



Work-Related Factors and Individual Characteristics on Asthenopia Symptoms among “Pecanting Batik” Workers in Klaten, Indonesia

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Article Info

Article History:

Submitted August 2024

Accepted October 2024

Published: April 2025

Keywords:

Asthenopia, Batik, Individual Characteristics; Sleep Quality; Work-Related

DOI

<https://doi.org/10.15294/kemas.v20i4.11303>

Abstract

Asthenopia is associated with close work, such as blurred vision, diplopia, dry eyes, and headaches. The incidence of asthenopia is quite common among workers who perform intensive visual tasks. The goal is to analyze the risk factors most related to asthenopia complaints. This type of observational research with a cross-sectional study design took time in July 2024 on 155 batik canters in 45 batik-making home industries in Jarum Village, Klaten Regency, Central Java, Indonesia. Variables were measured using a general questionnaire on age, length of service, length of work, and length of rest. In addition, the Pittsburgh Sleep Quality Index (PSQI) questionnaire is used to measure sleep quality. The worker's awkward posture was measured using the Rapid Upper Limb Assessment Worksheet. The distance to see the object is measured using the JOYKO brand 30cm Butterfly Iron Ruler between the object and the worker's eyes. The Visual Fatigue Index (VFI) questionnaire measured asthenopia complaints. The analysis of bivariate data with Spearman rank and multivariate correlation was used multiple linear regression test. This study showed that most respondents were 44,368 years old on average, felt that their sleep quality was not good, and had been working as a batik maker for ≥ 10 years. The risk factors most related to asthenopia complaints are sleep quality ($p=0.000$), age ($p=0.001$), and working period ($p=0.019$).

Introduction

Asthenopia, also known as eye fatigue, is characterized by symptoms associated with close work, such as blurred vision, diplopia, dry eyes, and headaches (Zhang *et al.*, 2023). These symptoms can be divided into three categories. They are visual disturbances, eye irritation, and extraocular symptoms (Anbesu & Lema, 2023). Data from the World Health Organization (WHO) shows that the incidence of asthenopia or eye fatigue ranges from 40% to 90% (World Health Organization, 2022; Abuallut *et al.*, 2022). The prevalence of asthenopia in computer operators in India is 87.3%, with various symptoms, one of which is blurred vision, as much as 18.7% (Arshad *et al.*, 2019).

Asthenopia can be diagnosed by paying attention to the subjective symptoms experienced by the individual, such as eye pain and blurred vision (Wang *et al.*, 2022). The causes of asthenopia vary but are generally related to factors that over-stress the visual system (Ferreira *et al.*, 2024). Age and longer working life are often correlated with an increase in complaints of asthenopia, due to a decrease in the ability of the eye to adapt with age (Chowdhury & Chakraborty, 2017). Long working hours without adequate rest also increase the risk of eye fatigue (López *et al.*, 2020; Prasetyo *et al.*, 2023). In addition, non-ideal visibility, poor sleep quality, and unergonomic work posture can worsen the symptoms of asthenopia (Anbesu & Lema,

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2023).

The incidence of asthenopia is quite common among workers who perform intensive visual tasks (Ostrovsky & Ilchenko, 2022). Previous research showed that as many as 79.16% of visual display terminal operators at Federal International Finance Group Bali experienced symptoms of asthenopia, with headache complaints being the most common (Primantara & Putere, 2020). Another study found that 38.7% of male professional tailors experienced symptoms of asthenopia (Sharma *et al.*, 2021). In the United States, 57.9% of manufacturing workers reported experiencing eye strain, with work stress and shift schedules as the main causes (Lu *et al.*, 2017). Physiologically, asthenopia occurs due to excessive strain on the eye muscles, disturbances in blood circulation in the eye, or problems with the nervous system that regulates visual functions (Hashemi *et al.*, 2019). When the eyes are forced to work continuously without rest, the eye muscles become tense and tired (Ostrovsky & Ilchenko, 2022). It can lead to impaired accommodation and convergence, which in turn triggers symptoms of eye fatigue (Kim *et al.*, 2023).

Previous research has identified that prolonged exposure of five to six hours without rest and working at a distance of 50 cm from a computer monitor poses a danger of eye fatigue (Irwan *et al.*, 2023). Other research conducted on wig manufacturing workers showed a relationship between work position and eye fatigue (Rulianti *et al.*, 2020). Age 28-29 years is an independent factor related to the incidence of asthenopia in college students (Hashemi *et al.*, 2019). One of the informal sector jobs involved in short-distance work and requires high precision is the batik industry, especially in the batik canting section (Oginawati *et al.*, 2023). Several specific phenomena may contribute to asthenopia complaints. The work process of making batik is still traditional. So workers often have to look at objects at a very close distance for a long period. The work postures are not always follow the anthropometry of the worker's body. In addition, long work patterns without adequate rest and a work environment with less than optimal lighting can exacerbate this condition (Prasetyo *et al.*, 2023).

Although much research has been done on asthenopia, there is a gap in the literature on asthenopia research in the informal sector. This study aims to fill this gap by providing empirical data on factors that affect asthenopia in informal sector industrial workers, namely in the batik industry. This study suspects that in addition to the factors described, there is a chance that sleep quality factors can also contribute to asthenopia in batik

workers. Lengthy work in the editing section, with additional work at home for four to five hours after hours, can lead to a lack of sleep. It is possible to aggravate asthenopia complaints.

Methods

This type of observational research with a cross-sectional study design was carried out in July 2024 in 45 *batik-making* home industries in Jarum Village, Klaten Regency, Central Java, Indonesia. The population is 285 *batik-making* workers with sampling using the purposive sampling technique. All *batik canting* workers became respondents in this study, namely 155 respondents. The independent variables were individual factors (Sleep Quality, Age) and Work-Related (Distance to See Objects, Rest Duration, Length of Work, Working Period, and Odd Work Posture). The bound variable is asthenopia complaints. Variables were measured using a general questionnaire on age, length of service, length of work, and length of rest. In addition, the Pittsburgh Sleep Quality Index (PSQI) questionnaire is used to measure sleep quality. BMI with weight measurement using Omron HN 289 Digital Scales and height using Stature Adult Height Meter MT-701. The worker's awkward posture was measured using the Rapid Upper Limb Assessment Worksheet. The distance to see the object is measured using the JOYKO brand 30cm Butterfly Iron Ruler between the object and the worker's eyes. The Visual Fatigue Index (VFI) questionnaire measured asthenopia complaints consisting of 22 questions. Each question has four possible answer options (never, sometimes, often, and always).

This research has received ethical approval from the Ethics Committee for Health Research, Faculty of Nursing and Health Sciences, University of Muhammadiyah Semarang, with certificate number 417/KE/06/2024. The research began with the informed consent signing, after which a questionnaire interview was conducted, and ended with the measurement of BMI, distance to see objects, and unusual work posture. Data analysis starts from univariate analysis, namely individual and occupational characteristic variables are presented in the form of a frequency

table with mean values \pm standard deviation or as a median (minimum-maximal). Then, the bivariate analysis of the relationship between risk factors and complaints of asthenopia was tested with a Spearman rank correlation because all data were numerical. Finally, multivariate analysis to determine the variables most related to asthenopia complaints used multiple linear regression tests. The data analysis was carried out using IBM SPSS Statistics 21.

Result and Discussion

Most research respondents were $44,368 \pm 8,412$ with an average BMI of $24,716 \pm 2,761$. Most respondents felt their sleep quality was not good (77.4%). Distribution analysis showed that 69% of respondents saw work objects with a standard distance of ≥ 25 cm. Most respondents took an average break of $60,130 \pm 16,768$, with an average length of work of $8,587 \pm 1,252$. More than half of *batik*

Table 1. Individual and Work-Related Characteristics of The Study Population (n=155)

Factors	Mean \pm SD	Median (Min-Max)	f(%)
Individual			
IMT (kg/m ²)	24,71 \pm 2,76	24,6 (17,2-31,9)	
< 18,5			7 (4,5)
18,5-22,9			22(14,2)
23-24,9			59(38,1)
25-29,9			66(42,6)
≥ 30			1 (0,6)
Sleep Quality (skor)	7,01 \pm 1,53	8,0 (4,0 -11,0)	
Bad			120(77,4)
Good			35(22,6)
Age (years)	44,36 \pm 8,41	46,0 (24,0-66,0)	
20-44			47(30,3)
45-64			106(68,4)
≥ 65			2 (1,3)
Work-Related			
Object Viewing Distance (cm)	25,21 \pm 2,91	26,0 (18,0- 30,0)	
< 25			48(31,0)
≥ 25			107(69,0)
Rest Length (minutes/day)	60,13 \pm 16,76	60,0 (20,0-120,0)	
< 60			21(13,5)
≥ 60			134(86,5)
Length of Work (hours/day)	8,58 \pm 1,25	8,0 (7,0-14,0)	
< 8			25(16,1)
≥ 8			130(83,9)

Factors	Mean±SD	Median (Min-Max)	f(%)
Working Period (years)	13,20±9,94	12,0 (1,0-54,0)	
< 10			54(34,8)
≥ 10			101(65,2)
Unergonomic posture (score)	5,14±1,45	5,0 (2,0-8,0)	
Unergonomic			134(86,5)
Ergonomic			21(13,5)
Astenopia Complaints (skor)	0,47±0,15	5,0 (0,25-0,9)	
None			53(34,2)
Exist			102(65,8)

(Source: Primary Data, 2024)

artisans have been working as *batik* artisans for ≥ 10 years (65.2%). As many as 86.5% of *batik* workers work with unergonomic posture. A total of 65.8% of respondents experienced complaints of asthenopia (Table 1).

More than half of the respondents

sometimes felt blurred vision (50.3%), double or shadowed vision (55.5%), and hot eyes (56.8%). The frequency of symptoms that were often experienced by the majority of respondents was frequent scratching of the eyes (50.3%), twitching or spasms of the eyelids (50.3%), and

Tabel 2. Response to Eye Fatigue Complaint Statement (n=155)

Asthenopia Symptoms	Response to Asthenopia Symptoms			
	Never f(%)	Sometimes f(%)	Often f(%)	Always f(%)
Pain or throbbing sensation around the eyeball	96(61,9)	54(34,8)	4(2,6)	1(0,6)
Painful eyes	70(45,2)	70(45,2)	14(9,0)	1(0,6)
Eyes feel heavy	95(61,3)	28(18,1)	5(3,2)	27(17,4)
Blurred vision	74(47,7)	78(50,3)	2(1,3)	1(0,6)
Double or shadowed vision	56(36,1)	86(55,5)	10(6,5)	3(1,9)
Eyes feel hot	53(34,2)	88(56,8)	12(7,7)	2(1,3)
Watery eyes	65(41,9)	37(23,9)	1(0,6)	52(33,5)
Sleepy	62(40,0)	52(33,5)	41(26,5)	0(0,0)
Eyes feel tense	50(32,3)	68(43,9)	24(15,5)	13(8,4)
Dry eyes	74(47,7)	47(30,3)	13(8,4)	21(13,5)
Itchy eyes	50(32,3)	38(24,5)	56(36,1)	11(7,1)
Headache	94(60,6)	27(17,4)	25(16,1)	9(5,8)
Eyes reddened	90(58,1)	37(23,9)	14(9,0)	14(9,0)
Difficulty focusing vision	113(72,9)	4(2,6)	15(9,7)	23(14,8)
Eyes are often rubbed	48(31,0)	15(9,7)	78(50,3)	14(9,0)
Glare	88(56,8)	1(0,6)	41(26,5)	25(16,1)
Eyelid twitching or spasms	53(34,2)	12(7,7)	78(50,3)	12(7,7)
Eyelids that are difficult to close	91(58,7)	24(15,5)	16(10,3)	24(15,5)

Pain when the eye moves the eyeball	29(18,7)	13(8,4)	101(65,2)	12(7,7)
Pain when closed firmly	114(73,5)	0(0,0)	16(10,3)	25(16,1)
Eyes feel sore	53(34,2)	1(0,6)	13(8,4)	88(56,8)
Eyes feel sandy	117(75,5)	1(0,6)	12(7,7)	25(16,1)

(Sumber: Data Primer, 2024)

pain when the eyes moved the eyeballs (65.2%). Meanwhile, as many as 56.8% of respondents always experience asthenopia complaints in the form of stinging eyes (Table 2).

There was a significant relationship between Sleep Quality and Age with asthenopia Symptoms in *batik* artisans in Klaten Regency with each value of $p=0.000$. In the occupational factor, there was a significant relationship between the distance to see the object ($p=0.018$),

the length of work ($p=0.015$), and the duration of work ($p=0.000$) and complaints of asthenopia in batik craftsman in Klaten Regency (Table 3).

The multivariate analysis showed 3 independent variables that were most related to asthenopia complaints in *batik canting workers* in Klaten Regency, namely sleep quality ($p=0.000$), age ($p=0.001$), and working period ($p=0.019$) (Table 4). The *canting* part of *batik* workers is the work of repainting patterns on

Tabel 3. Relationship of Work-Related Factors and Individual Characteristics on Asthenopia Symptoms (n=155)

Factors	Asthenopia Symptoms	
	p^*	Information
Individual		
Sleep Quality	0,000	There is a relationship **
Age	0,000	There is a relationship **
Work-Related		
Object Viewing Distance	0,018	There is a relationship **
Rest Length	0,692	No relationship ***
Length of Work	0,015	There is a relationship **
Working Period	0,000	There is a relationship **
Unergonomic Work Posture	0,353	No relationship ***

*Spearman's Rank Correlation; ** $p \leq 0,05$; *** $p > 0,05$

(Source: Primary Data, 2024)

Tabel 4. Multiple Regressions Linear Model for Asthenopia Symptoms

Factors	β	SE	BETA	p
Individual				
Sleep Quality	0,034	0,008	0,333	0,000*
Age	0,005	0,001	0,257	0,001*
Work-Related				
Object Viewing Distance	0,004	0,004	0,081	0,271**
Rest Length	0,000	0,001	0,017	0,826**
Length of Work	0,004	0,009	0,028	0,703**
Working Period	0,003	0,001	0,175	0,019*
Unergonomic Work Posture	0,003	0,008	0,024	0,756**

* $p \leq 0,05$;

** $p > 0,05$

(Source: Primary Data, 2024)

batik fabric. This job requires visual effort every time it works. Visual efforts in *batik* workers showed the results of a study with a prevalence of asthenopia symptoms of 65.8% in *batik* workers in the *canting* section. Research on students who use computers shows a prevalence of asthenopia of 53.3% (Xu *et al.*, 2019). In our study, three-quarters of respondents complained that their eyes felt sandy, their eyes hurt when closed firmly, and they had difficulty focusing their vision. In contrast to the results of other studies that explain that the complaints of asthenopia experienced by students are symptoms such as headaches, blurred vision, and eye fatigue that interfere with concentration and work efficiency (Chowdhury & Chakraborty, 2017).

This study shows that age is associated with asthenopia complaints. Young workers do not dominate because they are studying and working outside the village, so the sample is dominated by elderly. Old age is a risk factor for asthenopia (Deng *et al.*, 2019; Wang *et al.*, 2022). Our sample was mostly workers aged 45-64 who had complaints of asthenopia. Eye commodity decreases with age, and individuals over 40-45 years old are susceptible to asthenopia after prolonged close work (Deng *et al.*, 2019; Negishi *et al.*, 2021). This study revealed that respondents had difficulty sleeping. Sleep quality in this multivariate analysis was related to complaints of asthenopia. It happens because the quality of sleep is not good, as felt by most *batik* workers. Asthenopia causes symptoms of dry eyes and headaches, which can negatively affect sleep quality, thus worsening asthenopia (Stack *et al.*, 2017).

Workers who have worked longer than 10 years dominate (65.2%). The period of employment is the accumulation of activities that a person does over a long period. It is proven in this study that the working period is related to asthenopia. In line with previous research, a long working period can increase the risk of eye fatigue (Jang *et al.*, 2023; Rahman *et al.*, 2024). Work that requires precision causes the eyes to continue to be accommodated, causing tension in the eye muscles and fatigue of the eye nerves. Our study showed that object viewing distance was not associated with complaints of asthenopia. It happens because most of the distance to see the object of the *batik* workers

when “*canting*” is safe, which is ≥ 25 cm, as much as 69%. Closer pitch spacing causes more severe eye strain (Long *et al.*, 2017).

Most respondents' working time is ≥ 8 hours, which means overtime. Most of these workers are “wholesale workers” who bring the work at home so that workers are not supervised by the owner of the industrial home. Eye fatigue due to work is higher in workers who spend their time on visual efforts using electronic devices (Jang *et al.*, 2023). The rest duration in this study sample was mostly ≥ 60 minutes. The result is in line with previous research that explained that rest is not related to asthenopia in tailors (Zafar *et al.*, 2021). Unergonomic working posture is not associated with complaints of asthenopia. It is because most of the *canting batik* workers have an unergonomic posture. The results of this study are not aligned with the theory that an increase in ideal posture deviation indicates a health problem (Souchet *et al.*, 2023).

The symptoms of asthenopia that appear a lot affect a person's psychological condition, surrounding environment, health status, diet, and lifestyle behaviors (Zafar *et al.*, 2021). Ongoing symptoms can cause significant discomfort, affecting their personal and social lives (Wang *et al.*, 2022). Asthenopia can lead to decreased productivity because workers have difficulty maintaining the focus and details of the work required in the *batik-making* process (Ruliati *et al.*, 2020). The quality of *batik* is greatly influenced by its accuracy and precision. If workers experience Asthenopia, it can cause the risk of errors in *batik-making* and will reduce the quality of the *batik* produced. It will, of course, affect the image of the *batik* industry. This research has several limitations. We only conducted studies based on subjective perceptions of asthenopia complaints compared to measurements with more objective tools. There are still other factors related to asthenopia. Future research should include more potential factors and thoroughly explore risk factors for asthenopia.

Conclusion

Aging age is inevitably a natural risk factor for *batik canting* workers related to symptoms of asthenopia. In addition, poor

sleep quality is associated with confirming the symptoms of asthenopia. There are also work factors related to asthenopia symptoms. The longer the working period, the more the risk of asthenopia symptoms will increase because working only by experience and not based on applicable rules. Workers should maintain their sleep quality well and also work consistently according to the rules to minimize the onset of asthenopia symptoms. Further research is needed regarding risk factors for poor sleep quality, such as what can accelerate the appearance of asthenopia and continue using biological parameters that mark the occurrence of asthenopia.

Acknowledgment

The author would like to thank The Directorate General of Higher Education, Research, and Technology Ministry of Education, Culture, Research, and Technology, Republic of Indonesia, for providing research funding assistance in the master's thesis research grant scheme (No. 047/ES/PG.02.00.PL/2024 and No. 601-116/UN7.D2/PP/VI/2024). We also express our gratitude to the Jarum Village Government, Workers, and Owners of the Batik Home Industry for allowing the implementation of this research. Finally, we would also like to thank the Master of Health Promotion Study Program (Concentration on Occupational Safety and Health), Faculty of Public Health, Diponegoro University, Semarang, for support during the research.

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