Relationship Between Electronic Device Usage with Asthenopia in Workers at Pelita Harapan University Lippo Karawaci

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Abstract

Background:
Breast cancer is the most common malignancy among women and a leading cause of cancer-related mortality. Early detection is crucial to improve survival outcomes. Mammography is considered the gold standard for screening women over 40 years, while ultrasonography (USG) is frequently used in younger women with dense breasts. However, diagnostic accuracy varies, and comparative studies in Indonesia remain limited. To compare the diagnostic accuracy of mammography and ultrasonography in differentiating benign and malignant breast lesions using histopathology as the Gold standard.

Methods:
This cross-sectional analytic study included 91 patients who underwent mammography, ultrasonography, and histopathological confirmation at MRCCC Siloam Semanggi Hospital. Diagnostic parameters including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy, and area under the curve (AUC) were calculated. Statistical analysis used McNemar's test and ROC curve analysis based on Hanley & McNeil's method, with $p < 0.05$ considered significant.

Result:
Ultrasonography demonstrated higher sensitivity (98.4%) and NPV (92.3%) than mammography (96.7% and 88.9%), indicating better ability to rule out malignancy. Mammography showed higher specificity (53.3% vs. 40.0%) and PPV (80.8% vs. 76.9%), reflecting better performance in identifying benign lesions. Overall accuracy was slightly higher for mammography (82.4%) compared to USG (79.1%). The AUC for mammography was 0.750 (95% CI: 0.630–0.870), while USG had an AUC of 0.692 (95% CI: 0.565–0.819). Overlapping confidence intervals indicated no statistically significant difference in diagnostic accuracy between the two modalities ($p > 0.05$).

Conclusions:
Mammography and ultrasonography both demonstrated high diagnostic performance with complementary strengths. Mammography provided higher specificity and PPV, while USG offered superior sensitivity and NPV. Given the small difference in accuracy and overlapping AUC confidence intervals, no significant difference was found between the two modalities. Combined use of mammography and USG may improve diagnostic accuracy in clinical practice.

Introduction

Asthenopia is a condition characterized by a collection of ocular and visual symptoms marked by the appearance of dry eyes, itchy eyes, a feeling of foreign body in the eye, blurred vision, burning sensation, redness, and headaches. It also includes extra-ocular

symptoms in the body such as headaches, stiff neck, shoulder pain, and back pain.[1]

According to the World Health Organization (WHO), the prevalence of asthenopia worldwide has reached between 75% to 90%. In Indonesia alone, approximately 60 million people have been diagnosed with asthenopia, and the incidence rate continues to rise by 1 million cases each year.[2]

The use of electronic devices for a long duration (>4 hours/day), decreased blinking, exposure to blue light, and the viewing distance from electronic devices are said to increase the risk of developing Asthenopia.[1]

According to the Ministry of Communication and Information Technology (*Kementerian Komunikasi dan Informatika*/KOMINFO) Indonesia is the fourth largest country in the world in terms of electronic device users, with approximately 167 million Indonesians actively using electronic devices. According to the Indonesian Central Agency of Statistics (*Badan Pusat Statistika*/BPS), in 2022, 68% of the Indonesian population had mobile phones or gadgets. The highest prevalence of electronic device users is among those aged 25-49 (47.64%), followed by those aged 19-24 (14.69%), indicating that most electronic device users in Indonesia are in their productive age.[5]

As many as 68.76% of all electronic device users use their devices for work. Adults aged 30-49 are reported to use electronic devices for ≥5 hours per day, and individuals aged 20-29 are reported to use electronic devices for the same duration but with the use of 2 or more devices at the same time. In the study titled 'Prevalence of Asthenopia and Its Relationship with Electronic Screen Usage During the COVID- 19 Pandemic in Jazan, Saudi Arabia,' by Abuallut I et al. [14] out of a total of 784 participants, the prevalence of asthenopia was found to be highest in the age range of 18-24 (45.41%), 25-34 (27.17%), and 35-44 (17.22%). The duration of electronic screen usage is most prevalent at >6 hours (56.3%) and with daily screen usage time (89.92%). This study also found a relationship between occupations, particularly those using electronic devices, and the high prevalence of asthenopia.[14] However, in the study titled 'Asthenopia Among University Students: The Eye of the Digital Generation,' by Touma Sawaya et al it was stated that no relationship was found between the duration of electronic device usage and asthenopia.[6]

Individuals who continuously work using electronic devices must focus their vision on the device being used. The emergence of asthenopia symptoms can affect a person's comfort level when using their electronic devices. Symptoms such as blurred vision and dry eyes can exacerbate symptoms like eye fatigue and headaches. Therefore, it is important for someone to maintain and prevent the emergence of asthenopia symptoms.[7]

Based on the available research data, the relationship between the use of electronic devices and asthenopia contradicts one another. Therefore, this study aims to distinguish the relationship between the use of electronic devices and asthenopia. Ethical clearance was granted from Pelita Harapan University Ethics Committee with ethical clearance number 164/K-LKJ/ETIK/III/2025.

Material And Methods

This research was a comparative analytical study with a cross-sectional design. The inclusion criteria included: workers at Pelita Harapan University, Lippo Karawaci, and exclusion criteria were samples with eye disorders such as eye infections, cataracts, or ocular media opacities. The study sample involved 49 workers from Pelita Harapan University.

Data collection was conducted through an online form that was directly shared with respondents using inclusion and exclusion questionnaires, the Visual Fatigue Index (VFI) questionnaire to assess presence of asthenopia, electronic device usage and demographic questionnaires. The data obtained was tabulated using Microsoft Excel and analyzed with the IBM SPSS version 29.0. Statistical tests were conducted using Chi-Square.

Result

Table 1 depicts demographic data of participants involved.

Tabel 1. Demographic Data and Characteristics

Variable	Frequency n (%)
Age	
21-55 years old	49 (100)
Gender	
Man	25 (51)
Woman	24 (49)
Job	
High Risk Job (Administrator/Librarian)	38 (77.6)
Low Risk Job (Security/Cleaning Service)	11 (22.4)
Duration	
Mild (<4 hours)	7 (14.3)
Moderate (4-8 hours)	26 (53.1)
Severe (>8 hours)	16 (32.7)
Distance	
Not At Risk (40 -75 cm)	22 (44.9)
At Risk (≤40 cm & ≥75 cm)	27 (55.1)
Asthenopia	
Yes	25 (51.0)
No	24 (49.0)
Type of Electronic Device	
Smartphone	48 (97.9)
Laptop	18 (36.7)
Computer	25 (51)
Tablet	7 (14.2)
Number of Electronic Devices	
1 Device	64 (22.5)
2 Devices	220 (77.5)
3 Devices	10 (20.4)
4 Devices	4 (8.1)
Total	49 (100.0)

25 males (51%) and 24 females (49%) were included in this study. The respondents' ages ranged from 21 to 55 years. The respondents' jobs were also categorized into 2 categories: high risk and low risk jobs. The duration of electronic device use was divided into 3 categories: mild (<4 hours/day), moderate (4 – 8 hours/day), and severe (> 8 hours/day). 14.3% fell under the mild category, 53.1% fell under the moderate category, and 32.7% fell under the severe category. Based on the categories of the Ministry of Health of the Republic of Indonesia, the distance is divided into 2 categories, namely at-risk and not at risk. The at-risk category included 27 respondents (55.1%) and the not-at-risk category included 22 respondents (44.9%). Asthenopia was categorized into 2 groups: yes and no, with 51.0% in the yes category and 49.0% in the no category. 48 (97.9%) respondents used smartphones, 18 (36.7%) used laptops, 25 (51%) used computers, and 7 (14.2%) used tablet devices. Some respondents used two or more for work. A total of 20 (40.8%) people used 1 device, and 15 (30.6%) respondents used 2 devices, 10 (20.4%) respondents used 3 devices, and as many as 4 (8.1%) respondents used a total of 4 devices.

Table 2. Bivariate Chi-square Analysis of Duration with Asthenopia Test Results.

	Astenopia		Total	P-value
Duration	**Yes**	**No**		
	n	**n**	**n**	
Mild	4	3	7	
Moderate	8	18	26	
Severe	13	3	16	
Total	25	24	49	0,004

In the table above, it was found that of the 7 respondents with mild duration, 4 experienced asthenopia and 3 did not. Among the 26 respondents categorized as having moderate duration, 8 experienced asthenopia and 18 did not. Meanwhile,

respondents with severe duration had the highest number of subjects experiencing asthenopia, totaling 13, and 3 did not experience asthenopia. Chi-square analysis yielded a p- value of 0.004 ($p<0.05$), indicating a significant relationship between duration and asthenopia.

Table 3. Bivariate Chi-square Analysis of Distance with Asthenopia Test Results

	Astenopia		Total	P-value
Distance	Yes	No		
	n	n	n	
Not At Risk	10	12	22	
At- Risk	15	12	27	
Total	25	24	49	0,677

Table 3 depicts the analysis between distance and asthenopia. Anong the "not at risk" category, 10 people experienced asthenopia and 12 people did not experience asthenopia. Meanwhile, among the 27 respondents who fell into the at-risk category, 15 people experienced asthenopia and 10 people did not experience asthenopia. Chi-square analysis yielded a p-value of 0.677 ($p>0.05$) indicating no significant relationship between distance and asthenopia

Discussion

A p-value of 0.004 ($p <0.05$) was found in the analysis of the relationship between the duration of electronic device use and asthenopia, indicating a significant relationship between the two variables.

A p-value of 0.677 ($p > 0.05$) was obtained in the analysis of the relationship between the distance of electronic device use and asthenopia, indicating no significant relationship exists between the distance variable and asthenopia. 45% of participants in the not-at-risk distance category experienced asthenopia, whereas 55.5% in the at-risk distance category also experienced asthenopia. Several factors can contribute to this finding, however, not investigated in this study. Several factors that may contribute to asthenopia other than distance include: screen resolution, font-size, screen position, lighting when using gadgets and presence of refractive error.

Screen resolution affects how the eyes adjust by displaying a computer image that consists of a set of pixels. Prolonged screen usage, especially in poor screen resolution devices, requires the eyes to adjust constantly to receiving the displayed image sharply, causing the eyes to lag after using the computer, and may eventually lead to impaired ocular coordination or inadequate focus. [8,9]

Font size can cause asthenopia because it affects viewing distance. If the size of the objects on the screen too small, it may cause someone to look at the screen from too close, or conversely, if the objects on the screen are too large, it may cause someone to look at the screen from too far, resulting in a risky distance of electronic device use.

The presence of uncorrected or under-corrected refractive error is also believed to cause asthenopic symptoms. In uncorrected myopia, patients often move the objects closer to the eye to make it comfortable to read. Therefore, the eye will need more convergence for single vision, resulting in asthenopia. In hypermetropia patients, ocular refractive power may increase due to repeated ciliary muscle stimuli during near work. This can cause ciliary muscle fatigue which can also lead to asthenopic symptoms. Lastly, due to uneven accommodation in both eyes, uncorrected anisometropia patients can also result in asthenopia. [10]

Aside these confounding factors, data collection can also contribute to the insignificant difference between distance

and asthenopia. Data collection was conducted through filling Online Forms completed on each respondent's smartphone, meaning the researcher does not directly observe the variables like asthenopia, duration, and distance with the electronic device from the respondents. Biases such as dishonesty/rushing when filling in questionnaires may contribute to this insignificance.

The shortcomings of this study are that the data collection method used a questionnaire filled out personally by the respondents, which could lead to bias from the respondents or dishonest responses. Other factors of the electronic device itself, such as lighting, font size, or objects present on the screen, and the position of the screen was also not asked in this study, making it one of the shortcomings of this research. Some of the respondents' jobs also do not entirely involve being in front of electronic devices, which may yield different results compared to workers who use electronic devices or are more often in front of electronic screens. The history of diseases or other health conditions that were exclusion criteria for this study also did not arise from a doctor's diagnosis but only through the questionnaire filled out by the respondents, which could be a limitation of this study. Asthenopia is also a condition caused by multiple factors, while this research only investigated duration and distance factors, making this a limitation of the study.

Conclusion

It can be concluded that the duration of electronic device use has a significant relationship with asthenopia, while the distance of electronic device use does not have a significant relationship with asthenopia.

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