

The Influence of Working Posture on the Risk of Musculoskeletal Disorders in Batik Craftsmen

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ABSTRACT

Background: Complaints of musculoskeletal disorders (MSDs) such as feelings of pain, soreness or soreness in the skeletal muscles felt by batik makers both during work and after work. This study aimed to examine the influence of work posture on the risk of MSDs in batik craftsmen.

Subjects and Method: This was a cross-sectional study. Total sample was 200 batik craftsmen was selected by cluster random sampling. The dependent variables were pain and musculoskeletal disorders. The independent variables were age, work posture, work duration, work period, and type of batik craftsmen. Pain was measured using visual analog scale (VAS). MSDs was measured using the Nordic Body Map (NBM). Other variables were collected using questionnaire. The data were analyzed using a multiple logistic regression.

Results: Batik craftsmen with non-ergonomic working postures (OR= 2.98; 95% CI=1.27 to 6.99; p= 0.012), age \geq 40 years old (OR= 3.45; 95% CI=1.28 to 10.49; p= 0.015), works \geq 5 hours/day (OR= 3.52; 95% CI= 1.46 to 8.47; p= 0.012), tenure \geq 5 years (OR= 7.04; 95% CI= 3.00 to 16.53; $<$ 0.001) significantly increased the risk of MSDs. There was no significant association between type of batik craftsmen and MSDs (OR= 2.76; 95% CI= 0.81 to 9.38; p= 0.102). Nagelkerke R²= 30.8%.

Conclusion: Non-ergonomic working postures, age \geq 40 years old, works \geq 5 hours/day, tenure \geq 5 years significantly increase the risk of MSDs. There is no significant association between type of batik craftsmen and MSDs.

Keywords: musculoskeletal disorder, pain, work duration, work period, age, batik making

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BACKGROUND

Adjusting your posture and working position is important to improve Occupational Health and Safety (K3) in the workplace. The Health and Safety Authority (HAS) in 2015 reported that the rate of Occupational Diseases (PAK) was 27.1 per 1000 workers

(Health and Safety Authority, 2015). Meanwhile, BPJS Employment serves work accident cases in Indonesia, where in 2020 it reached 221,740, in 2021 cases increased by 5.65% to 234,270 cases of minor and fatal accidents (Employment Social Security Administering Agency, 2021).

Work processes that are carried out repetitively and require a long time and work attitudes that are not ergonomic will cause symptoms of disorders in the body such as chronic fatigue and musculoskeletal disorders (Das et al., 2021). Disorders of the musculoskeletal system can reduce productivity and cause permanent disability in workers. In 2021, the World Health Organization also stated that disorders of the musculoskeletal system, especially lower back pain, are the main factor causing disability throughout the world.

The World Health Organization (WHO) in 2022 reported a Global Burden of Disease (GBD) of around 1.71 billion people experiencing musculoskeletal cases in 160 countries, with the Southeast Asia region reaching 369 million people (World Health Organization, 2022). Meanwhile in Indonesia, based on the 2018 Basic Health Research, the Ministry of Health of the Republic of Indonesia reported that the musculoskeletal prevalence rate reached 7.3%.

One of the industries in Indonesia that is increasing in number is the textile industry, especially in the batik sector. Batik is recognized by the United Nations Educational Scientific and Cultural Organization as an intangible cultural heritage or Masterpieces of the Oral and the Intangible Heritage of Humanity. According to the Data Center of the Indonesian Ministry of Industry, batik export activities will reach 988,477 in 2022. There are around 2,951 batik industrial units spread across Indonesia. The high number of batik production causes batik makers to work optimally. A good work attitude can have a positive impact on productivity at work, and vice versa. Improper biomechanics of a batik worker's body refers to a working position that causes the body to move away from the ergonomic position, so that the further the

body part is positioned from the body's center of gravity, the higher the risk of muscle and bone complaints (Shenkman et al., 2017).

A bent or flexed neck position can trigger rounded shoulders, headaches, and even low back pain (As-syifa et al., 2020). The working position is sitting and without support, where the position is statically bent down 20-30° which triggers heavy muscle loading (Yani et al., 2020). Static working posture for more than 5 hours causes muscle problems. If this happens for a long time, there will be an accumulation of load on the muscles and tendons which will trigger a buildup of lactic acid due to decreased transport of metabolic waste, so that the muscles lack oxygen due to decreased blood flow (Scheffold et al., 2020).

Based on the explanation above, it is revealed that when carrying out the batik making process, workers face problems in working postures that are not ergonomic. This produces discomfort that has the potential to trigger complaints in the Musculoskeletal system. Based on this, researchers are interested in taking up the risk topic related to "The Influence of Work Posture on the Risk of Musculoskeletal Disorders in Batik Makers".

SUBJECTS AND METHOD

1. Study Design

This was a cross-sectional study carried out in Surakarta from October to November 2023.

2. Population and Sample

Study population was 550 batik craftsmen in Surakarta. Total sample of 200 batik craftsmen was selected using a cluster random sampling.

3. Study Variables

The dependent variables were pain and musculoskeletal disorders. The independent variables were age, work posture, work

duration, work period, and type of batik craftsmen.

4. Operational Definition of Variables

Musculoskeletal Disorders are complaints of musculoskeletal disorders such as feelings of pain, soreness or soreness in the skeletal muscles that batik makers feel both while working and after working. Work Posture is an assessment of work posture when carrying out risky work related to Musculoskeletal and ergonomic aspects.

Age is the time span since a person's existence which can be measured using time units in a chronological context. In normal individuals, the progress of their anatomical and physiological development can be observed.

Work duration is the length of time a person spends carrying out activities or tasks while working. Work duration includes the period during which a person is exposed to risk factors during work. Tenure is the duration or period of time that a worker spends while he or she is working at a company.

Types of batik craftsmen are workers who have expertise in creating batik cloth. The types of batik in this research are written batik and stamped batik.

5. Study Instruments

Pain was measured using Visual Analog Scale. MSDs was measured using the Nordic Body Map (NBM) with a visual image of the body, in order to evaluate pain in the body and measure the extent to which musculoskeletal disorders or injuries occur (Tamala, 2013). Working posture is measured using the work ergonomic risk assessment to analyze observations of good working posture and identify awkward working postures (Ramaganesh et al., 2021). Data collection related to age, duration of work, length of service and type of batik maker was carried out using questionnaire.

6. Data analysis

Univariate analysis for categorical data were shown as numbers (n) with percentage (%). Interval data in 2 groups were compared with independent t test. A multiple logistic regression model was used to ascertain associations between MSDs, work posture, age, working duration, tenure, types of batik craftsmen, and odds ratios (OR) and 95% confidence intervals (CI) were calculated. All tests were two-sided and statistical significance was set at $p < 0.050$.

7. Research Ethics

Research ethics including informed consent, anonymity, and confidentiality, were handled carefully throughout the research process. A letter of approval for research ethics permission was obtained from the Research Ethics Committee of RST Dr. Soedjono Magelang, Indonesia, with letter number 721/UN.27.20.3.3/PM-/2023, on November 10, 2023.

RESULTS

1. Sample Characteristics

Sample characteristics are explained in Table 1. Over two-third of batik craftsmen were at age 40 years old. A third of study subjects were female. Mostly, their education was primary school.

The majority of batik craftsmen exhibited elevated SBP (≥ 120 mmHg), DBP (≥ 80 mmHg), and O_2 saturation ($\geq 90\%$). Approximately half of the sampled individuals had a body weight within the range of 61-70 kg.

There are two main types of batik craftsmen: stamped batik and written batik. Approximately 70.50% of batik craftsmen work for ≥ 5 hours per day, while 66.50% have accumulated more than 5 years of experience in their craft. A notable 66% of workers reported experiencing severe pain, and 56% were diagnosed with musculoskeletal disorders.

Table 1. characteristics of research subjects

Variable	Frequency (n)	Percentage (%)
Age		
<40 years	47	23.50
≥40 years	153	76.50
Gender		
Male	122	61.00
Female	78	39.00
Education		
Primary school	81	40.50
Junior high school	57	28.50
Senior high school	62	31.00
Systolic Blood Pressure		
<120 mmHg	58	29.00
≥120 mmHg	142	71.00
Diastolic Blood Pressure		
<80 mmHg	70	35.00
≥80 mmHg	130	65.00
Weight		
40-50 kg	17	8.50
51-60 kg	36	18.00
61-70 kg	98	49.00
71-80 kg	46	23.00
>80 kg	3	1.50
Height		
140-150 cm	22	11.00
150-160 cm	98	49.00
160-170 cm	72	36.00
>170 cm	8	4.00
O₂ Saturation		
≥90%	177	88.50
<90%	23	11.50
Work Posture		
Ergonomic	64	32.00
Not Ergonomic	136	68.00
Age		
<40 years	47	23.50
≥40 years	153	76.50
Working Duration		
<5 hours	59	29.50
≥5 hours	141	70.50
Tenure		
<5 years	67	33.50
≥5 years	133	66.50
Types of Batik Makers		
Stamped batik craftsmen	100	50.00
Written batik craftsmen	100	50.00
Pain Level		
Low	68	34.00
High	132	66.00
MSDs		
Low	88	44.00
High	112	56.00

2. Bivariate Analysis

Table 2 presents the outcomes of an independent t-test. Batik craftsmen with non-ergonomic postures while working (Mean= 54.58; SD= 19.5) had higher scores of MSDs compared to those with ergonomic postures (Mean= 45.35; SD= 19.2), $p=0.002$.

Older batik craftsmen (Mean= 34.48; SD= 18.06) showed higher scores of MSDs compared to younger craftsmen (Mean= 56.90; SD= 17.79), $p<0.001$.

Batik craftsmen working more than 5 hours per day (Mean= 56.34; SD= 18.46) demonstrated higher scores of MSDs

compared to those working less than 5 hours per day (Mean= 40.37; SD= 19.83), $p<0.001$.

Workers who have been employed for more than 5 years (Mean= 57.75; SD= 16.60) had higher scores of MSDs compared to those who have worked for less than 5 years (Mean= 29.47; SD= 21.27), $p<0.001$.

There was no significant difference in MSDs scores between stamped (Mean= 49.96; SD= 19.53) and written batik craftsmen (Mean= 53.31; SD= 20.79), $p=0.241$.

Table 2. The results of independent t-test examining the correlations between work posture, age, work duration, tenure, and the type of batik craftsmen, and MSDs

Variable	N	Mean	SD	p
Work Posture				
Ergonomic	64	45.35	19.2	0.002
Not Ergonomic	136	54.58	19.5	
Age				
<40 years	47	34.48	18.06	<0.001
≥40 years	153	56.90	17.79	
Working Duration				
<5 hours	59	40.37	19.83	<0.001
≥5 hours	141	56.34	18.46	
Tenure				
<5 years	67	29.47	21.27	<0.001
≥5 years	133	57.75	16.60	
Types of Batik Craftsmen				
Stamped batik craftsmen	100	49.96	19.53	0.241
Written batik craftsmen	100	53.31	20.79	

3. Multivariate analysis

Table 3 presents the outcomes of multivariable logistic regression analyzing the relationship between age, work posture, work duration, tenure, and the type of batik craftsmen on MSDs. Batik craftsmen with non-ergonomic working postures (OR= 2.98; 95% CI=1.27 to 6.99; $p=0.012$), age ≥40 years old (OR= 3.45; 95% CI=1.28 to 10.49; $p=0.015$), works ≥5 hours/day (OR= 3.52; 95% CI= 1.46 to 8.47; $p=0.012$),

tenure ≥5 years (OR= 7.04; 95% CI= 3.00 to 16.53; $p<0.001$) significantly increased the risk of MSDs. There was no significant association between type of batik craftsmen and MSDs (OR= 2.76; 95% CI= 0.81 to 9.38; $p=0.102$).

Nagelkerke R^2 indicates that 30.8% factors of MSDs among batik craftsmen was attributed by age, work posture, work duration, tenure, and type of batik craftsmen.

Table 3. Results of multiple logistic analysis of the relationship between work posture, age, work duration, tenure, type of batik craftsmen, and MSDs

Independent Variables	OR	95% CI		p
		Upper Limit	Lower Limit	
Non-ergonomic posture	2.98	1.27	6.99	0.012
Older age (≥ 40 years old)	3.67	1.28	10.49	0.015
Works ≥ 5 hours/ days	3.52	1.46	8.47	0.005
Tenure ≥ 5 years	7.04	3.00	16.53	<0.001
Written batik craftsmen	2.76	0.81	9.38	0.102
Constant	0.01	0.00	0.06	<0.001
N Observation	200			
-2 loglikelihood	94.82			
Nagelkerke R ²	30.8%			

DISCUSSION

Poor ergonomic postures in workers can lead to pain, discomfort, and health issues, including upper extremity musculoskeletal disorders (UEMD) and lower extremity musculoskeletal disorders (LEMD) (Alias et al., 2020). Batik craftsmen with non-ergonomic working postures are associated with a 2.9-unit higher risk of developing musculoskeletal disorders (MSDs) compared to those with ergonomic working postures.

This analysis suggests that as the posture worsens, it becomes less ergonomic, making individuals more susceptible to MSDs compared to batik makers with ergonomic postures. This finding aligns with Rahman et al. (2015), indicating that non-ergonomic postures pose a higher risk of MSDs. The analysis further indicates a decline in labor productivity, emphasizing that a high Work Ergonomic Risk Assessment score is associated with reduced workforce productivity.

The relationship between age and the onset of musculoskeletal diseases (MSDs) is complex, and various studies provide varying support regarding the type and severity of injuries experienced by older workers (Oakman et al., 2016). Several sources also explain that older workers tend to experience work-related illnesses such as fractures, sprains and strains more often,

compared to younger workers (Algarni et al. 2015). This is proven by that batik makers aged more than 40 years tend to have a risk of MSDs 3.6 units higher than those aged less than 40 years.

This study found that age has positive relationship with MSDs. This findings align with Negm et al. (2017), indicating that older age contributes to an elevated risk of MSDs. The prevalence of MSDs is notably high among firefighters, with severity increasing in correlation with age and years of service. Additionally, the study underscores that cumulative exposure and injury are more likely to occur in older workers.

There is a correlation between the duration of work and the occurrence of complaints related to MSDs. The length of work is essentially the cumulative time exposed to various risk factors. When the working time extends beyond 5-8 hours for 5 working days a week, it may lead to the onset of occupational diseases (Rinawati et al., 2023). This underscores the connection between the duration of work and the risk of MSDs in batik makers. Specifically, batik makers with a working duration exceeding 5 hours per day are inclined to have a 3.5-unit higher risk of developing MSDs compared to those with a working duration of less than 5 hours per day.

This study suggests that the longer the duration, individuals become more susceptible to experiencing MSDs compared to batik craftsmen with ergonomic postures. These findings align with Afsharian et al. (2023), indicating that work duration influences the incidence of MSDs. The study explains that an extended work duration can increase complaints related to MSDs, and a heavier workload imposed on workers is associated with a higher likelihood of MSDs.

As individuals adapt to their work, positive effects include reduced tension and enhanced understanding of job tasks. However, negative effects may also emerge, such as prolonged exposure to work processes, leading to MSDs (Wildasari & Nurcahyo, 2023). Previous study indicates a relationship between length of service and the risk of MSDs. Specifically, batik makers with more than 5 years of service tend to have a 7.0-unit higher risk of MSDs compared to those with less than 5 years of service.

This study found that the longer the work period, namely 5 years, the more susceptible you will be to experiencing MSDs compared to those with tenure less than 5 years. These results are in line with research (Afsharian et al., 2023), that work period influences the incidence of MSDs. This research explains that workers with a work period of more than 6 years tend to have a greater potential for MSDs and poor mental health compared to workers with a work period of less than 6 years.

Batik workers engaged in stamped and written batik types exhibit varying levels of risk for MSDs. The process of creating written batik, performed in a static sitting position, can lead to reduced mobility and tension in several leg muscles. On the other hand, the production of stamped batik, characterized by an unnatural body posture and the use of a

canting stamp with a load ranging from 0.5 to 3.5 kg, contributes to musculoskeletal complaints in the arm area of batik makers (Rosifah et al., 2017).

AUTHOR CONTRIBUTION

All authors have made significant contributions to data analysis as well as preparing the final manuscript.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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