

Original Research**Visual Risk Factors of Asthenopia in Karawo Craftsmen: A Cross-Sectional Study****Fatmawaty Mallapiang^{1*}, Amalia Jayanti¹, Lilis Widiastuty¹, Nildawati Nildawati¹
Rezki Ramdani²**¹Department of Public Health, Faculty of Medicine and Health Sciences, UIN Alauddin Makassar²Department of Health Administration, Faculty of Sports and Health Sciences, Universitas Negeri Makassar**ABSTRACT**

Background: Work-related visual strain remains a significant occupational health problem, particularly among workers performing visually demanding tasks. Karawo craftsmen are at increased risk due to prolonged visual focus, suboptimal lighting, and close viewing distances, yet evidence on key contributing factors in this group remains limited. This study aims to analyze the relationship between several visual risk factors, including age, eye-to-object distance, length of service, working hours, lighting, work posture, and medical history, and asthenopia complaints among karawo craftsmen.

Methods: The results showed significant associations between age ($p = 0.001$), eye-to-object distance ($p = 0.007$), lighting ($p = 0.002$), and medical history ($p = 0.001$) and asthenopia among karawo craftsmen. Meanwhile, length of service ($p = 0.072$), working hours ($p = 1.000$), and work posture ($p = 1.000$) were not associated with asthenopia.

Results: The results showed significant associations between age ($p = 0.001$), eye-to-object distance ($p = 0.007$), lighting ($p = 0.002$), and medical history ($p = 0.001$) and asthenopia among karawo craftsmen. Meanwhile, length of service ($p = 0.072$), working hours ($p = 1.000$), and work posture ($p = 1.000$) were not associated with asthenopia.

Conclusion: The study found that age, eye-to-object distance, lighting, and medical history were significantly associated with asthenopia complaints among karawo craftsmen. It is recommended that karawo craft entrepreneurs collaborate with local health centers or health services so that elderly craftsmen or those with a history of vision problems can receive regular eye examinations.

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INTRODUCTION

Occupational health plays a crucial role in protecting workers from health risks and ensuring their well-being across both formal and informal sectors. Effective occupational health efforts aim to prevent work-related diseases and adverse health effects arising from

workplace exposures. Hazards in the workplace are quite diverse, one of which is physical hazards in the form of lighting in the workplace. Poor lighting design in the workplace can affect health and safety performance, such as eye fatigue (Mindayani, Hanum, & Hamidah, 2022).

Occupational risk factors, including work-related fatigue, contribute to an estimated 2.78 million deaths annually due to work-related diseases and injuries worldwide (World Health Organization & International Labour Organization, 2021). Visual impairment and blindness remain major public health concerns in Indonesia, with prevalence reaching approximately 3% of the population. These conditions can significantly reduce work productivity and are largely preventable if detected early. Eye fatigue can be influenced by several factors, both work-related and environmental. Work-related factors include risky behaviors, age, heredity, refractive errors, and the duration of work. Environmental conditions, including lighting intensity and quality, significantly influence visual function and may increase the risk of eye disorders and visual fatigue (Fan et al., 2024).

Adequate lighting is essential in all workplaces, as visual performance, task accuracy, and worker comfort largely depend on lighting conditions (Boyce, 2021). Poor lighting can lead to eye strain, decreased work efficiency, mental fatigue, soreness around the eyes, headaches, and damage to the visual system. (Mindayani et al., 2022). Therefore, appropriate lighting is a key factor in maintaining workers' eye health and productivity.

Field research on labor efficiency shows that when the physical and physiological comfort of workers improves, they become more efficient in performing their tasks, and the resulting output increases, making it more profitable for the company. One factor that contributes to a comfortable working environment is the quality and quantity of lighting, both in the immediate work area and throughout the entire workplace, as it can positively affect workers' health, safety, and comfort. Therefore, Proper lighting in the workplace plays an important role in improving workers' health and safety, as well as creating a comfortable working environment (Abdelfattah et al, 2025).

The observations conducted by Amali (2022) show that 9.1% of the lighting intensity in Karawo craftsmen's workspaces is below the KEPMENKES No. 7/1404/2002 standard (less than 300 lux), and only 9.90% meet or exceed the standard of 300 lux (Amali, 2022). Based on a survey at IKM Isna Karawo, 90% of the craftsmen's workspaces have a lighting intensity of less than 270 lux, indicating that they do not meet the required standards. Workplace lighting that does not meet the requirements—whether it is too bright, too dim, or creates glare—can impair vision because the pupils must constantly adjust to the amount of light entering the eyes. As a result, the eyes must squint or contract excessively. When lighting is either too bright or too dim, the pupils must continuously adjust to the amount of light entering the eyes. Excessive or insufficient lighting requires continuous pupillary adjustments to regulate retinal illumination. The pupil constricts under bright light and dilates in dim conditions, and prolonged or repeated adaptation may contribute to visual fatigue (Pan et al., 2021).

Unnatural working postures often arise from a mismatch between job demands, workload, work equipment, and workplace design with the worker's physical capabilities and limitations (Adams et al., 2024). Work posture is one of the factors contributing to fatigue and refers to the position of the body while performing job tasks. Inappropriate work postures can increase physical workload and prevent workers from performing optimally (Allo & Yanti, 2023). In the long term, this situation may also increase the risk of musculoskeletal disorders among workers.

Non-ergonomic work postures force workers to adopt awkward or constrained positions while carrying out their tasks. If eyes with refractive errors are used for prolonged periods to view close objects, their accommodative ability becomes weakened. As a result, vision may decrease and become blurry (Mallapiang et al., 2021). Eye disorders or a history of eye disease, such as myopia, hyperopia, astigmatism, or cataracts, increase the risk of experiencing eye fatigue (Riadyani & Herbawani, 2022).

Based on this background, this study aims to examine visual risk factors of asthenopia among karawo craftsmen using a cross-sectional design, addressing gaps in evidence related to visually demanding traditional occupations. Specifically, this study aims to identify the relationship between visual work conditions, duration of near-work activities, and the occurrence of asthenopia among karawo craftsmen. The results are expected to inform occupational health strategies for preventing visual fatigue.

MATERIALS AND METHOD

This study employed an analytical observational design with a cross-sectional approach to examine visual risk factors of asthenopia among karawo craftsmen. This design was selected because it allows simultaneous measurement of exposure variables (age, eye-to-object distance, length of service, working hours, lighting, work posture, and medical history) and the outcome variable (asthenopia complaints), making it appropriate for identifying associated factors in a specific population. Furthermore, this approach allows data to be collected quickly without disrupting the respondents' work.

The study population consisted of karawo craftsmen, and total sampling was applied to include all eligible participants, resulting in a sample size of 51 respondents. This approach was justified due to the relatively small and accessible population, ensuring comprehensive representation and minimizing selection bias. The inclusion criteria were: (1) active karawo craftsmen during the study period; (2) having at least 6 months of work experience; (3) engaging in visually demanding tasks (e.g., embroidery) for ≥ 2 hours per day; and (4) willingness to participate by providing informed consent. The exclusion criteria were: (1) respondents with a history of diagnosed eye diseases (e.g., cataract, glaucoma); (2) those currently undergoing eye treatment; and (3) incomplete questionnaire responses.

Data were collected using a structured questionnaire and direct measurements. Asthenopia was assessed using a symptom-based questionnaire adapted from previous studies, consisting of complaints such as eye strain, blurred vision, double vision, dry eyes, and headaches. Each symptom was rated based on frequency, and respondents were classified as experiencing asthenopia if they reported one or more symptoms occurring frequently during or after work. The questionnaire underwent validity and reliability testing prior to data collection. The validity test was conducted using Pearson correlation, and all items were declared valid ($r\text{-count} > r\text{-table}$). Reliability testing showed a Cronbach's alpha coefficient of >0.7 , indicating acceptable internal consistency. Lighting intensity was measured using a lux meter, and eye-to-object distance was measured using a ruler or measuring tape during work activities. Work posture was assessed through direct observation using an ergonomic checklist.

Data analysis included univariate and bivariate analyses. Univariate analysis was used to describe the distribution of variables, while bivariate analysis using the chi-square test was performed to examine the association between independent variables and asthenopia complaints. A p -value of <0.05 was considered statistically significant. The

results of the analysis are then presented in the form of a frequency distribution table to facilitate the interpretation of the data.

This study was conducted in accordance with ethical research standards and was approved by the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences, UIN Alauddin Makassar, with approval number B.022/KEPK/FKIK/XII/2023. Informed consent was obtained from all participants prior to data collection. Participants were also assured of confidentiality and the voluntary nature of their participation throughout the study.

RESULTS

Table 1. Distribution Based on Respondent Characteristics (n = 51)

Research Variable	Category	Frequency (n)	Percentage (%)
Age (Years)	30–34	21	41.2
	35–39	10	19.6
	40–44	12	23.5
	45–50	8	15.7
Total		51	100
Education	Elementary School	12	23.5
	Junior High School	29	56.9
	Senior High School	10	19.6
Total		51	100
Marital Status	Married	49	96.1
	Not Married	2	3.9
Total		51	100

Based on the table, the majority of respondents were aged 30–34 years (41.2%), followed by those aged 40–44 years (23.5%), 35–39 years (19.6%), and 45–50 years (15.7%). In terms of education level, most respondents had completed junior high school (56.9%), while the rest had elementary school (23.5%) and senior high school (19.6%) education. Regarding marital status, almost all respondents were married (96.1%), with only a small proportion not married (3.9%).

Table 2. Frequency Distribution of Factors Associated with Asthenopia Complaints (n=51)

Variable	Category	Frequency (n)	Percentage (%)
Age	Not at Risk	43	84.3
	At Risk	8	15.7
Eye–Object Distance	Not at Risk	40	78.4
	At Risk	11	21.6
Length of Service	Not at Risk	18	35.3
	At Risk	33	64.7
Working Duration	Not at Risk	45	88.2
	At Risk	6	11.8
Lighting	Meets Requirements	31	60.8
	Does Not Meet Requirements	20	39.2
Work Posture	Ergonomic	12	23.5
	Non-Ergonomic	39	76.5

Variable	Category	Frequency (n)	Percentage (%)
Medical History	No History	45	88.2
	Has History	6	11.8
Asthenopia Complaints	No	40	78.4
	Yes	11	21.6
Total		51	100

Table 2 shows that among the 51 respondents, most were not at risk in terms of age (84%). Additionally, 78.4% had no risk related to eye-to-object distance, 88.2% had no risk in terms of working hours, and 64.7% were at risk based on their length of service. Furthermore, 60.8% had adequate lighting, 88.2% had no medical history, and 76.5% had non-ergonomic work postures. Regarding asthenopia, the majority of respondents did not report asthenopia complaints (78.4%).

Table 3. Factors Associated with Asthenopia Complaints (n = 51)

Variable	Asthenopia Complaints						<i>p-value</i>
	Yes		No		Total		
	n	%	n	%	n	%	
Age							
At Risk	6	75.0	2	25.0	8	100	0.001*
Not At Risk	5	11.6	38	88.4	43	100	
Eye-Object Distance							
At Risk	6	54.5	5	45.5	11	100	0.007*
Not At Risk	5	12.5	35	87.5	40	100	
Length of Service							
At Risk	10	30.3	23	69.7	33	100	0.072
Not At Risk	1	5.6	17	94.4	18	100	
Working Duration							
At Risk	1	16.7	5	83.3	6	100	1.000
Not At Risk	10	22.2	35	77.8	45	100	
Lighting							
Does not Meet Requirements	9	45.0	11	55.0	20	100	0.002*
Meets Requirements	2	6.5	29	93.5	31	100	
Work Posture							
Non-Ergonomic	9	16.7	30	76.9	39	100	1.000
Ergonomic	2	23.1	10	83.3	12	100	
Medical History							
Has History	5	83.3	1	16.7	6	100	0.001*
No History	6	61.3	39	86.7	45	100	

Note: * Positively correlated ($p < 0.05$)

Table 3 shows that the chi-square test results indicate that the variables of age ($p = 0.001$), eye-to-object distance ($p = 0.007$), illumination ($p = 0.002$), and medical history ($p = 0.001$) have a significant relationship with asthenopia complaints, as indicated by p -values < 0.05 . Meanwhile, the variables of length of service ($p = 0.072$), working hours

($p = 1.000$), and work posture ($p = 1.000$) do not have a significant relationship with asthenopia complaints, as their p -values are > 0.05 .

DISCUSSION

The study found that age, eye-to-object distance, lighting, and medical history were significantly associated with asthenopia complaints among karawo craftsmen. These factors were identified as important determinants that may contribute to the occurrence of visual fatigue in this occupational group. Eye fatigue may occur under both insufficient and excessive lighting conditions, as these can reduce visual performance and comfort. In low-light environments, the visual system requires increased accommodative effort, which may lead to symptoms such as blurred vision, visual discomfort, and eye strain (Chen et al., 2023).

In this study, a significant relationship was found between age and asthenopia complaints. As age increases, the eyes experience a decline in sensory function, a reduction in accommodative ability, and decreased efficiency of the ocular muscles responsible for the thickening and thinning of the lens. These changes elevate the risk of eye fatigue. Asthenopia reflects a decline in visual efficiency during prolonged visual tasks, particularly in digital environments, which may reduce situational awareness in the workplace (Ekuase, 2024).

Age plays a significant role in work performance, as advancing age is generally associated with reduced physical capacity, which may affect productivity, especially among workers aged 45 years and older (OECD, 2020). Conversely younger workers aged 20–45 typically possess stronger physical abilities that can enhance their work performance. This finding is consistent with research by Pabala et al. (2021), which reported a significant relationship between age and eye fatigue (asthenopia) among tailors in Kuanino Village, Kupang City. However, this differs from the findings of Prasasti (2023), whose analysis showed no significant association between age and asthenopia.

The distance between the eyes and an object is associated with complaints of asthenopia. When the eyes are positioned too close to an object, they undergo increased contraction and ciliary muscle strain, causing the eyes to tire more quickly. This explains why viewing distance is closely related to asthenopia complaints. At close viewing distances, the eyes must contract and exert greater ciliary muscle effort to focus images on the retina (Khurya & Prayoga, 2021). Thus, the distance between the eyes and the work object is a risk factor for eye fatigue, as near-vision tasks require a high degree of visual coordination and energy. The closer the viewing distance, the more frequently the eyes must accommodate and converge, which can eventually lead to ocular muscle fatigue (Chandraswara & Rifai, 2021).

Working hours were not associated with asthenopia complaints, because even if an individual has long working hours, as long as these hours do not exceed the recommended limits, they do not necessarily cause rapid onset of boredom or fatigue. This finding aligns with a study by Mindayani et al. (2022), which reported no relationship between working hours and eye fatigue among tailors in Lubuk Alung District, Padang Pariaman Regency. This suggests that working hours alone are not sufficient as a primary indicator of eye strain without taking into account other influencing factors.

Working hours were not correlated with complaints of asthenopia, as most respondents had non-risky working hours, namely less than 8 hours per day. In addition, when work is interspersed with stretching exercises, it helps prevent muscle tension and fatigue. This finding is consistent with the study by Purwaningtyas (2021), which reported

no relationship between working hours and eye fatigue among embroidery seamstresses at CV. X Bangil–Pasuruan. However, it contrasts with the study conducted by Pabala et al. (2021), which found a significant relationship between working hours and eye fatigue among seamstresses in Kuanino Village, Kupang. Prolonged working hours without adequate rest can reduce workers' physical capacity and increase the risk of musculoskeletal disorders and fatigue. Workers who exceed standard working hours tend to experience higher muscle workload and insufficient recovery time (Hu et al., 2024).

In this study, lighting was found to be associated with asthenopia complaints, as most respondents who reported asthenopia worked in environments where lighting did not meet the required standards. Adequate lighting is essential for Karawo craftsmen, as their work demands a high level of focus and precision. Therefore, lighting levels must comply with recommended standards; lighting that is either too high or too low can cause visual discomfort.

Eye fatigue (asthenopia) may cause various symptoms including blurred vision, double vision, dry or irritated eyes, eye discomfort, difficulty focusing, and headaches. (Liu et al., 2022). Workplace lighting that does not meet the requirements whether too bright, too dim, or producing glare can impair visual performance. When lighting is excessively bright or dim, the pupils must constantly adjust to regulate the amount of light entering the eyes. This continuous effort forces the pupils to either dilate or constrict excessively. For example, the pupils constrict when exposed to bright light. Such repeated adjustments can contribute to eye fatigue (Purwaningtyas, 2021).

This study is consistent with the findings of Nurhayati et al. (2022), who reported a significant relationship between lighting intensity and eye fatigue among sewing operators at PT. X. However, it differs from the study by Mindayani et al. (2022), which found no relationship between lighting and eye fatigue among tailors in Lubuk Alung District, Padang Pariaman Regency. High lighting intensity carries a 77.271-fold greater risk of eye fatigue. Excessive light intensity may lead to glare, which is influenced by several factors including the luminance and size of the light source, its position relative to the observer, and the contrast between the source and the surrounding visual environment (Tyukhova, 2024).

In occupations that require high precision, such as sewing, inadequate lighting can contribute to eye fatigue. This occurs due to fatigue of the eye muscles and optic nerves as a result of continuous visual strain (Pane et al., 2022). Work posture was not associated with asthenopia complaints, as most respondents, whether they had ergonomic or non-ergonomic work postures—did not report experiencing asthenopia. A non-ergonomic work posture is not necessarily a risk factor for asthenopia complaints. This may also be influenced by the respondents' bent working position, downward head posture, history of illness, and the fact that many had a long duration of service, such as 7, 8, or even 10 years. The hunched posture commonly adopted by tailors for prolonged periods can continuously lead to muscle imbalance (Maylani et al., 2024).

The work object should be positioned below eye level but not too low, as an excessively lowered head position increases the area of the eye covered by the eyelids when looking downward. As a result, the eyes blink more frequently without conscious awareness. This helps the eyes maintain adequate lubrication, keeping the eye surface moist and smooth (Pando, 2022). This finding is consistent with the study conducted by Entianopa et al. (2021), which reported no relationship between work posture and fatigue. However, it contrasts with the findings of Mindayani et al. (2022), who identified a

significant association between work posture and eye fatigue among seamstresses in Lubuk Alung District.

The results of this study indicate that a history of disease is closely related to complaints of asthenopia. Although respondents who reported asthenopia and had a history of disease did not reach 50%, the association remains meaningful because most respondents with asthenopia complaints were aged 40 years and above. Increasing age is associated with reduced ocular flexibility, which can impair vision. Thus, even though the majority of respondents did not report a history of eye disease, many were aged 40 years or older, making it possible that some were unaware of existing refractive errors or had never undergone an eye examination. As age increases, the likelihood of refractive errors also rises, and individuals with refractive errors are more prone to experiencing asthenopia. Karawo craftsmen who have visual disorders (such as refractive errors) tend to exert greater effort to maintain focus on the work object, which can lead to quicker onset of eye fatigue.

As individuals age, both near and distance vision begin to deteriorate due to reduced lens flexibility, which limits the eye's ability to accommodate and to see clearly at close range, such as within arm's length. This change typically occurs naturally around the age of 40 and thereafter (Dana, 2020). Eye health disorders increase the risk of eye fatigue complaints, such as those associated with a history of nearsightedness, farsightedness, cataracts, astigmatism, or the use of corrective lenses. Workers with pre-existing ocular conditions are more likely to experience higher levels of eye fatigue compared to those without such conditions (Abubaker et al., 2025). This study aligns with the findings of Alfonso (2022), which reported a significant relationship between a history of eye disease and eye fatigue complaints among garment workers in the Medan City market area. However, this finding contrasts with other studies that found no significant association between worker characteristics and eye fatigue (Wang et al, 2024).

This study provides several important implications for occupational health management in the informal sector, suggesting that asthenopia prevention among Karawo craftsmen should prioritize engineering controls, such as optimizing task lighting and workspace ergonomics to maintain ideal eye-to-object distances, rather than merely restricting working hours. The primary strength of this research lies in its methodological approach, which combines subjective reports of visual strain with objective measurements of lighting intensity and viewing distance in a specialized traditional craft population that is often overlooked in occupational health studies.

However, some limitations must be acknowledged. The cross-sectional design prevents the establishment of definitive causal relationships between the identified risk factors and asthenopia. Furthermore, the relatively small sample size from a specific geographic area may limit the generalizability of the findings to craftsmen in different regions. Future research should consider longitudinal designs and account for potential confounding variables, such as daily screen time and non-occupational visual activities, to provide a more comprehensive understanding of visual health in this workforce.

CONCLUSION

This study successfully addresses the evidence gap regarding visual strain in traditional occupations by identifying that age, eye-to-object distance, lighting, and medical history are the primary risk factors associated with asthenopia among Karawo craftsmen. These findings imply that occupational health strategies for this informal sector must prioritize environmental and ergonomic engineering, specifically by

optimizing workspace illumination and facilitating proper visual distances, rather than focusing on administrative controls such as limiting working hours. It is recommended that employers of Karawo craftsmen collaborate with local health centers or health services to ensure that elderly craftsmen or those with a history of visual impairment receive regular eye examinations.

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REFERENCES

- Abdelfatah, D., Abdelwahab, S., Eldars, M. Z., & Mayhoub, M. S. (2025). *Evaluating the impact of lighting conditions on workers' safety and health in industrial settings*. *Journal of Daylighting*, 12(2), 420–440. <https://doi.org/10.15627/jd.2025.26>
- Abubaker, S. K., Samaana, S. B., Saidi, Q. N., Qaddumi, J. A. S., Abualhasan, H., & Abusalha, S. I. (2025). Prevalence of dry eye disease among indoor and outdoor workers and the impact on work productivity in the West Bank of Palestine in 2024: A cross-sectional study. *BMC Public Health*, 25, 1642. <https://doi.org/10.1186/s12889-025-22779-0>
- Adams, R., & Nino, V. (2024). Work-related psychosocial factors and their effects on mental workload perception and body postures. *International Journal of Environmental Research and Public Health*, 21(7), 876. <https://doi.org/10.3390/ijerph21070876>
- Alfonso, W. (2022). *Hubungan Intensitas Pencahayaan dengan Kelelahan Mata pada Penjahit di Pusat Pasar Kota Medan*. Universitas Sumatera Utara.
- Allo, A. A., & Yanti, P. (2023). Hubungan antara sikap kerja dengan kelelahan kerja pada tukang jahit di Kecamatan Mentirotik, Toraja Utara. *Jurnal Dinamika Kesehatan Masyarakat*, 2(1), 11–20. <https://jpii.upri.ac.id/index.php/jdkm/article/view/86/96>
- Amali, K. (2022). Implementasi standar intensitas penerangan untuk meningkatkan kualitas sulam karawo. *Jambura Journal of Electrical and Electronics Engineering*, 4(2), 104–107. <https://doi.org/10.37905/jjee.v4i2.14170>
- Boyce, P. R. (2021). *Human factors in lighting* (4th ed.). CRC Press.
- Chandraswara, B. N., & Rifai, M. (2021). Hubungan antara Usia, Jarak Penglihatan dan Masa Kerja dengan Keluhan Kelelahan Mata pada Pembatik di Industri Batik Tulis Srikuncoro Dusun Giriloyo Kabupaten Bantul. *Promotif: Jurnal Kesehatan Masyarakat*, 11(1), 38–44. <https://doi.org/10.56338/pjkm.v11i1.1516>
- Chen, Y., Ma, T., Ye, Z., & Li, Z. (2023). Effect of illuminance and colour temperature of LED lighting on asthenopia during reading. *Ophthalmic and Physiological Optics*, 43(1), 73–82. <https://doi.org/10.1111/opo.13051>

- Dana, M. M. (2020). Gangguan Penglihatan Akibat Kelainan Refraksi yang Tidak Dikoreksi. *Jurnal Ilmiah Kesehatan Sandi Husada*, 9(2), 988–995. <https://doi.org/10.35816/jiskh.v10i2.451>
- DetikHealth. (2023, October 12). *Hari Penglihatan Sedunia 12 Oktober 2023: Kemenkes, 3 dari 100 lansia alami kebutaan*. <https://health.detik.com/berita-detikhealth/d-6977964/hari-penglihatan-sedunia-12-oktober-2023-kemenkes-3-dari-100-lansia-alami-kebutaan>
- Fan, Q., Xie, J., Dong, Z., & Wang, Y. (2024). The effect of ambient illumination and text color on visual fatigue under negative polarity. *Sensors*, 24(11), 3516. <https://doi.org/10.3390/s24113516>
- Ekuase, A. U., Mdegela, M., & Ihedike, C. (2024). The potential association between asthenopia and its risk factors amongst students at the University of Sunderland. *International Journal of Advanced Multidisciplinary Research and Studies*, 4(6), 525–532. <https://doi.org/10.62225/2583049X.2024.4.6.3469>
- Entianopa, Harahap, P. S., & Rahma, D. (2021). Hubungan Aktivitas Berulang, Sikap Kerja dan Lama Kerja Dengan Keluhan Kelelahan Otot Pekerja Getah Karet. *Public Health and Safety International Journal*, 1(1), 7–11. <https://doi.org/10.55642/phasij.v1i01>
- Hu, B., Wu, Y., Pan, Y., Ding, X., Niu, D., Li, J., & Yan, T. (2024). Association of long working hours and multi-site work-related musculoskeletal disorders among transportation industry workers in Beijing, China. *International Archives of Occupational and Environmental Health*. <https://doi.org/10.1007/s00420-024-02110-x>
- Khurya, K. R., & Prayoga, D. (2021). Kelelahan Mata selama Pandemi Covid-19: Literature Review. *Jurnal Ilmiah Permas: Jurnal Ilmiah Stikes Kendal*, 11(4). <https://doi.org/10.32583/pskm.v11i4.1648>
- Liu, Z., Zhang, K., Gao, S., Yang, J., & Qiu, W. (2022). Correlation between eye movements and asthenopia: A prospective observational study. *Journal of Clinical Medicine*, 11(23), 7043. <https://doi.org/10.3390/jcm11237043>
- Mallapiang, F., Azriful, Nildawati, Syarfaini, Muis, M., & Adriansyah. (2021). The relationship of posture working with musculoskeletal disorders (MSDs) in the weaver West Sulawesi Indonesia. *Gaceta Sanitaria*, 35(1), S15–S18. <https://doi.org/10.1016/j.gaceta.2020.12.005>
- Maylani, S., Nugroho, F., & Rustiana, Y. (2024). Pengaruh Deep Neck Flexor Exercise terhadap Neck Pain Non-Specific pada Penjahit. *Jurnal Fisioterapi Terapan Indonesia*, 4(2). <https://doi.org/10.7454/jfti.v4i2.1116>

- Mindayani, S., Hanum, N. Z., & Hamidah, N. B. (2022). Faktor-Faktor yang Berhubungan dengan Kelelahan Mata pada Penjahit di Kecamatan Lubuk Alung Kabupaten Padang Pariaman Tahun 2021. *PubHealth Jurnal Kesehatan Masyarakat*, 1(1), 1–11. <https://doi.org/10.56211/pubhealth.v1i1.16>
- Nurhayati, I., Atmojo, T. B., & Sari, Y. (2022). Hubungan Intensitas Pencahayaan dan Jarak Penglihatan dengan Keluhan Kelelahan Mata Operator Jahit. *Ikesma: Jurnal Ilmu Kesehatan Masyarakat*, 18(1), 45–50. <https://doi.org/10.19184/ikesma.v18i1.26436>
- OECD. (2020). *Promoting an age-inclusive workforce: Living, learning and earning longer*. Paris: OECD Publishing. <https://doi.org/10.1787/59752153-en>
- Pabala, J. L., Roga, A. U., & Setyobudi, A. (2021). Hubungan Usia, Lama Kerja dan Tingkat Pencahayaan dengan Kelelahan Mata (Astenopia) pada Penjahit di Kelurahan Kuanino Kota Kupang. *Media Kesehatan Masyarakat*, 3(2), 215–225. <https://doi.org/10.35508/mkm.v3i2.3258>
- Pando, A. C. (2022). *Faktor yang Berhubungan dengan Keluhan Kelelahan Mata (Astenopia) Pada Karyawan Dinas Komunikasi Informatika dan Persandian Kabupaten Sinjai*. (Skripsi, Universitas Hasanuddin). <http://repository.unhas.ac.id/id/eprint/18801>
- Pane, J. P., Saragih, I. S., & Laoli, T. L. (2022). Hubungan lama penggunaan gadget dengan kejadian astenopia pada mahasiswa program studi ners. *Jurnal Penelitian Perawat Profesional*, 4(3), 947–954. <https://doi.org/10.37287/jppp.v4i3.1050>
- Prasasti, G. D. (2023). Asthenopia Sebagai Dampak Internet Gaming Disorder: Studi Terhadap Remaja di Yogyakarta. *Jurnal Ilmiah Kohesi*, 7(3), 215–221. <https://etd.repository.ugm.ac.id/penelitian/detail/187317>
- Pan, Q., Zhang, S., Bian, J., Luo, T., Wei, M., Xue, P., Xie, J., & Liu, J. (2026). Pupil dynamic adaptation in response to environmental luminance: A controlled laboratory study. *Building and Environment*, 287, 113887. <https://doi.org/10.1016/j.buildenv.2025.113887>
- Riadyani, A. P., & Herbawani, C. K. (2022). Systematic Review Pengaruh Intensitas Cahaya Terhadap Kelelahan Mata Pekerja. *Jurnal Kesehatan Masyarakat (Undip)*, 10(2), 167–171. <https://doi.org/10.14710/jkm.v10i2.32475>
- Tyukhova, Y. (2024). Discomfort glare in outdoor environments after dark: A review of methods, measures, and models. *Building and Environment*. <https://doi.org/10.1016/j.buildenv.2024.111850>
- Wang, G., & Cui, Y. (2024). Meta-analysis of visual fatigue based on visual display terminals. *BMC Ophthalmology*, 24, 489. <https://doi.org/10.1186/s12886-024-03721-1>

World Health Organization, & International Labour Organization. (2021). *WHO/ILO joint estimates of the work-related burden of disease and injury, 2000–2016*. Geneva: World Health Organization.
<https://www.who.int/publications/i/item/9789240034945>