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Awareness of Workplace Environmental Hazards and Health Risks for Workers in The Home Industry of Batik

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Abstract

Exposure to physical and chemical environmental hazards in the work process of making batik results in the occurrence of disturbance of the health of workers. The batik process poses hazards, with about 30.77% in the stamping process and 38.46% among dye workers. Work to prevent the occurrence of risky health in place work. This study aims to analyze individual factors that work with awareness of the related dangerous physical and chemical effects on workers who are batik craftsmen. This is a study with a cross-sectional design with 285 batik workers all over batik workers as the population in this research, and the sample is 98 batik workers in Klaten, Central Java. This study uses a purposive sampling technique. The research instrument used was a general questionnaire, which included age, type, gender, level of education, and length of service. Besides that, questionnaire awareness about the factor danger physique used a modified interview questionnaire from the Victorian Trades Hall Council, while questionnaire awareness of the factors chemistry and material symbols chemistry with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). These studies disclose the existence of a connection between gender type (p=0.011) and length of service (p=0.000) with knowledge about physical danger. At the same time, awareness about chemical hazards and related factors with the type of gender (p=0.011) and age (p=0.004) were associated with awareness of dangerous chemistry in workers. Workers' awareness of physical danger and dangerous chemistry is terrible, so there is a need to provide training, education, and related monitoring.

Introduction

The interaction of the batik work process using hazardous materials and work processes results in exposure for workers during work activity (Junaidi *et al*., 2020). It is known that the batik industry, as an important sector, plays a role in the development of Indonesia's economy. It makes a significant contribution to national income (Muchson *et al*., 2024). The demand is increasing alongside the growing number of workers exposed to environmental hazards, whether physical or chemical.

Hazardous materials and processes are present at every stage of batik production. Previous research explained the related hazards category in every batik working process. The hazardous processes include batik making (10.26%), the stamping process (30.77%), and the highest is the dyeing process (38.46%) (Junaidi *et al*., 2020). Exposure hazards in the manufacturing process include candles or *malam*. Workers make pattern coatings with wax, coloring, and refining candles at the time, which involves heat hazards (Nikmah *et al*., 2023). Health risks in this process include thermal injury when applying wax (Febriana *et al*., 2023) that causes skin irritation and allergic reactions, which can result in skin disturbance

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(OSD or Occupational Skin Diseases). The prevalence of workers who experience OSD is as high as 27.5 % (Febriana *et al*., 2023). Research explains that as many as 26.12% experienced OSD, which happened to the most workers with working experience of ≥ 10 years, as much as 75.9% (Febriana *et al*., 2023).

Apart from that, the use of hazardous substances is found in the use of chemicals. If burnt, a hazardous *malam* material or candle produces dominant gases containing CO (carbon monoxide) and H2S (Hydrogen Sulfide). H2S inhaled during the combustion of candles can result in the occurrence of death cells and inhibit cell proliferation. CO poisoning can bind Hb (Hemoglobin), which should be bound to Oxygen, so that hypoxia happens and causes other symptoms such as tiredness, not feeling well, sickness, headache, dizziness, confusion, disorientation, blurred vision, nausea, and vomiting. Common symptoms include chest pain, respiratory depression, non-cardiogenic pulmonary edema, ataxia, syncope, tachypnea, dyspnea, palpitations, and rhabdomyolysis, as well as severe symptoms such as hypotension, arrhythmia, myocardial ischemia, coma, and seizures.

Using chemicals other than synthetic dye turns out to contain several metal weights used in batik production, namely Pb (Oginawati *et al*., 2022), which can result in the occurrence of neurological and cognitive disorders, delayed development in children, neurobehavioral disorders, hematological disorders, DNA damage, and damaging system immunity (Collin *et al*., 2022; Delgado *et al*., 2018; Dobrakowski *et al*., 2017; Li *et al*., 2018; Mason *et al*., 2014; Ramírez Ortega *et al*., 2021). This is proven by a study conducted in the batik industry, explaining that test results showed a metal weight content in the wastewater (Oginawati *et al*., 2022) and dye (Collin *et al*., 2022; Ramírez Ortega et al., 2021).

Exposure to physical and hazardous materials and chemicals among batik workers causes serious accidents and illnesses because of daily exposure. Exposure will exacerbate the underlying causes of the accident. The batik-making environment and equipment are unsafe, and the work practices exhibited are also unsafe (Junaidi *et al*., 2020). Proven with most common problems found is the lack of use of Personal Protective Equipment (PPE) (Febriana *et al*., 2023) such as boots, hand gloves, and an apron. This shows that workers do not know and realize that the process and materials used every day are very hazardous (Junaidi *et al*., 2020). Research on the relationship between individual characteristics and workers' awareness of physical and chemical hazards in the batik industry sector remains limited. Therefore, it is important to study and analyze the relevant factors by considering physical and chemical hazards in the work environment of batik makers.

Method

A cross-sectional study was conducted in the batik artisan industry center in Klaten, Central Java, Indonesia. The population in the study is all batik workers in the industry village of Batik House Jarum, as many as 285 workers. This study used a purposive sampling technique. All batik workers who encountered and are related to chemicals directly and indirectly are the respondents in this study. This is as many as 96 workers. Respondents consist of canting workers, drooping workers, dyers, and pattern makers.

The dependent variable in this study is the awareness among batik industry workers regarding physical hazards (such as hot working environments, electricity, fire, and lighting) and chemical hazards. Meanwhile, the independent variables comprise the individual characteristics and work-related factors of home-based batik industry workers. The research instrument is a general questionnaire that contains age, gender, educational level, and length of service. The questionnaire related to the awareness of physical and chemical hazards uses a modified interview questionnaire from the Victorian Trades Hall Council. To evaluate worker awareness of physical hazards, the questionnaire consists of 7 questions involving the hazard of hot exposure, 4 questions concerning the electricity hazard, 6 questions concerning fire hazard, and 6 questions concerning lighting hazard. While the questionnaire concerning awareness of chemical factors consists of 9 questions related to the knowledge of hazardous chemical material and 11 questions involve

appropriate chemical material symbols with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Agreement from the Committee of Ethics, Faculty of Nursing and Health, Muhammadiyah University of Semarang, No. 417/KE/06/2024, was obtained before the start of the research. Participants were informed about the objective of the research and the benefits to be shared, and oral consent was obtained. Data collected anonymously. Confidentiality and privacy are guaranteed throughout the study. Data is checked for completeness, after being collected, data is input and analyzed using the IBM SPSS (Statistical Package for Social Sciences) version 21. Descriptive statistics (frequency, average, and standard deviation) are used to summarize the characteristic data of individuals, and the work factor test x^2 is used to analyze the connection between individual factor characteristics and factors related to work with awareness of physical and chemical hazards.

Result and Discussion

This study found that the workers were mostly women, with the dominant age group falling within the young adult range of 20-44 years. Most of the respondents were estimated to work in the batik industry for ≥ 8 hours, and most of the workers worked for ≥ 10 years (Table 1).

The study explained that most workers had poor knowledge of lighting hazards, electrical equipment hazards, and fire hazards, but most workers knew the hazards of heat exposure. The study explained that most of the workers' awareness was poor concerning the hazards of chemicals and hazardous chemical symbols. All workers in the Pattern section had poor awareness of the hazards of chemicals. While in the awareness of chemical symbols, the highest percentage related to poor awareness was among the workers in the coloring section (Table 2).

The conditions studied in the Batik Craftsman Industry Center, where workers in the Nglorot section said that the temperature in their workplace was not suitable because of the process of dissolving *malam* wax with boiling water, exacerbated by the majority of workers not being comfortable wearing clothes, then said that the ventilation conditions were poor and there was no air conditioning for Nglorot workers. On the other hand, Canting workers said that the temperature in their workplace was suitable, and the ventilation conditions were good. Workers in the batik craftsman industry center, an informal industry, said

TABLE 1. Socio-Demographic Characteristics of Batik Workers

Variables	Canting (f = 38) f(%)	Nglorot (f = 25) f(%)	Coloring (f = 18) f(%)	Pattern f(%) (f = 17)	N(%)
Gender					
Male	0(0.0)	17(68.0)	9(50.0)	14(82.4)	40(40.8)
Female	38(100.0)	8(32.0)	9(50.0)	3(17.6)	58(59.2)
Age, years					
Young Adult (20-44 years)	12(31.6)	19(76.0)	12(66.7)	12(70.6)	55(56.1)
Middle Adult (45-64 years)	26(68.4)	6(24.0)	6(33.3)	5(29.4)	43(43.9)
Length of Work, years					
<10	11(28.9)	23(92.0)	9(50.0)	3(17.6)	46(46.9)
≥10	27(71.1)	2(8.0)	9(50.0)	14(82.4)	52(53.1)
Duration of Work, hours					
< 8	10(26.3)	7(28.0)	12(66.7)	7(41.2)	36(36.7)
≥ 8	28(73.7)	18(72.0)	6(33.3)	10(58.8)	62(63.3)

Source: Primary Data, 2024

TABLE 2. Level of Knowledge Concerning Physical and Chemical Hazards in each Type of Work

Variabel	**Canting (*f* = 38)**		**Nglorot (*f* = 25)**		**Coloring (*f* = 18)**		**Pattern (*f* = 17)**	
	Poor	Good	Poor	Good	Poor	Good	Poor	Good
Physical Hazard								
Hazards of Heat Exposure	9 (20.0)	29 (54.7)	23 (51.1)	2 (3.8)	10 (22.2)	8 (15.1)	3 (6.7)	14 (26.4)
Hazards of Electrical Equipment	27 (34.6)	11 (55.0)	25 (32.1)	0 (0.0)	15 (19.2)	3 (15.0)	11 (14.1)	6 (30.0)
Hazards of Lighting	16 (32.0)	22 (45.8)	13 (26.0)	12 (25.0)	11 (22.0)	7 (14.6)	10 (20.0)	7 (14.6)
Hazards of Fire	37 (48.1)	1 (4.8)	19 (24.7)	6 (28.6)	10 (13.0)	8 (38.1)	11 (14.3)	6 (28.6)
Chemical Hazard								
Hazardous Chemical Material	16 (42.1)	22 (57.9)	14 (56.0)	11 (44.0)	11 (61.1)	7 (38.9)	17 (100.0)	-
Chemical Symbol	20(52.6)	18 (47.4)	17 (68.0)	8 (32.0)	15 (83.3)	3 (16.7)	8 (47.1)	9 (52.9)

Source: Primary Data, 2024

that the temperature and humidity for each type of worker were not monitored, and they did not recognize early signs of heat-related illnesses, and pre-employment examinations were not yet available. Most batik workers are not directly related to the use of electrical equipment, which is in accordance with the results of the study, which explains that most workers do not know about the license of electrical equipment inspection technicians, and do not know about the routine inspection of electrical equipment. Most workers are not informed about the dangers of electricity. Most canting workers reported that the working area causes their eyes to tire quickly, but Nglorot, dye, and pattern workers do not experience eye strain. The canting workers said that the work area was not free from shadows, not a glare-free work area. They did not comply with the rules for cleaning lighting and emergency lighting units, as well as lighting measurements. Most workers explained that they did not know about emergencies that could occur and did not know about fire extinguishers and their inspections. In addition, the majority did not know about exit access and the storage conditions for flammable materials. Briefing on emergency evacuation of the batik craftsmen industry center workers was still lacking in information, and workers did not know what could cause a fire (Table 3).

Most workers in all work areas know about the dangers of using chemicals, with each percentage among canting workers, nglorot workers, dye workers, and pattern workers being 100%, 88%, 94.4%, and 70.6%. In addition, most workers know the health effects of exposure to chemical hazards and the use of personal protective equipment, and know the dangers of other chemicals. Workers are aware that emergency doors are important. However, not all workers know the existence and use of SDS. Most of the awareness is low about knowledge of safety rules in their workplace, batik workers are less aware of information about occupational safety and health, and workers do not know how to identify, handle, and overcome chemical leaks or spills in the batik industry (Table 4).

The results of the x2 test analysis that investigates the relationship between individual and job characteristic factors with knowledge of physical environmental hazards. The results reveal a relationship between gender and length of service with knowledge of these physical hazards. The results of the x^2 test analysis that investigates the relationship between individual and job characteristic factors with knowledge

TABLE 3. Physical Hazards

Variables	Canting (f = 38)			Nglorot (f = 25)			Coloring (f = 18)			Pattern (f = 17)		
	Yes	No	Do not know	Yes	No	Do not know	Yes	No	Do not know	Yes	No	Do not know
Heat Stress Hazards Exposure												
The temperature at your workplace is appropriate	27 (71.1)	11 (28.9)	-	2 (8.0)	23 (92.0)	-	8 (44.4)	10 (55.6)	-	12 (70.6)	5 (29.4)	-
Ventilation in your workplace is good	27 (71.1)	11 (28.9)	-	2 (8.0)	23 (92.0)	-	8 (44.4)	10 (55.6)	-	8 (47.1)	9 (52.9)	-
There is a cooler room in the workplace	6 (15.8)	32 (84.2)	-	0 (0.0)	25 (100.0)	-	0 (0.0)	18 (100.0)	-	14 (82.4)	3 (17.6)	-
Temperature and humidity are monitored	-	38 (100.0)	-	-	25 (100.0)	-	-	18 (100.0)	-	-	17 (100.0)	-
Recognize the early signs of heat-related illness	14 (36.8)	24 (63.2)	-	2 (8.0)	23 (92.0)	-	7 (38.9)	11 (61.1)	-	5 (29.4)	12 (70.6)	-
Use comfortable clothes for your workplace	18 (47.4)	20 (52.6)	-	2 (8.0)	23 (92.0)	-	8 (44.4)	10 (55.6)	-	14 (82.4)	3 (17.6)	-
There is a pre-employment screening process to filter out candidates who do not meet the requirements	7 (18.4)	31 (81.6)	-	0 (0.0)	25 (100.0)	-	0 (0.0)	18 (100.0)	-	4 (23.5)	13 (76.5)	-
Hazard of Electrical Equipment												
Installation of electricity done by a licensed electrician	-	2 (5.3)	36 (94.7)	-	6 (24.0)	19 (76.0)	-	0 (0.0)	18 (100.0)	-	2 (11.8)	15 (88.2)
Electric equipment is checked regularly	10 (26.3)	2 (5.3)	26 (68.4)	0 (0.0)	0 (0.0)	25 (100.0)	0(0.0)	0 (0.0)	18 (100.0)	2 (11.8)	0(0.0)	15 (88.2)
The power cord, plug, and socket are in good condition and not overloaded	1 (2.6)	1 (2.6)	36 (94.7)	0 (0.0)	25 (100.0)	0 (0.0)	3 (16.7)	15 (83.3)	0 (0.0)	0 (0.0)	17 (100.0)	0 (0.0)
Workers are provided with information regarding electrical hazards	0 (0.0)	0 (0.0)	38 (100.0)	0 (0.0)	16 (64.0)	9 (36.0)	0 (0.0)	11 (61.1)	7 (38.9)	4 (23.5)	1 (5.9)	12 (70.6)
Hazards Lighting												

Variables	Canting (f = 38)			Nglorot (f = 25)			Coloring (f = 18)			Pattern (f = 17)		
	Yes	No	Do not know	Yes	No	Do not know	Yes	No	Do not know	Yes	No	Do not know
The working area is free from shadows	15 (39.5)	23 (60.5)	0 (0.0)	4 (16.0)	5 (20.0)	16 (64.0)	4 (22.2)	3 (16.7)	11 (61.1)	1 (5.9)	3 (17.6)	13 (76.5)
Employees can see without experiencing eye strain	0(0.0)	38 (100.0)	0 (0.0)	4 (16.0)	5 (20.0)	16 (64.0)	4 (22.2)	3 (16.7)	11 (61.1)	0 (0.0)	4 (23.5)	13 (76.5)
Glare-free work area	16 (42.1)	21 (55.3)	1 (2.6)	3 (12.0)	4 (16.0)	18 (72.0)	2 (11.1)	4 (22.2)	12 (66.7)	1 (5.9)	4 (23.5)	12 (70.6)
The lighting unit is cleaned regularly	3(7.9)	3 (7.9)	32 (84.2)	3 (12.0)	5 (20.0)	17 (68.0)	1 (5.6)	3 (16.7)	14 (77.8)	2 (11.8)	5 (29.4)	10 (58.8)
The emergency light is well-functioning	3(7.9)	1 (2.6)	34 (89.5)	7 (28.0)	0 (0.0)	18 (72.0)	3 (16.7)	0 (0.0)	15 (83.3)	5 (29.4)	1 (5.9)	11 (64.7)
On-site lighting measurements are conducted periodically	-	3 (7.9)	35 (92.1)	-	3 (12.0)	22 (88.0)	-	2 (11.1)	16 (88.9)	-	4 (23.5)	13 (76.5)
Hazard Fire												
Recognize the emergency condition in the workplace	-	16 (42.1)	22 (57.9)	-	7(28.0)	18(72.0)	-	5 (27.8)	13 (72.2)	-	4(23.5)	13 (76.5)
A fire extinguisher is available and inspected regularly	0 (0.0)	-	38 (100.0)	3(12.0)	-	22(88.0)	2 (11.1)	-	16 (88.9)	2 (11.8)	-	15 (88.2)
The emergency door is kept away from obstacles	4 (10.5)	1 (2.6)	33 (86.8)	1(4.0)	8 (32.0)	16 (64.0)	3 (16.7)	3 (16.7)	12 (66.7)	1 (5.9)	4 (23.5)	12 (70.6)
Flammable materials are stored properly	1 (2.6)	0 (0.0)	37 (97.4)	4(16.0)	6 (24.0)	15 (60.0)	7 (38.9)	2 (11.1)	9 (50.0)	4 (23.5)	2 (11.8)	11 (64.7)
Staff were given directions for emergency evacuation	-	13 (34.2)	25 (65.8)	-	6 (24.0)	19 (76.0)	-	4 (22.2)	14 (77.8)	-	4 (23.5)	13 (76.5)
Staff are aware of potential fire hazards	-	13 (34.2)	25 (65.8)	-	7 (28.0)	18 (72.0)	-	5 (27.8)	13 (72.2)	-	3 (17.6)	14 (82.4)

Source: Primary Data, 2024

TABLE 4 . Level of Knowledge of Chemical Hazards in Each Type of Work

Variables	Canting (f = 38)		Nglorot (f = 25)		Coloring (f = 18)		Pattern (f = 17)	
	Yes	No	Yes	No	Yes	No	Yes	No
Level of knowledge of chemical hazards and the symbols in the workplace								
Recognize the hazardous chemicals	38 (100.0)	-	22 (88.0)	3 (12.0)	17 (94.4)	1 (5.6)	12 (70.6)	5 (29.4)
Understand the Health Impacts of Hazardous Chemicals	36 (94.7)	2 (5.3)	15 (60.0)	10 (40.0)	17 (94.4)	1 (5.6)	15 (88.2)	2 (11.8)
Know the relevant Personal Protective Equipment (PPE)	30 (78.9)	8 (21.1)	19 (76.0)	6 (24.0)	10 (55.6)	8 (44.4)	8 (47.1)	9 (52.9)
Recognize hazards other than chemicals	30 (78.9)	8 (21.1)	20 (80.0)	5 (20.0)	11 (61.1)	7 (38.9)	9 (52.9)	8 (47.1)
The importance of an emergency exit	36 (94.7)	2 (5.3)	22 (88.0)	3 (12.0)	16 (88.9)	2 (11.1)	14 (82.4)	3 (17.6)
Know the Safety Data Sheet (SDS)	-	38 (100.0)	-	25 (100.0)	-	18 (100.0)	-	17 (100.0)
Understand the safety rules in this workplace	4 (10.5)	34 (89.5)	1 (4.0)	24 (96.0)	5 (27.8)	13 (72.2)	1 (5.9)	16 (94.1)
Possessing information regarding occupational health	3 (7.9)	35 (92.1)	5 (20.0)	20 (80.0)	3 (16.7)	15 (83.3)	2 (11.8)	15 (88.2)
Understand how to identify, handle, and address chemical leaks or spills in the batik industry	10 (26.3)	28 (73.7)	4 (16.0)	21 (84.0)	7 (38.9)	11 (61.1)	3 (17.6)	14 (82.4)
Description of worker awareness regarding chemical hazard symbols								
Recognize the hazardous chemicals	38 (100.0)	-	22 (88.0)	3 (12.0)	17 (94.4)	1 (5.6)	12 (70.6)	5 (29.4)
Understand the Health Impacts of Hazardous Chemicals	36 (94.7)	2 (5.3)	15 (60.0)	10 (40.0)	17 (94.4)	1 (5.6)	15 (88.2)	2 (11.8)
Know the relevant *P*ersonal *P*rotective *E*quipment (PPE)	30 (78.9)	8 (21.1)	19 (76.0)	6 (24.0)	10 (55.6)	8 (44.4)	8 (47.1)	9 (52.9)
Recognize hazards other than chemicals	30 (78.9)	8 (21.1)	20 (80.0)	5 (20.0)	11 (61.1)	7 (38.9)	9 (52.9)	8 (47.1)
The importance of an emergency exit	36 (94.7)	2 (5.3)	22 (88.0)	3 (12.0)	16 (88.9)	2 (11.1)	14 (82.4)	3 (17.6)
Know the Safety Data Sheet (SDS)	-	38 (100.0)	-	25 (100.0)	-	18 (100.0)	-	17 (100.0)
Understand the safety rules in this workplace	4 (10.5)	34 (89.5)	1 (4.0)	24 (96.0)	5 (27.8)	13 (72.2)	1 (5.9)	16 (94.1)

Variables	Canting (f = 38)		Nglorot (f = 25)		Coloring (f = 18)		Pattern (f = 17)	
	Yes	No	Yes	No	Yes	No	Yes	No
Possessing information regarding occupational health	3 (7.9)	35 (92.1)	5 (20.0)	20(80.0)	3 (16.7)	15 (83.3)	2 (11.8)	15 (88.2)
Understand how to identify, handle, and address chemical leaks or spills in the batik industry	10 (26.3)	28 (73.7)	4 (16.0)	21 (84.0)	7 (38.9)	11 (61.1)	3 (17.6)	14 (82.4)

Source: Primary Data, 2024

TABLE 5. Relationship between individual characteristics and characteristics of work with physical and chemical hazards

Variable	Awareness of Physical Hazards					Awareness of Chemical Hazards				
	Poor f(%)	Good f(%)	Total f(%)	p-value	PR	Poor f(%)	Good f(%)	Total f(%)	p-value	PR
Gender										
Male	15 (28.3)	25 (55.6)	40 (40.8)	0.011*	0.572 (0.368-0.890)	31 (77.5)	9 (22.5)	40 (100.0)	0.011*	1,550 (1,141-2,107)
Female	38 (71.7)	20 (44.4)	58 (59.2)			29 (50.0)	29 (50.0)	58 (100.0)		
Age, years										
Young Adult	27 (50.9)	28 (62.2)	55 (56.1)	0.359	0.812 (0.565-1.166)	41 (74.5)	14 (25.5)	55 (100.0)	0.004*	1.687 (1.166-2.442)
Middle Adult	26 (49.1)	17 (37.8)	43 (43.9)			19 (44.2)	24 (55.8)	43 (100.0)		
Length of Work, years										
<10	46 (86.8)	0 (0.0)	46 (46.9)	0.000*	7,429 (3,729-	28 (60.9)	18 (39.1)	46 (100.0)	1,000	0.989 (0.721-1.357)
≥10	7 (13.2)	45	52 (53.1)			32 (60.0)	20 (38.5)	52 (100.0)		
Duration of Work, hours										
< 8	18 (34.0)	18 (40.0)	36 (36.7)	0.684	0.886 (0.598-1.312)	17 (47.2)	19 (52.8)	36 (100.0)	0.051	0.681 (0.463-0.999)
≥ 8	35 (66.0)	27 (60.0)	62 (63.3)			43 (69.4)	19 (30.6)	62 (100.0)		

*Significant ≤0.05
Source: Primary Data, 2024

of chemical environmental hazards. The test results explain that individual characteristics are related to chemical hazard awareness in workers, while job characteristics have no relationship with chemical hazard awareness (Table 5).

The purpose of this cross-sectional study was to describe the level of awareness of physical hazards and chemical hazards among workers in the batik craft industry center. Most workers in our study explained that they have good awareness of physical hazards, including hot working climates, but poor awareness of electrical hazards, lighting hazards, fire hazards, and poor awareness of chemical hazards. Awareness of occupational safety plays an important role in preventing occupational diseases (Jalali *et al*., 2016). However, many industries do not implement occupational safety and health. This causes many accidents and occupational diseases.

The types of work that are exposed to heat hazards in batik workers are the canting process, the nglorot process, and the coloring and drying processes that are outdoors. Awareness of the dangers of heat exposure among batik workers is categorized as good. The wax melting process is carried out in a frying pan as a container. The frying pan is placed on the stove, becomes hot, and produces melted wax by conduction (Ni'mah *et al*., 2024). In this process, workers are at risk of being exposed to heat from the stove fire and heat from the heated wax, in addition to being exposed to hot wax or a hot stove or pan, which results in redness of the skin. Another risk is that, if inhaled, hot wax vapor causes dizziness and shortness of breath (Junaidi *et al*., 2020). Another study on stamped batik explained that the percentage of heat hazard from using wax was 30.77% (moderate category), resulting in burns due to hot wax (Arfiani *et al*., 2023; Junaidi *et al*., 2020).

Meanwhile, nglorot workers in boiling cloth in water can transfer heat by conduction into the body (Ni'mah *et al*., 2024). This study explains that nglorot workers have the worst level of awareness among other workers about the dangers of a hot work climate. This is explained in the results that most nglorot workers feel that the temperature in their workplace is not suitable. This happens because nglorot workers are directly exposed to fire sources in the process of boiling cloth and soda ash to remove wax from batik cloth. Meanwhile, the process of drying batik outdoors results in the transfer of solar heat radiation to the bodies of Batik workers (Ni'mah *et al*., 2024). The entire batik industry in this study explained that there was no monitoring of temperature and humidity. The results of previous research on hot work climate measurements explained that the ISBB was above the threshold value (NAV), namely ISBB 31.4 ◦ C, humidity 70%, and wind speed 0.035 m/s (Suhardi *et al*., 2018). Monitoring is needed by measuring temperature and humidity to determine whether the work area is dangerous for workers or not, so that controls can be designed.

In addition, exposure to the dangers of light occurs in batik workers (Permenaker, 2018). The results of the study explain that most workers have poor awareness of lighting hazards; all batik workers in this study stated that they had never measured lighting. In addition, all canting workers stated that their workplace was glaring, while batik work required a high precision of view of the object, so that the eyes are easily tired. Canting work requires a more dominant vision performance when making fine patterns to large patterns, compared to other jobs. In accordance with batik workers, other studies on weaving workers also require precision that is susceptible to the quality and intensity of lighting. The study explained that textile workers in the weaving section explained that the light intensity in the weaving area was still below the NAB (Threshold Limit Value) (Muharry, 2015). Dim light or lighting below standard will cause eye fatigue, eye strain, headaches, and irritation, which will reduce productivity (Benedetto *et al*., 2014). The intensity of lighting in the workplace has a significant relationship with worker productivity (Muharry, 2015).

The use of electrical equipment, such as lamps, irons, and other electrical equipment, in the production process is one of the hazards in the Batik Industry. Every work tool that uses electricity has an electrical risk, such as the risk of death, electric shock, or other injuries caused directly or indirectly by electricity (Safe

Work Australia, 2012). The results of the risk assessment of workers in the Sorong Screen Printing batik home industry explain that there is an electrical hazard in the process of mixing dyes with machines (Maulana *et al*., 2024).

Electrical technicians must have skills and knowledge related to electrical operations, equipment, installations, and have safety training to recognize and avoid the hazards involved (Roy *et al.,* 2015). Our study explains that canting workers, nglorot workers, pattern workers, and dye workers stated that checking electrical equipment in the batik industry was not carried out by licensed technicians, checking electrical equipment was irregular, sockets were overloaded, and most workers were not informed about the dangers of electrical equipment. Another study explains that more than 2/5 of electrical technicians are exposed to electrical hazards, which is an indicator of low knowledge and practice of workers in recognizing hazards and their preventive measures (Elsayed & Mekhmier, 2017). There needs to be an education about the dangers of electricity in the batik industry.

Regarding the dangers of fire, batik raw materials in the form of cloth and chemicals in the batik-making process are among the factors contributing to the presence of flammable raw materials. The second factor causing fires is the presence of a fire source or heat source from candles, electrical short circuits, and chemical reactions. Thus, it is necessary to know about the factors that cause fires among batik industry workers, where the work process is directly related to the dangers of fire in the wax heating process. The results of this study explain that workers' awareness is low regarding the dangers of fire, the availability of fire extinguishers, and emergencies. Another study explains that in the Sekar Arum and Mahkota Laweyan batik industries, fires were caused by wax-heating stoves (Junaidi *et al*., 2020).

In addition, health problems can occur from the use of chemicals in the coloring section. The results of the risk analysis in previous studies explained that the dyeing and washing of fabrics and drying sections were exposed to dyes (naphthol) and NaOH, NaNO2, which resulted in skin irritation, eye irritation, and, if inhaled, caused dizziness and shortness of breath (Junaidi *et al*., 2020). Chemicals that are often used in the batik industry include pigments, dyes, and wax or *malam*. *Malam* is a traditional wax that is commonly used in the batik-making process, which contains a mixture of paraffin, microcrystalline wax, beeswax, and triterpenoid resin (Febriana *et al*., 2020) where the burning of this wax causes emissions that are harmful to health, especially shortness of breaths (Massoudi & Hamidi, 2017). Common textile dyes come from azo compounds and benzene derivatives, which take a long time to degrade and are toxic if swallowed, inhaled, or in direct contact (Handajani & Narissi, 2016). The explanation above shows that the use of chemicals in batik work contains hazardous substances.

Most of the results of our study explain that most workers have a good awareness of chemical hazards. Contrary to previous research, which stated that workers do not agree that there is a danger in the chemicals used in the production process (43%) (Hawali *et al*., 2022). However, a more detailed explanation regarding awareness of chemicals that most workers have low awareness of safety regulations in their workplace. Batik workers are less aware of information about occupational safety and health and do not know how to identify, handle, and overcome chemicals in the batik industry. Although the results of awareness of chemical hazards are good, it is undeniable that the results of worker awareness of chemical hazard symbols are still low.

Many factors can cause low worker awareness of hazards and risks in the workplace. Education has an impact that can be seen and felt directly by providing stimulus to cognitive, affective, and psychomotor abilities (Uran *et al*., 2024). Gender is related to worker awareness of physical hazards and is related to awareness of chemical hazards. The involvement of women in occupational safety and health management allows for a better understanding and handling of risks and hazards (Mubita *et al*., 2023). Women in this study showed that they bring unique perspectives, skills, and approaches to problems. Workers who use chemicals in nglorot workers are aware of the use of personal protective equipment. In accordance with previous studies, which explain that batik

workers use PPE regularly (Febriana *et al*., 2023). Appropriate use of PPE is one of the important measures to protect workers from occupational hazards (Tadesse *et al*., 2016).

Conclusion

Type of gender become factor associated with workers' awareness of physical hazards. Besides that, the working period is also related to awareness of physical hazards. The longer work period will make workers more aware of hazards. A risk factor affecting the occurrence of awareness among workers about hazardous chemicals is age. Intervention-related improvement in awareness about physical and chemical hazards in on-site work, in the form of giving knowledge about physical and chemical hazards to new and old workers. The author would like to thank the Research and Community Services Board of Universitas Muhammadiyah Semarang for funding the research and for assisting during the article's writing. There are no significant competing professional or personal interests that might affect performance.

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