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OCCUPATIONAL HEALTH PERSPECTIVE ON UPPER-EXTREMITY MUSCULOSKELETAL DISORDERS AMONG TRADITIONAL "BATIK" "CANTING" WORKERS: A CROSS-SECTIONAL STUDY

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ABSTRACT
Musculoskeletal Disorders (MSDs) are chronic health issues frequently experienced by batik workers due to discrepancies between workstation design and anthropometric principles. The process of canting (hand-waxing) involves static postures and repetitive movements that trigger muscle tissue ischemia and lactic acid accumulation. This study aims to identify MSDs complaints in the upper extremities specifically the shoulders, elbows, and wrists hand and analyze the contributing risk factors. This observational study utilized a cross-sectional design involving 166 batik workers in Jarum Village, Klaten. Data were collected through individual characteristic questionnaires (age, years of service, and daily work duration) and the Nordic Body Map (NBM) adopted from the Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Data analysis was performed using the Chi-Square test to determine the significance of relationships between variables. The findings indicate that the majority of respondents were aged 45 – 64 years (59%) with a daily work duration of ⩾ 8 hours (56.6%). There was a statistically significant assosiation between age and years of service with wrist-hand pain. The 45 – 64 age group reported the highest prevalence of wrist pain, reaching 92.9%. Age and years of service are significantly associated with upper extremity musculoskeletal complaints, particularly in the wrist and hand, among batik workers. Ergonomic engineering interventions are necessary to mitigate the risk of injury resulting from poor working postures during the batik-making process.

Keywords: batik; canting elbow pain; shoulders pain; wrist hand pain

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INTRODUCTION

Musculoskeletal Disorders (MSDs) are defined as a group of disorders affecting the musculoskeletal system, including muscles, tendons, ligaments, joints, and the peripheral nervous system, which frequently manifest as chronic pain or discomfort(Mahdavi et al., 2020; Pratiwi et al., 2019; Soares et al., 2019; Soraya Putri et al., 2024). MSDs are commonly experienced by batik workers, arising from the mismatch between worker capacity and traditional workstation designs that do not align with anthropometric principles(Pratiwi & Nuriati, 2022; Pristianto et al., 2025). he primary causes of MSDs are a combination of awkward working postures, such as extreme spinal flexion during the canting process, static work durations that exceed the muscle recovery threshold, and repetitive wrist movements(Soraya Putri et al., 2024). One study reported that the highest exposure risk scores were found in the back(Pratiwi & Nuriati, 2022), however, other research also indicated that the most affected body parts were the waist (60%), followed by the back and legs (57%)(Daruis et al., 2024). One study reported that the highest exposure risk scores were found in

the back; These occurrences demonstrate a significant morbidity burden among the batik-making population. The distribution of these complaints is predominantly concentrated in the waist, lower back, neck, shoulders, and legs, which clinically correlates with the use of low stools (dingklik) and prolonged stooping positions during the production process(Astutik et al., 2025; Daruis et al., 2024; Pristianto et al., 2025).

Musculoskeletal Disorders in batik workers are triggered by muscle tissue ischemia resulting from prolonged static contractions. This condition obstructs venous blood flow, leading to the accumulation of lactic acid and inflammatory mediators within the muscle fibers(Novalesi et al., 2025). Based on observations and literature studies, the frequent use of deep squatting positions or low stools (dingklik), combined with a stooped posture, causes intradiscal compression of the spine and an imbalance in muscle workload between the dominant and non-dominant arms(Daruis et al., 2024; Setyaningsih et al., 2025). Recent research indicates that the batik-making process demands awkward body postures including standing, precision manual tool handling, bending, twisting, and repetitive reaching for 4 to 8 hours all of which serve as risk factors that exacerbate MSDs(Daruis et al., 2024).

Although extensive research has been conducted on MSDs among batik workers, studies specifically focusing on the upper extremities remain scarce. Most previous studies tend to focus their analysis on back and waist complaints(Aswin & Hidayati, 2023; Pamungkas et al., 2024; Wardani & Prilly, 2026), often neglecting an in-depth analysis of the shoulder, elbow, and wrist segments, which are the primary functional units in canting activities. Furthermore, there is a significant research gap regarding how daily work duration directly affects the rate of muscle recovery in the wrists, which perform high-frequency repetitive movements(Liu et al., 2022). Moreover, few studies have examined how age and years of service may serve as potent predictors for the onset of wrist-hand pain compared to working posture alone. To address these research gaps, this study aims to identify MSDs complaints in the upper extremities specifically the shoulders, elbows, and wrists hand and analyze the contributing risk factors. Furthermore, this study evaluates how daily work duration affects the wrists , and examines how individual characteristics like age and occupational factors such as years of service act as predictors for the onset of wrist-hand pain.

METHOD

This study is an observational research utilizing a cross-sectional design, conducted in July 2024 across 45 batik home industries in Jarum Village, Klaten Regency, Central Java, Indonesia. The study population consisted of 166 hand-drawn (tulis) and stamped (cap) batik workers from these industries. Sampling was conducted using a total population sampling technique. Participation was restricted to respondents who were willing to participate and specifically worked in the canting (waxing) section.The study variables included individual characteristics (age), work-related factors (years of service and daily work duration), and musculoskeletal complaints as the dependent variable. Data collection was performed using a two-part questionnaire. The first section gathered information regarding age, years of service, and daily work duration. The second section utilized the Nordic Body Map (NBM) questionnaire to assess MSDs, specifically focusing on three anatomical regions: the shoulders, elbows, and wrists/hands (Kuorinka et al., 1987). Ethical clearance for this study was granted by the Ethics Committee of the Faculty of Nursing and Health Sciences, Unimus (Number 417/KE/06/2024). Participation was both anonymous and voluntary. Written informed consent was obtained from each participant along with the completed questionnaires.Data analysis began with a univariate analysis, where individual and occupational characteristics were presented in frequency tables as mean ± standard deviation or as median (minimum–maximum). Subsequently, bivariate analysis was performed using the Chi-Square test, with a p-value ≤ 0,05 considered statistically significant. Statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS) software.

RESULT

Based on the analysis of 166 *canting* batik workers, the majority of the subjects were in the age range of 45 to 64 years (59.0%), with a mean age of 45.2 years. The cohort was dominated by individuals with 10 or more years of service (60.8%), with an average of 10.3 years of experience. Furthermore, the majority of the subjects spent 8 hours or more per day at work (56.6%), with an average daily working duration of 9.7 hours.

Table 1.
Respondents Characteristics (n=166)

Factors		f	%
Age, Year (Rasio)	20-44	68	41.0
	45-64	98	59.0
Mean±SD			45.2 ± 9.3
Median (Min-Max)			46 (25-63)
Length of work, year	≥ 10	101	60.8
	< 10	65	39.2
Mean±SD			10.3 ± 4.8
Median (Min-Max)			11 (1-26)
Duration of work, hour	≥ 8	94	56.6
	< 8	72	43.3
Mean±SD			9.7 ± 1.9
Median (Min-Max)			9 (8-14)

Table 2 presents the cross-tabulation results regarding the relationship between individual characteristics (age), occupational characteristics (years of service and daily work duration), and upper extremity musculoskeletal complaints (shoulders, elbows, and wrists/hands) among batik workers.Three specific anatomical areas were examined: the shoulder, elbow, and wrist. The highest prevalence of shoulder pain (68.1%) was reported by workers with a daily work duration of ≥ 8 hours. Conversely, the lowest prevalence (56.9%) was observed in workers with either less than 10 years of service or a daily work duration of < 8 hours.

Table 2.
Upper Extremity Musculoskeletal Complaints by Respondent Characteristics

	Factors Indivdual	Numbers of respondents	Numbers of Shoulder Pain	Numbers of Elbow Pain	Numbers of Wrist Hand Pain
Age, Year (Rasio)	20-44	68 (41.0)	45 (66.2)	47 (69.1)	33 (48.5)
	45-64	98 (59.0)	60 (61.2)	65 (66.3)	91 (92.9)*
Tenure, year	≥ 10	101 (60.8)	68 (67.3)	68 (67.3)	69 (68.3)
	< 10	65 (39.2)	37 (56.9)	44 (67.7)	55 (84.6)*
Duration of work,	≥ 8	94 (56.6)	64 (68.1)	63 (67.0)	70 (74.5)
hour	< 8	72 (43.3)	41 (56.9)	49 (68.1)	54 (75.0)

**p≤0,05: significant*

Regarding elbow pain, the highest prevalence reached 69.1% in the 20–44 age group, while the lowest (66.3%) was found in the 45–64 age group. Specifically regarding the wrist/hand area, the bivariate analysis revealed a statistically significant association ($p \leq 0,05$) between age and years of service with wrist-hand pain. By age, the prevalence of wrist pain was significantly higher in the 45–64 age group (92.9%) compared to the 20–44 age group (48.5%). Meanwhile, regarding years of service, wrist-hand pain was more prevalent among workers with less than 10 years of service (84.6%) compared to those with 10 or more years of service (68.3%).

DISCUSSION

Canting workers utilize the shoulder, elbow, and wrist-hand complex as a unified mechanical system during the canting process. This study demonstrates the prevalence of upper extremity musculoskeletal pain among these workers, which is largely attributed to the nature of applying hot wax onto fabric to create hand-drawn batik(Pratiwi & Nuriati, 2022). Further findings from this study confirm that wrist-hand pain among batik artisans is significantly associated with inherent physical capacity specifically age and the cumulative exposure to occupational hazards, as indicated by years of service. These disorders are highly prevalent among manual craft workers due to the combination of repetitive tasks, awkward postures, and prolonged work durations(Pristianto et al.,

2025). Such conditions frequently affect the shoulders, elbows, and wrists, leading to chronic pain and functional impairment(Chonsin et al., 2025).

The high prevalence of wrist pain observed in this study aligns with the natural degenerative processes of the human body, wherein the functional and physiological capacity of the musculoskeletal system gradually declines with age(Pereira, 2015). During the canting process, workers are required to maintain a constant pinch grip posture on the canting tool. When this static pinch grip and repetitive, high-precision movements are performed under degenerative conditions, workers become significantly more susceptible to injury, chronic pain, and functional decline(Guimera et al., 2019; Halma et al., 2025; Wright & Tejpar, 2018). Age is strongly correlated with articular cartilage wear (osteoarthritis)(Weiss & Rodner, 2007). Furthermore, the repetitive use of an angled handle combined with a sustained pinch grip can lead to muscle fatigue, reduced grip strength, and the potential for nerve compression if the workstation and tools are not ergonomically optimized(Balogh & Kociolek, 2025; Yudhistira & W. Wahyuni, 2023).

Meanwhile, the batik-making workforce is dominated by senior workers with 10 or more years of service. This aligns with the occurrence of Work-related Musculoskeletal Disorders (WMSDs) stemming from long-term exposure to hazards, such as highly repetitive tasks and forced working postures during production. Musculoskeletal disorders manifest as complaints ranging from mild to severe pain resulting from disorders of the joints, ligaments, tendons, and skeletal muscles(Chandrayana et al., 2024). The cumulative load on the shoulders and other upper extremities over several years is a consequence of static work performed continuously, which ultimately impairs the workers' quality of life and work capacity(Gómez-Galán et al., 2017). Canting process requires the wrist to maintain awkward postures repeatedly while applying hot wax to the fabric. However, prolonged exposure over years without adequate rest intervals or ergonomic interventions triggers the accumulation of micro trauma in the muscle tissues, tendons, and nerves within the carpal tunnel(Glenday et al., 2021).

In contrast to the findings regarding the wrist, the other two anatomical areas the shoulder and elbow did not show a significant association with age and years of service. This discrepancy suggests that awkward working postures are the primary drivers of pain in these regions, regardless of age or tenure. Field observations indicate that workers across all age and tenure groups consistently exhibit high-risk behaviors, including shoulder elevation, extreme shoulder flexion, repetitive elbow flexion-extension, hanging elbow postures, and forearm rotation. These conditions likely impose significant mechanical loads on the shoulders and elbows. This is supported by previous studies on weavers, which demonstrate that awkward postures, such as shoulder flexion and repetitive tasks, are significant contributors to shoulder and elbow pain(Jlassi et al., 2025; Junaidi et al., 2020; Suhardi et al., 2018). Musculoskeletal disorders significantly impair a worker's quality of life(Greggi et al., 2024). Ergonomic assessments, such as the Rapid Upper Limb Assessment (RULA), have identified high-risk postures in batik-making tasks, necessitating immediate interventions to mitigate physical strain(Darliana M et al., 2020). A limitation of this study is that we relied on observational assessments of working postures without quantitative measurement. Therefore, future research should incorporate quantitative postural analysis to further strengthen these findings.

CONCLUSION

This study concludes that age and years of service are significantly associated with upper extremity musculoskeletal complaints, particularly in the wrists, among canting batik workers. These findings indicate that the canting process carries a high risk of inducing Musculoskeletal Disorders (MSDs) due to its inherently static and repetitive postures. Consequently, future research focusing on ergonomic engineering interventions is highly recommended to mitigate the risk of occupational injuries.

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