones. J Mid-life Health, 2022,13, 20-25.
19. Zayed HAM, Saied SM, Younis EA, Atlam SA. Digital eye strain: prevalence and associated factors among information technology professionals, Egypt. Environmental Science and Pollution Research, 2021,20(2),25187-25195. doi: 10.1007/s11356-021-12454-3
20. Gowrisankaran S, Nahar NK, Hayes JR, et al. Asthenopia and blink rate under visual and cognitive loads. Optom Vis Sci, 2012,89(1), 97-104.
21. Thorud HM, Helland M, Aarås A, et al. Eye-Related Pain Induced By Visually Demanding Computer Work. Optom Vis Sci, 2012,89(4), E452-E464.
22. Tawil LA, Aldokhayel S, Zeitouniwil L, et al. Prevalence Of Self-Reported Computer Vision Syndrome Symptoms And Its Associated Factors Among University Students. European Journal of Ophthalmology, 2020, 30(1), 189-195. https://doi.org/10.1177/1120672118815110
23. Szczotka-Flynn LB, Maguire MG, Ying GS, et al. Impact of Dry Eye on Visual Acuity and Contrast Sensitivity: Dry Eye Assessment and Management Study. Optom Vis Sci, 2019, 96(6),387-396.

CONTRAST SENSITIVITY AND ASTHENOPIA ANALYSIS IN WORKERS

by FK Husnun Amalia

Submission date: 18-Jun-2025 08:31AM (UTC+0700)
Submission ID: 2701425727
File name: 10445-Volume52_Issue2_25-0038.pdf (218.32K)
Word count: 3528
Character count: 18108

sciendo
10.2478/AMB-2025-0038

ORIGINAL ARTICLE

CONTRAST SENSITIVITY AND ASTHENOPIA ANALYSIS IN WORKERS

H. Amalia[1], A. Adiwardhani[1], A. Devita[2], M. Pratiwi[3], R. Witjaksana[1], A. Dewi[4], E. Yousif[5]

[1]Department of Ophthalmology, Faculty of Medicine, Universitas Trisakti – Jakarta, Indonesia
[2]Department of Microbiology, Faculty of Medicine, Universitas Trisakti – Jakarta, Indonesia
[3]Medical Professional Education Program, Faculty of Medicine, Universitas Trisakti – Jakarta, Indonesia
[4]Department of Ophthalmology, Faculty of Medicine, Universitas Islam Malang – Malang, Indonesia
[5]Department of Chemistry, Al-Nahrain University – Bagdad, Iraq

Abstract. *In the digital age, complaints of eyestrain, or asthenopia, have become increasingly common. This condition is often associated with prolonged near-work activities, such as extended use of computers or digital devices, with reported prevalence rates ranging from 40% to 90%. Eye fatigue is influenced by a decline in the eye's accommodative capacity. Optimal visual function and acuity contribute to reducing visual discomfort by enhancing contrast sensitivity – the ability to clearly and precisely discern the boundaries of microscopic or fine-detail objects.* ***Materials and Methods:*** *The study design was observational analytics and a cross-sectional approach. The number of patients was 94 people aged 18-60 years, without having anatomical abnormalities of the eye in the form of corneal opacities, cataracts, turbidity of refractive media, and retinal abnormalities. Research instruments in the form of asthenopia questionnaires and Pelli Robson charts were used to examine eye contrast sensitivity. Results: 84% of respondents in this study were aged > 25 years, 72.4% had worked for > 2 years, and 34% did close viewing activities for 2-5 hours/day. The incidence of asthenopia was 76.6%, and 96.8% had normal eye contrast sensitivity ability. Analysis using the chi-square test showed no significant relationship (p = 1,000) between contrast sensitivity and asthenopia.* ***Conclusion:*** *There was no significant relationship between contrast sensitivity and asthenopia.*

Key words: *contrast sensitivity, asthenopia, length of work, near vision activities*

Corresponding author: *Husnun Amalia, Department of Ophthalmology, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia, email: husnun_a@trisakti.ac.id*

ORCID: *0000-0001-9727-8874*

Received: *14 July 2024;* ***Accepted:*** *07 January 2025*

INTRODUCTION

In accordance with the Regulation of the Minister of Health of the Republic of Indonesia (PERMENKES) in 2016, the vulnerable adult age is 19-44 years [1]. Generally, those in the adult age category are already active in activities using electronic devices daily. During this pandemic, the use of electronic devices has increased, and people who are used to doing activities directly but switch to online work are required to continuously stare at the screen. This, of course, endangers human health, especially eye health [2]. Asthenopia is one of the impacts that can occur in eye health problems [3].

Asthenopia or tired eyes is a condition characterized by non-specific symptoms such as eye strain, tired eyes, eye discomfort, eye irritation, hot sensation, and headaches [4]. The main cause of asthenopia is fatigue of the ciliary and extraocular muscles due to prolonged accommodation and excessive accommodation work to see at close range. Other causative factors that can have implications for asthenopia are staring at the screen for too long and reduced blinking frequency, which causes the eyes to experience excessive evaporation so that the eyes become dry [5].

The World Health Organization (WHO) found that the incidence of eye fatigue globally reached 40% to 90% [6]. The high prevalence of eye fatigue was also found in students in various countries such as China (53.5%), Malaysia (89.9%), and Egypt (86%) [7]. According to research conducted by Fernanda in 2018, the incidence of asthenopia in Indonesia is quite high, reaching 69.7% [8].

Contrast sensitivity (CS) is the ability to see the boundaries of small objects clearly and distinctly. CS testing uses a Pelli-Robson chart to measure visual sensitivity at various levels of contrast and can assess early visual impairment [9]. Several studies have shown that CS provides useful information about everyday visual function that is not reflected in visual acuity and visual field test results. CS affects various aspects of vision, especially motion detection, visual fields, dark adaptation, and visual acuity [10].

Research on the difference in eye sensitivity to asthenopia in adults has never been done. CS can affect visual acuity so that it can overcome eye fatigue or asthenopia. Based on this, researchers aim to identify the relationship between contrast sensitivity and asthenopia in adults.

MATERIALS AND METHODS

The study was conducted using an analytical observational design and a cross-sectional approach in Jakarta, Indonesia, in 2024. The total study sample was 94 workers collected using consecutive non-random sampling. The inclusion criteria in this study were 18-60 years old and willing to take part in the study, while the exclusion criteria were having a history of eye anatomical abnormalities (corneal opacities, cataracts, and retinal abnormalities).

The research instrument utilized was the asthenopia questionnaire on Google Forms. This questionnaire comprises 15 questions concerning subjective complaints related to asthenopia. Each response is scored as follows: a score of 0 is assigned for "never"; 1 for "rarely"; 2 for "sometimes"; 3 for "quite often"; 4 for "often"; and 5 for "always". The total score for the 15 questions ranges from 0 to 75. Subjects are deemed at risk of asthenopia if their total score exceeds 9. Those with a total score lower than 9 are categorized in the negative symptom group, while those with a total score greater than 9 are placed in the positive symptom group [11].

Contrast assessment of eye sensitivity was carried out using a Pelli Robson card placed at a distance of 1 meter in front of the respondent. Respondents were asked to read the letters listed on the card. The results of the contrast sensitivity response ability in the right eye, left eye, and both eyes (Binocular) were recorded, with normal values being log > 1.80 and less if < log 1.80.

Data analysis used the SPSS (Statistical Package for Social Science) program. This study has obtained research ethics approval from the Research Ethics Committee of the Faculty of Medicine, Trisakti University, with the number 003/KER/FK/I/2024.

RESULTS

Univariate analysis in this study assessed the frequency distribution of respondents.

Table 1. Characteristics of respondents

Variable	Frequency	Percentage (%)
Age		
< 25 years old	15	16
> 25 years old	79	84
Gender		
Man	29	30.9
Woman	65	69.1
Duration of Work		
< 2 years	13	13.8
> 2 years	68	72.4
Not Working	13	13.8
Near Vision Activities		
< 2 hours	22	23.4
2-< 5 hours	32	34.0
hour	29	30.9
> 8 hours	11	11.7
Asthenopia		
Yes	72	76.6
No	22	23.4
Contrast Sensitivity		
Normal	91	96.8
Less	3	3.2

The age of respondents was between 19-59 years with an average of 37.98+10.774, with the most common age being 43 years (8 people). The duration

of work is between 0-39 years with an average of 10.61+10.159.

Table 2. Relationship of Contrast Sensitivity with Asthenopia and Risk Factors

Variable	Contrast Sensitivity		p	Asthenopia		p
	Normal	Less		Yes	No	
Age						
< 25 years old	15	0	1.000*	11	4	0.745§
> 25 years old	76	3		61	18	
Gender						
Man	28	1	1.000*	17	12	0.006§
Woman	63	2		55	10	
Duration of Work						
< 2 years	13	0	0.553§	9	4	0.581§
> 2 years	63	3		54	14	
Not Working	13	0		9	4	
Near Vision Activities						
< 2 hours	21	1	0.418§	14	8	0.175§
2-< 5 hours	32	0		24	8	
5-8 hours	27	2		26	3	
> 8 hours	11	0		8	2	

*Fisher exact test; §Chi Square test

Table 3. Relationship between the Asthenopia Questionnaire and the Incidence of Asthenopia

Questionnaire	Relationship with Asthenopia (p)
Eye fatigue	0.000
Red eye	0.131
Heavy sensation in the eyes	0.000
Dry eye	0.018
Sleepy	0.000
Difficult to remember what just read	0.000
Pain around the eyes	0.001
Headache around the forehead or back of the head	0.001
Blurry vision	0.000
Sometimes double eye vision at near sight	0.000
Some lines are missed when reading	0.001
When I read, I was confused about how to read it	0.000
Difficulty focusing/losing concentration when reading/writing/working	0.000
Must squint your eyes to focus your vision when reading/writing/working	0.006
Seeing words/letters jumping/moving	0.097

Table 2 shows a significant relationship between gender and asthenopia (p = 0.006). Table 3 shows that the Pearson Chi-Square test on all asthenopia questionnaires was associated (p < 0.05) with asthenopia except for complaints of red eyes (p = 0.131) and seeing words/letters jumping/moving (p = 0.097). Table 4 shows no relationship between contrast sensitivity and asthenopia (p = 1.000).

Table 4. Relationship of Contrast Sensitivity with Asthenopia

Variable	Asthenopia		p
	Yes	No	
Contrast Sensitivity			
Normal	69	3	1.000*
Less	22	0	

*Fisher exact test

DISCUSSION

Out of all of the respondents in this study, 84% were aged > 25 years, 72.4% had worked for > 2 years, and 34% did near-vision activities for 2-5 hours/day. The data were tested for normality using the Kolmogorov–Smirnov test and showed that the distribution was not normal. This is because this study used a data collection design with consecutive non-random sampling, making it difficult to obtain data with a normal distribution.

Our study shows that 96.8% of respondents have normal contrast sensitivity abilities. Killeen et al. [12] reported a similar finding and found that 10% of the population had CS impairment. This statement shows that 90% of the population has normal CS abilities. CS is an eye health screening examination as important as visual acuity, which is currently considered an additional examination only. As it reflects the quality of vision and in many cases declines earlier, while visual acuity remains normal (6/6 or better) [13], many conditions (age, myopia, etc.) and eye diseases (diabetes, cataracts, glaucoma, etc.) affect contrast sensitivity just before any change in visual acuity is detected [14]. Zheng et al. state that contrast sensitivity will be impaired in people with vision disorders such as myopia, asthenopia, foggy vision, and ocular hypertension [15]. Various studies on changes in contrast sensitivity depending on the case and the impact of these changes on the patient's daily life have been conducted worldwide by various researchers. As we age, body functions begin to decline, and so does contrast sensitivity. However, neurological changes that cause loss of contrast sensitivity with age have not been generally established by studies

in patients with good visual acuity. The frequency of those initially affected is the lowest and begins to occur after the age of 40 [14].

Our research shows that there is no significant difference between age and CS (p = 1.000), while a different finding was reported by Killeen et al. [12], with p ≤ 0.001. This difference can be caused by the large number of samples. Killeen et al. [12] had a total sample of 3817, while our study had only 94 samples. Apart from that, there are differences in age groups: our study used an employee age group of 19-59 years, while Killeen et al. [12] had respondents in the age group > 71 years. In our study, gender and CS do not have a significant relationship (p = 1000). A similar finding was reported by Killeen et al. [12] who reported no relationship between gender and CS, with p = 0.39.

The prevalence of asthenopia was found to be quite large in employees, namely 76.6%, which is also confirmed by the studies by Amalia H. et al. [16], who found the prevalence of 69.7%, and Fernanda N. et al. [8] (prevalence of 83.7%). Table 2 shows that there is a relationship between asthenopia and gender risk factors with p = 0.006, while other risk factors, namely age, length of work, and the length of near vision activity do not show a relationship (p > 0.05). This could be because the data distribution in this study was not normal, as seen by the amount of asthenopia reaching 76.6% and normal contrast sensitivity of 96.8%.

Research by Singh H. et al. [17] states that there is a relationship between gender and the severity of asthenopia with p = 0.019. This is confirmed by our research, which shows that more women suffer from asthenopia than men. Korpole NR et al. [18] stated that women have a higher risk factor for eye diseases or complaints due to the lack of awareness of regular check-ups after the age of 40 years, early menopause, childhood malnutrition, hormonal imbalance, inappropriate drug usage causing ocular side effects, hormonal changes after menopause, which increase the risk, environmental exposure such as smoke and dry air, etc. Fernanda N. et al. [8] stated that there was an influence of accommodation insufficiency with asthenopia, but our study did not assess the respondent's accommodation ability.

Our study shows that there is no relationship between the length of close viewing activity (p = 0.418) and asthenopia; this follows the results of research by Amalia H. et al. [16], with p = 0.700. The highest prevalence was reported by Singh H. et al. [17] who found asthenopia in 96% of students in India.

Our study did not show a significant relationship between length of work and asthenopia (p = 0.581). A different finding was reported by Zayed HAM et al. [19] who stated that there was a relationship between the duration of computer use and Digital Eye Strain (DES) (p = 0.000). Zayed HAM's research did not analyze asthenopia, but DES here is eye fatigue due to close viewing activities.

Asthenopia is a type of computer vision syndrome that manifests clinically with various complaints such as visual disturbances, dry, red, and watery eyes, gritty itching, disturbances when reading, diplopia, and headaches [20]. These symptoms often occur associatively with doing close work to read and write, where eye accommodative processes and vergence movements are more intense [17]. This is a significant problem for public health in the era of modern technological life [21]. The use of electronic devices is widespread and has become an indispensable part of life. Adults and children alike use computers and other electronic devices for both vocational and recreational purposes. These devices purportedly make life easier but can also cause harm if used improperly [22]. Symptoms of asthenopia can be severe if individuals do not limit their near-vision activities. This can result in the development of age-related eye diseases [17].

The incidence of asthenopia was 76.6%, and 96.8% had normal eye contrast sensitivity ability. Analysis using the chi-square test showed no relationship (p = 1000) between CS and asthenopia. Research regarding the relationship between CS and asthenopia has never been conducted before. Based on research, it is stated that CS can affect visual acuity. In addition, significantly decreased CS is related to the meibomian gland obstruction and the degree of abnormality in the meibomian gland secretion, which can cause dry eye symptoms. These dry eye symptoms will affect asthenopia. The tear film in individuals with worsening CS will be more unstable compared to individuals with poor visual acuity, as measured by meibomian gland blockage and tear film breakdown time [23].

CONCLUSION

This study found that contrast sensitivity was not significantly different from asthenopia, and gender was a risk factor associated with asthenopia. Further research can be done by increasing the number of samples and using stratified random sampling for the contrast sensitivity group so that it is expected to obtain data with a normal distribution.

Acknowledgment Statement: *The authors are grateful to the Nutrition Study Center, Faculty of Medicine, Universitas Trisakti.*

Funding Statement: *The study was supported by the Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia.*

Author Contribution Statement:

HA, AA, AD: *Study conception and design, data collection, results analysis, reviewing, and approving the final results and manuscripts;*

MYVP, RW: *Data collection, drafted and wrote the manuscript;*

ARD, EY: *reviewed and approved the final version of the manuscript.*

Conflict of Interest Statement: *The authors declare no conflicts of interest.*

Ethics Approval Statement: *Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Trisakti University, with number 003/KER/FK/I/2024.*

REFERENCES

1. Peraturan Menteri Kesehatan Republik Indonesia Nomor 25 Tahun 2016 Tentang Rencana Aksi Nasional Kesehatan Lanjut Usia Tahun 2016-2019 [Internet], Available from: http://hukor.kemkes.go.id/uploads/produk_hukum/PMK_No._25_ttg_Rencana_Aksi_Nasional_Kesehatan_Lanjut_Usia_Tahun_2016-2019_.pdf.
2. Firdani F, Sari PN, Alfian AR. Study Of Visual Fatigue Due To Extended Gadget Use During The Covid-19 Pandemic. ijph, 2023,18(2), 219-229. DOI:https://doi.org/10.20473/ijph.v18i2.2023.219-229.
3. Sawaya RIT, Meski NEI, Saba JB, et al. Asthenopia Among University Students: The Eye of the Digital Generation. J Family Med Prim Care, 2020, 9(8), 3921-3932. doi: 10.4103/jfmpc.jfmpc_340_20.
4. Han CC, Liu R, Liu RR, et al. Prevalence of asthenopia and its risk factors in Chinese college students. Int J Ophthalmol, 2013, 6(5), 718-722.
5. Chandra J, Kartadinata E. Hubungan antara durasi aktivitas membaca dengan astenopia pada mahasiswa. J Biomedika dan Kesehat, 2018, 1(3), 185-190.
6. Gumunggilung D, Doda DVD, Mantjoro EM. Hubungan Jarak Dan Durasi Pemakaian Smartphone Dengan Keluhan Kelelahan Mata Pada Mahasiswa Fakultas Kesehatan Masyarakat Unsrat Di Era Pandemi Covid-19. J Kesmas, 2021, 10(2), 12.
7. Pane JP, Saragih IS, Laoli TL. Hubungan lama penggunaan gadget dengan kejadian astenopia pada mahasiswa program studi ners. J Penelit Perawat Prof, 2022,4(3), 947-954. Available from: http://jurnal.globalhealthsciencegroup.com/index.php/JPPP
8. Fernanda N, Amalia H. Hubungan akomodasi insufisiensi dan astenopia pada remaja di Jakarta Barat. J Biomedika dan Kesehat, 2018, 1(1),10-17.
9. Kaur K, Gurnani B. Contrast Sensitivity. 2023 Jun 11. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing, 2024 Jan–, Available from: https://pubmed.ncbi.nlm.nih.gov/35593849/
10. Ichhpujani P, Thakur S. An Overview of Spaeth/Richman Contrast Sensitivity (SPARCS): A Web-based, Contrast Sensitivity Testing Tool. TouchREVIEWS in Opthalmology, 2024, 18(1), 18-24.
11. Pratama PPAI, Setiawan KH, Purnomo KI. Asthenopia: Diagnosis, Tatalaksana, Terapi. Ganesha Med, 2021, 1(2), 97-102.
12. Killeen OJ, De Lott LB, Zhou Y, et al. Population Prevalence of Vision Impairment in US Adults 71 Years and Older: The National Health and Aging Trends Study. JAMA Ophthalmol, 2023,141(2), 197-204. doi:10.1001/jamaophthalmol.2022.5840
13. Pateras E, Karioti M. Contrast Sensitivity Studies and Test-Review. Biomed J Sci & Tech Res, 27(1)-2020. BJSTR. MS.ID.004439
14. Mc Kendrick AM, Sampson GP, Walland MJ, Badcock DR. Contrast sensitivity changes due to glaucoma and normal aging: low spatial frequency losses in both magnocellular and parvocellular pathways, Investigative Ophthalmology & Visual Science, 2007;48(5), 2115-2122.
15. Zheng F, Hou F, Chen Ret al. Investigation of the Relationship Between Subjective Symptoms of Visual Fatigue and Visual Functions. Front Neurosci, 2021,15,1-11.
16. Amalia H, Suardana GG, Artini W. Accommodative insufficiency as a cause of asthenopia in computer-using students. Universa Medicina, 2010, 29(2), 78-83. https://doi.org/10.18051/UnivMed.2010.v29.78-83.
17. Singh H, Tigga MJ, Laad S, et al. Prevention Of Ocular Morbidity Among Medical Students By Prevalence Assessment Of Asthenopia And Its Risk Factors. J. Evid. Based Med. Health, 2016, 3(15), 532-536. doi: 10.18410/jebmh/2016/122
18. Korpole NR, Kurada P, Korpole MR. Gender difference in ocular diseases, risk factors and management with specific reference to role of sex steroid hormones. J Mid-life Health, 2022,13, 20-25.
19. Zayed HAM, Saied SM, Younis EA, Atlam SA. Digital eye strain: prevalence and associated factors among information technology professionals, Egypt. Environmental Science and Pollution Research, 2021,20(2),25187-25195. doi: 10.1007/s11356-021-12454-3
20. Gowrisankaran S, Nahar NK, Hayes JR, et al. Asthenopia and blink rate under visual and cognitive loads. Optom Vis Sci, 2012,89(1), 97-104.
21. Thorud HM, Helland M, Aarås A, et al. Eye-Related Pain Induced By Visually Demanding Computer Work. Optom Vis Sci, 2012,89(4), E452-E464.
22. Tawil LA, Aldokhayel S, Zeitouniwil L, et al. Prevalence Of Self-Reported Computer Vision Syndrome Symptoms And Its Associated Factors Among University Students. European Journal of Ophthalmology, 2020, 30(1), 189-195. https://doi.org/10.1177/1120672118815110
23. Szczotka-Flynn LB, Maguire MG, Ying GS, et al. Impact of Dry Eye on Visual Acuity and Contrast Sensitivity: Dry Eye Assessment and Management Study. Optom Vis Sci, 2019, 96(6),387-396.

CONTRAST SENSITIVITY AND ASTHENOPIA ANALYSIS IN WORKERS

ORIGINALITY REPORT

14%	10%	9%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Fakultas Kedokteran Gigi Universitas Trisakti Student Paper	2%
2	journals.sagepub.com Internet Source	2%
3	perpustakaan.poltekkes-malang.ac.id Internet Source	2%
4	pmc.ncbi.nlm.nih.gov Internet Source	1%
5	Hyunjean Jung, Sung Uk Han, Sangyeop Kim, Hyunmin Ahn, Ikhyun Jun, Hyung Keun Lee, Kyoung Yul Seo, Tae-im Kim. "Comparison of two different contrast sensitivity devices in young adults with normal visual acuity with or without refractive surgery", Scientific Reports, 2022 Publication	1%
6	Submitted to University of Technology, Sydney Student Paper	1%
7	assets.researchsquare.com Internet Source	1%
8	Armelia Sari Widyarman, Muhammad Ihsan Rizal, Moehammad Orliando Roeslan, Carolina Damayanti Marpaung. "Quality	1%

	Improvement in Dental and Medical Knowledge, Research, Skills and Ethics Facing Global Challenges", CRC Press, 2024 Publication	
9	repo.stikesicme-jbg.ac.id Internet Source	1 %
10	Cylla Revata, Mulia Rahmansyah. "Delayed asymptomatic blunt traumatic diaphragmatic hernia: an unusual case report", Universa Medicina, 2022 Publication	<1 %
11	academic.oup.com Internet Source	<1 %
12	www.researchgate.net Internet Source	<1 %
13	biomedres.us Internet Source	<1 %
14	ejournal.seaninstitute.or.id Internet Source	<1 %
15	Wulan Sari, Winda Septiani. "Malnutrisi pada lansia di Kota Pekanbaru", Jurnal Kesehatan Komunitas, 2019 Publication	<1 %
16	ejournal.unsrat.ac.id Internet Source	<1 %
17	hdl.handle.net Internet Source	<1 %

Exclude quotes	Off	Exclude matches	< 10 words
Exclude bibliography	On		