



Relationship of Work, Environmental, and Individual Factors with Eye Fatigue Complaints in Batik Tulis Workers

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ABSTRAK

Pekerjaan batik tulis membutuhkan ketelitian visual yang tinggi dengan jarak pandang dekat dan durasi kerja yang lama, sehingga menimbulkan risiko kelelahan mata. Keluhan umum meliputi mata perih, penglihatan kabur, dan kesulitan fokus. Secara global, prevalensi gejala kelelahan mata berkisar antara 67-70%, dan dapat melebihi 90% pada kelompok tertentu. Penelitian di Pakistan menemukan sekitar 48% responden mengalami kelelahan mata. Sebuah studi pendahuluan pada pekerja batik menemukan 60% responden mengalami keluhan serupa. Jika tidak dikendalikan, kondisi ini dapat mengurangi produktivitas, kualitas kerja, dan kesehatan pekerja. Studi ini bertujuan untuk menganalisis hubungan antara faktor kerja, lingkungan, dan individu dengan keluhan kelelahan mata di kalangan pekerja batik tulis. Metode: Penelitian observasional analitis dengan pendekatan cross-sectional dilakukan pada 35 pekerja batik tulis di pusat batik Kota Semarang menggunakan purposive sampling. Variabel independen meliputi usia, lama kerja per hari, periode kerja, jarak mata ke objek, dan intensitas pencahayaan, sedangkan variabel dependen adalah keluhan kelelahan mata. Analisis data menggunakan uji Chi-Square, uji Fisher's Exact, dan uji Mann-Whitney. Hasil: Sebanyak 42,9% responden mengalami keluhan kelelahan mata. Terdapat hubungan signifikan antara waktu kerja per hari ($p=0,005$) dan jarak mata ke objek ($p=0,000$) dengan keluhan kelelahan mata. Usia, periode kerja, dan intensitas pencahayaan tidak menunjukkan hubungan yang signifikan. Kesimpulan: Waktu kerja dan jarak pandang yang tidak ergonomis berhubungan dengan kelelahan mata pada pekerja batik tulis. Pencegahan harus fokus pada pengaturan durasi kerja dan penerapan jarak pandang ergonomis.

ABSTRAK

Background: Batik tulis work requires high visual precision with close viewing distance and long work duration, posing a risk of eye fatigue. Common complaints include sore eyes, blurred vision, and difficulty focusing. Globally, the prevalence of eye fatigue symptoms ranges from 67-70%, and can exceed 90% in certain groups. Research in Pakistan found approximately 48% of respondents experienced eye fatigue. A preliminary study on batik workers found 60% of respondents experienced similar complaints.

Keywords

batik artisans; eye fatigue; eye-to-object distance; working hours

If uncontrolled, this condition may reduce productivity, work quality, and worker health. This study aims to analyze the relationship between work, environmental, and individual factors with eye fatigue complaints among batik tulis workers. Methods: Observational analytical research with a cross-sectional approach was conducted on 35 batik tulis workers at the Semarang City batik center using purposive sampling. Independent variables included age, length of work per day, working period, eye-to-object distance, and lighting intensity, while the dependent variable was eye fatigue complaints. Data analysis used Chi-Square test, Fisher's Exact Test, and Mann-Whitney test. Results: A total of 42.9% of respondents experienced eye fatigue complaints. There was a significant relationship between working time per day ($p=0.005$) and eye-to-object distance ($p=0.000$) with eye fatigue complaints. Age, working period, and lighting intensity did not show a significant relationship. Conclusion: Working time and non-ergonomic viewing distance are related to eye fatigue in batik tulis workers. Prevention should focus on regulating working duration and implementing ergonomic viewing distance.

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Indonesia is a country rich in culture and tradition, one of which is batik, recognized by UNESCO on October 2, 2009, as a Masterpiece of the Oral and Intangible Heritage of Humanity. Batik is not only a national cultural identity, but also plays an important role in the national economy, absorbing labor largely in the informal sector (Steelyana, 2012).

The process of making batik tulis demands high visual accuracy and concentration. Batik workers must attend to small-scale motif details at close range continuously for a relatively long time, averaging 6-8 hours per day. This intensive visual activity causes the accommodative muscles of the eye to work continuously, which can lead to eye fatigue or asthenopia. Eye fatigue is a visual disorder characterized by symptoms such as sore and tense eyes, watering eyes, blurred vision, headaches, and difficulty concentrating.

Globally, the prevalence of eye fatigue symptoms among workers with high visual demands ranges between 67-70%. In Indonesia, research on batik workers in Giriloyo, Bantul, found a significant relationship between working viewing

distance and length of service with eye fatigue complaints. Meanwhile, comprehensive research on eye fatigue among batik tulis workers, particularly in Semarang City, remains very limited.

Batik tulis centers in Semarang City include Kampung Batik Rejomulyo, the Tembalang area, Meteseh, Gunungpati, and surrounding areas. Most batik workers work in home-based conditions with varying lighting, viewing distances, and work durations, and have not yet applied optimal ergonomic standards. This condition has the potential to increase the risk of eye fatigue. This study aims to analyze the relationship between work factors (work duration, working period, eye-to-object distance), environmental factors (lighting intensity), and individual factors (age) with eye fatigue complaints among batik tulis workers in Semarang City.

1. Methods

This study is a quantitative observational analytical study with a cross-sectional design. The study was conducted at 4 batik tulis centers in Semarang City, Central Java Province (Kampung Batik Rejomulyo, Tapak Dara Meteseh batik, Durenan

Tembalang batik, and Kampung Batik Malon Gunungpati), in January-February 2026.

The study population was all batik tulis workers in Semarang City. The sample consisted of 35 respondents selected using purposive sampling based on inclusion criteria: willing to be respondents and working as batik tulis/canting workers. Exclusion criteria included having a history of eye disease and being absent from work.

The dependent variable was eye fatigue complaints, measured using a questionnaire (Pheasant, 1991) with categories yes (≥ 1 complaint) and no (< 1 complaint). Independent variables included: (1) work duration, categorized as heavy (> 4 hours/day), moderate (2-4 hours/day), and light (< 2 hours/day); (2) working period, categorized as long (> 10 years), moderate (6-10 years), and new (< 6 years) based on Tulus (1992); (3) eye-to-object distance, categorized as at risk (≤ 30 cm) and not at risk (> 30 cm) using a measuring tape; (4) lighting intensity, categorized as not meeting standard (< 300 lux and ≥ 1000 lux) and meeting standard (300-1000 lux) per Permenaker No. 5 Year 2018, measured with a lux meter; and (5) age, categorized as at risk (≥ 40 years) and not at risk (< 40 years).

Data analysis was performed univariately and bivariately. The Mann-Whitney test was used to assess the relationship between work duration and working period with eye fatigue complaints (as chi-square requirements were not met). Chi-Square tests were used for eye-to-object distance and lighting intensity. Fisher's Exact Test was used for age, with a 95% confidence level ($\alpha = 0.05$).

2. Results

Univariate Analysis

Table 1 presents the distribution of research variables.

Table 1. Distribution of Research Variables

Variable	n	%
Work Duration		
Heavy (> 4 hours/day)	16	45.7
Moderate (2-4 hours/day)	18	51.4
Light (< 2 hours/day)	1	2.9
Working Period		
Long (> 10 years)	15	42.9
Moderate (6-10 years)	6	17.1
New (< 6 years)	14	40.0
Eye-to-Object Distance		
At risk (≤ 30 cm)	14	40.0
Not at risk (> 30 cm)	21	60.0
Lighting Intensity		
Does not meet standard (< 300 lux and ≥ 1000 lux)	23	65.7
Meets standard (300-1000 lux)	12	34.3
Age		
At risk (≥ 40 years)	29	82.9
Not at risk (< 40 years)	6	17.1
Eye Fatigue Complaints		
Yes	15	42.9
No	20	57.1
Total	35	100.0

Source: Primary data, 2026

The study involved 35 batik tulis workers at the Semarang City batik center. The majority of respondents were aged ≥ 40 years (82.9%), while 17.1% were aged < 40 years, indicating that most respondents are in an at-risk age group that physiologically experiences decreased eye accommodation capacity.

Regarding work duration, most respondents worked 2-4 hours per day (51.4%), followed by > 4 hours (45.7%), and < 2 hours (2.9%). From the working period perspective, 42.9% had worked > 10 years, 40.0% for < 6 years, and 17.1% for 6-10 years. As for eye-to-object distance, 60.0% of respondents worked at a non-risky distance (> 30 cm), while 40.0% still worked at a distance of ≤ 30 cm. For lighting intensity, 65.7% worked under conditions that did not meet the standard (< 300 lux or ≥ 1000 lux), while 34.3% met the standard

(300-1000 lux). Eye fatigue complaints were experienced by 15 respondents (42.9%), while 57.1% did not experience complaints.

Bivariate Analysis

1. Relationship Between Work Duration and Eye Fatigue Complaints

Table 2. Mann-Whitney Test Results for Work Duration and Eye Fatigue Complaints

Work Duration	Eye Fatigue	N	Mean Rank	p-value
	Yes	15	13.03	0.005
	No	20	21.73	
	Total	35		

Source: Primary data, 2026

The Mann-Whitney test yielded $p = 0.005$ (< 0.05), indicating a significant relationship between work duration and eye fatigue complaints among batik tulis workers. The mean rank of respondents who did not experience eye fatigue (21.73) was higher than those who did (13.03). Theoretically, work duration exceeding 4 hours per day can increase the risk of eye fatigue because batik-making activities demand high visual concentration at close range and relatively static working posture. Prolonged visual exposure causes the accommodative muscles to work continuously, triggering symptoms such as sore eyes, blurred vision, and headaches. Field interviews revealed that batik workers rarely take adequate rest breaks due to concern that the wax (malam) will harden and disrupt the work process. This finding aligns with research by Rahman et al. (2024) and Pada & Kantor (2023), which reported that work duration has a significant relationship with eye fatigue complaints.

2. Relationship Between Working Period and Eye Fatigue Complaints

Table 3. Mann-Whitney Test Results for Working Period and Eye Fatigue Complaints

Working Period	Eye Fatigue	N	Mean Rank	p-value
	Yes	15	14.87	0.090
	No	20	20.35	
	Total	35		

Source: Primary data, 2026

The Mann-Whitney test yielded $p = 0.090$ ($p > 0.05$), indicating no significant relationship between working period and eye fatigue complaints. This can be explained through several possibilities. First, physiological and psychological adaptation: batik workers with longer working periods have generally become accustomed to the visual demands of the work and have their own strategies for managing work rhythm. Second, working period does not necessarily reflect daily exposure duration, as flexibility in the informal sector allows workers to adjust working hours according to physical condition. Third, eye fatigue complaints are subjective and can be influenced by individual perception of discomfort. This finding aligns with Maulina & Syafitri (2019) who found no significant relationship between working period and eye fatigue ($p = 0.844$).

3. Relationship Between Eye-to-Object Distance and Eye Fatigue Complaints

Table 4. Chi-Square Test Results for Eye-to-Object Distance and Eye Fatigue Complaints

Eye-to-Object Distance	Yes	%	No	%	Total	p-value
At risk (≤ 30 cm)	12	85.7	2	14.3	14	0.000
Not at risk (> 30 cm)	3	14.3	18	85.7	21	
Total	15	42.9	20	57.1	35	

Source: Primary data, 2026

The Chi-Square test showed $p = 0.000$ ($p < 0.05$), indicating a significant relationship between eye-to-object distance and eye fatigue complaints. As many as 85.7% of batik workers who worked at a risky eye distance (≤ 30 cm) experienced eye fatigue, while only 14.3% of those at a non-risky distance (> 30 cm) experienced complaints. Field observations showed that some batik workers tend to bend forward and bring the cloth close to their face when making fine motif details. Physiologically, working distance that is too close causes the ciliary muscles to work harder to maintain focus. Prolonged contraction can cause eye strain, blurred vision, and discomfort. This finding aligns with Kesehatan & Dahlan (2021), who stated that batik workers with viewing distance < 30 cm have a higher risk of eye fatigue.

4. Relationship Between Lighting Intensity and Eye Fatigue Complaints

Table 5. Chi-Square Test Results for Lighting Intensity and Eye Fatigue Complaints

Lighting Intensity	Yes	%	No	%	Total	p-value
Does not meet standard (< 300 and ≥ 1000 lux)	12	52.2	11	47.8	23	0.123
Meets standard (300-1000 lux)	3	25.0	9	75.0	12	
Total	15		20		35	

Source: Primary data, 2026

The Chi-Square test showed $p = 0.123$ ($p > 0.05$), indicating no significant relationship between lighting intensity and eye fatigue complaints. Descriptively, complaints were more frequent in the group with non-standard lighting (52.2%) compared to the standard group (25.0%), but this difference was not statistically significant. Field observations showed that most batik workers work with a combination of natural

lighting and supplementary lamps, and have adapted to these conditions. Eye fatigue among batik workers is more influenced by close viewing distance and work duration than by lighting intensity. This aligns with Sitorus & Purba (2011) who also found no significant relationship between lighting intensity and eye fatigue ($p = 0.122$).

5. Relationship Between Age and Eye Fatigue Complaints

Table 6. Fisher's Exact Test Results for Age and Eye Fatigue Complaints

Age	Yes	%	No	%	Total	p-value
At risk (≥ 40 years)	14	48.3	15	51.7	29	0.207
Not at risk (< 40 years)	1	16.7	5	83.3	6	
Total	15		20		35	

Source: Primary data, 2026

Fisher's Exact Test showed $p = 0.207$ ($p > 0.05$), indicating no significant relationship between age and eye fatigue complaints. Although descriptively, a higher proportion of eye fatigue complaints was found among batik workers aged ≥ 40 years (48.3%) compared to those aged < 40 years (16.7%), this difference was not statistically significant. This may be because older batik workers have accumulated extensive work experience and better visual adaptation capacity. Previous research on tailors also showed that age was not significantly related to eye fatigue (Maulina & Syafitri, 2018).

3. Discussion

Based on the results of this study, two factors were proven to have a significant relationship with eye fatigue complaints in batik tulis workers: work duration per day and eye-to-object distance. Work duration with $p = 0.005$ confirms that prolonged visual activity without adequate rest triggers accommodative muscle fatigue, manifesting as sore eyes and blurred vision.

This finding is consistent with various previous studies showing that visual work duration is one of the main determinants of eye fatigue (Rahman et al., 2024; Pada & Kantor, 2023).

Eye-to-object distance with $p = 0.000$ is the strongest factor associated with eye fatigue in this study. The high proportion (85.7%) of eye fatigue complaints among workers with viewing distance ≤ 30 cm confirms the physiological mechanism of accommodative strain that occurs when ciliary muscles contract continuously to maintain near focus. This is further exacerbated by reduced blinking frequency, which causes the eye surface to dry out more quickly. These findings support the ergonomic guidelines recommending a minimum working distance of 30-40 cm for close visual work.

In contrast, working period, lighting intensity, and age did not show a statistically significant relationship with eye fatigue complaints. For working period, physiological and psychological adaptation of experienced workers may reduce their perception of fatigue symptoms. For lighting intensity, the eye's natural adaptation mechanism through pupillary constriction and dilation, combined with workers' long-term habituation to mixed lighting conditions, may explain the lack of significance. For age, experienced older batik workers may have developed compensatory strategies that offset the physiological decline in accommodative capacity.

These findings highlight the importance of ergonomic interventions specifically targeting work duration regulation and viewing distance. Prevention strategies should integrate behavioral approaches (scheduled eye breaks, 20-20-20 rule) with environmental improvements (adjustable workstations, optimal viewing distance guidance) to effectively reduce eye fatigue risk in the batik tulis industry.

4. Conclusion

Based on this study of batik tulis workers in Semarang City, 42.9% of respondents experienced eye fatigue complaints, primarily sore eyes, blurred vision, and difficulty focusing. The majority of respondents worked more than 4 hours per day, had working periods of more than 10 years, were aged ≥ 40 years, and some still worked at eye-to-object distances of ≤ 30 cm with lighting intensity that did not meet the standard. Analysis results showed that work duration per day has a significant relationship with eye fatigue complaints ($p = 0.005$), and eye-to-object distance also has a significant relationship ($p = 0.000$). Meanwhile, working period ($p = 0.090$), lighting intensity ($p = 0.123$), and age ($p = 0.207$) did not show significant relationships. Work duration and non-ergonomic viewing distance are the key factors associated with eye fatigue among batik tulis workers. Prevention should be focused on regulating work duration and implementing ergonomic viewing distance, including scheduled rest breaks and maintaining a minimum eye-to-object distance of 30 cm during batik-making activities.

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