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## **Implementation of education to batik workers about contact dermatitis in Tanjung Bumi, Bangkalan, Madura, Indonesia**

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**Abstract**--The harmful substances used in the batik industry may cause health problems to batik workers. Knowledge of occupational-related diseases is necessary for workers. This study evaluated the knowledge of batik workers about contact dermatitis and assessed their work-related skin complaints. This experimental study was conducted in Tanjung Bumi, Bangkalan district, Madura Island, Indonesia. Pre-test and post-test were conducted before and after the

intervention of health education session. Fifty batik workers were involved in this study. The mean age of the subjects was  $36.5 \pm 10.201$ . Analysis with paired-samples *t*-test showed that there was a significant difference between the pre-test and post-test scores ( $p = 0.040$ ). It was found that almost half of the subjects experienced direct exposure to wax and dyes with forty-four percent and forty-two percent, respectively. The use of gloves while working was not common among the subjects with only thirty-four percent using gloves. The most complained symptom among the batik workers was dry skin. The knowledge about occupational contact dermatitis related to the batik industry's work environment can be beneficial to prevent the incidence of the disease and raise awareness about the importance of maintaining a safe and healthy work environment among batik workers.

**Keywords**---Contact dermatitis, Batik worker, Health education, Public health, Safe working environment.

## Introduction

Batik is a form of visual art created on textile materials that is one of the Indonesian cultural heritages. Batik is a unique creation that is made conventionally and protected by copyright law as a form of creation. The motives of batik in each region in Indonesia have distinct characteristics that can be seen in the variation of colors and patterns. Furthermore, batik is listed in UNESCO's Representative List of Oral and Intangible Cultural Heritage of Humanity since 2009 (Rahayu, 2011; Tresnadi & Sachari, 2015). Madura Island, located in East Java Province in Indonesia, is also known for its unique batik motives with bold and bright colors such as red, yellow, or green and flower or leaves patterns (Suminto, 2015). Tanjung Bumi, Bangkalan District, Madura Island, is famous for "*batik gentongan*" which refers to the technique of dyeing batik by soaking the cloth in barrels or dye baths using natural or synthetic dyes (Rahayu, 2011; Suminto, 2015).

Due to the rapid growth of batik industry, the use of synthetic dyes is preferred because it is more practical and faster. However, the use of these synthetic dyes increases the risk of exposure to harmful substances such as heavy metals, suspended solids, and other substances. These substances may enter the body through the skin and respiratory mucosa and cause health problems for batik workers (Prakoewa et al., 2021; Tresnadi & Sachari, 2015). As a worker in the batik industry, knowledge about occupational health risks is necessary. Unfortunately, not all owners and workers in the batik industry are aware of this. There are still many workers who work with their bare hands and let the dyes come in direct contact with the skin, especially those who work in dyeing the cloth. Workers who use *canting* (pen-like tool containing wax) to create patterns on the cloth are also at risk of exposure to the materials they use. This continuous exposure can disrupt the physiological function of the skin and make the skin more susceptible to disease, one of which is contact dermatitis (Ramos et al., 2018; Young et al., 2019)

In the previous study, an intervention was carried out to reduce exposure to the harmful substance in batik workers using neoprene gloves. The study proved that the use of neoprene gloves could reduce the effects of harmful substances on the skin which was better than latex gloves, but it was not optimal. Due to the size of neoprene gloves commonly sold on the market could not cover the entire arm that came in contact with the substances (Prakoewa et al., 2021). In this study, more focus was given to educational intervention. Knowledge evaluations of occupational contact dermatitis were conducted before and after giving education and information on the matter.

## Method

This experimental study was conducted in Tanjung Bumi, Bangkalan district, Madura Island, Indonesia. The data was collected from 50 batik workers using questionnaires. The inclusion criteria for this study were batik workers who actively contributed to the production of batik and who were willing to participate in the study. The educational media used in this study were health education and the distribution of educational booklets about contact dermatitis in batik workers. Pre-test and post-test on the topic of basic knowledge of contact dermatitis in batik workers were conducted before and after the health education session. Questionnaires consisting of the subject's characteristics, history of skin complaints before and after working as a batik worker, and habits related to skin complaints were also distributed to give a better understanding of the epidemiological data and occupational-related skin diseases among batik workers. The data were collected and analyzed with descriptive analysis and paired-samples *t*-test with IBM SPSS Statistics for Windows, version 26 (IBM Corp., USA) because the scores of the pre-test and post-test had normal distributions. This study received ethical approval from the Ethical Committee of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia (No.11/EC/KEPK/FKUA/2022).

## Results

This study involved 50 batik workers from Tanjung Bumi, Bangkalan district, Madura Island, Indonesia. The subjects were dominated by females (46 subjects, 92%) and only 4 subjects (8%) were male. The mean age of the subjects was  $36.5 \pm 10.201$  with an age range of 20 - 60 years old. Forty-four subjects (88%) worked in the dry work section (drawing motives and details on the fabric with wax and dyes) while 6 subjects (12%) worked in the wet work section (washing, boiling, and coloring the fabric with dyes or dye bath). Most of the subjects (32 subjects, 64%) had more than 6 hours of work per day, 10 subjects (20%) worked 3-6 hours per day, 7 subjects (14%) worked 1-2 hours per day, and 1 subject (2%) worked less than an hour per day (Table 1). The educational backgrounds of the subjects were elementary school (62%), junior high school (10%), senior high school (16%), and uncategorized (12%).

Table 1. Subject's characteristics

Characteristics	Total (%)
Gender	
Female	46 (92)

Male	4 (8)
Age Group (years old)	
20-24	7 (14)
25-29	6 (12)
30-34	12 (24)
35-39	6 (12)
40-44	8 (16)
45-49	4 (8)
50-54	4 (8)
55-59	2 (4)
≥60	1 (2)
Work Section	
Dry work	44 (88)
Wet work	6 (12)
Working hours per day	
<1	1 (2)
1-2	7 (14)
3-6	10 (20)
>6	32 (64)

Data from pre-test and post-test from all 50 subjects were gathered. The mean score for the pre-test was  $62.67 \pm 13.47$  and the mean score for the post-test was  $65.60 \pm 15.38$ . The analysis with paired-samples *t*-test showed that there was a significant difference between pre-test and post-test scores ( $p = 0.040$ ).

Table 2. History of skin complaint

History of skin complaint before working as batik worker	Total (%)
Dry skin	13 (26)
Feeling of thickness on the skin	9 (18)
Scaly skin	5 (10)
Itchy skin	4 (8)
Rash	3 (6)
Stinging/burning sensation on the skin	2 (4)
Edema	1 (2)
Skin blisters	1 (2)

History of skin complaints that were not related to work or before working as a batik worker was also assessed in the questionnaire. As shown in Table 2, the most complained symptom was dry skin with 13 out of 50 subjects (26%), followed by the feeling of thickness on the skin with (9 subjects, 18%), and the least complained symptoms were edema and skin blisters (1 subject, 2%). The hands were the most common part that experienced skin complaints (48%), followed by the trunk (14%) and feet (14%).

Table 3. Skin complaints in batik workers

Skin complaints in batik workers	Total (%)
Risk assessment	
Washing hands after work	48 (96)

Use of water and soap to wash hands	44 (88)
Wax exposure	22 (44)
Dyes exposure	21 (42)
Use of gloves at work	17 (34)
Use of mask at work	16 (32)
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Skin complaints involving work	
Dry skin	20 (40)
Stinging/burning sensation on the skin	12 (24)
Feeling of thickness on the skin	9 (18)
Scaly skin	9 (18)
Itchy skin	6 (12)
Edema	5 (10)
Rash	4 (8)
Skin blisters	3 (6)
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Characteristic of symptom(s)	
Improving symptom(s) when not working	31 (62)
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Effects of skin complaint	
Effect on sleeping habits	31 (62)
Effect on emotional condition	10 (20)
Effect on daily activities	7 (14)
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The risk of getting skin problems and history of skin complaints as a batik worker were shown in Table 3. Almost half of the subjects experienced direct exposure to wax and dyes with 44% and 42%, respectively. The use of gloves while working was not common among the subjects with only 34%. However, almost all subjects admitted that they regularly wash their hands after work with water and soap.

The most complained symptoms among the batik workers were dry skin (40%) followed by stinging or burning sensation on the skin (24%). The least common complaints were rash and skin blisters with 8% and 6%, respectively. Thirty-one subjects or 62% confessed that the symptoms would improve when they were not working. Other substances related to the worsening of the symptom were laundry detergent (60%), antiseptic soap (32%), and dishwashing soap (2%). Skin complaints affected 62% of the subject's sleeping habits and less commonly affected the emotional condition or daily activities.

Table 4. Habits related to skin complaints in batik workers

Habits related to skin complaints	Total (%)
Use of hand moisturizers	23 (46)
Handwashing times per day	
0-5	23 (46)
6-10	20 (40)
11-20	3 (6)
>20	4 (8)
Type of soap for handwashing	
Antiseptic soap	36 (72)
Non-antiseptic soap	14 (28)
How to deal with the skin complaints	
Consult with a medical professional	19 (38)

Herbal medicine	17 (34)
Over-the-counter medicine	9 (18)

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Table 4 showed that 46% of the subjects used hand moisturizers regularly. The majority of the subjects (46%) washed their hands 5 times or less in a day, 40% of the subjects washed their hands 6 to 10 times a day, and washing hands 11 times or more in a day was less common among the subjects. The type of soap used for handwashing was mostly antiseptic soap (72%). Approximately 38% of the subjects admitted that they would consult about their skin complaints with medical professionals. Subjects also considered self-medication with herbal or over-the-counter medicines to treat their skin complaints with 34% and 18%, respectively.

### Discussion

Contact dermatitis is an inflammatory disorder of the epidermis that occurs as a result of direct contact with irritative or allergenic substances. Irritant contact dermatitis is induced by physical damage to the epidermis after exposure to irritative chemical substances and occurs more quickly than the delayed hypersensitivity reaction that causes allergic contact dermatitis (Kang et al., 2019). Occupational contact dermatitis is the most common occupational skin disorder. A high prevalence of contact dermatitis was found in hair and make-up professionals, beauty clinics, health workers, food processing workers, and metal industry workers (Ginting et al., 2021; Prakoeswa et al., 2021).

Batik manufacturing requires the use of several substances that might serve as irritants or allergens, resulting in contact dermatitis and other health risks. The main steps of producing batik cloth are preparing the fabric or materials, drawing patterns, blocking part of the fabric with melted wax, dyeing or filling with colors, removing the wax, rinsing, and fixating the fabric. Some steps should be repeated several times depending on the desired colors and patterns. Traditional batik manufacturers are mostly home industries that employ workers with medium to low educational backgrounds from their neighborhoods. Batik workers are dominated by women in the dry work section which is hand-drawing patterns on the fabric, while the wet work section including dyeing, rinsing, and wax removal is dominated by men (Malte et al., 2020). In this study, the subjects were dominated by women (92%) with only two women working in the wet work section while the rest of them were in the dry work section. According to the history of Madura's batik, the tradition was originally brought by people who were mostly sailors at that time. They taught the batik tradition to wives to do in their spare time if their husbands went sailing for months. This made the batik tradition more popular among women and wives (Universitas Airlangga, 2021).

Social support and socioeconomic status are thought to influence health status. Furthermore, education enables a person to generate better health by gaining more knowledge about health factors (e.g., medical treatment, exercise, external exposure), therefore changing their health behaviors which eventually affect their health status in general (Dursun et al., 2018). Most of the subjects in this study had only graduated from elementary school (62%) which supports the previous study about the batik worker population having a medium to low educational

background (Malte et al., 2020). Based on this finding, the lack of knowledge about health factors among the batik workers might increase their risks of getting health problems from their occupational environment, such as occupational contact dermatitis.

The outcome of educational intervention in this study was proven by the significant improvement of test scores after the intervention ( $p = 0.040$ ). However, the impact of the increased level of knowledge on health outcomes might need further studies. Some factors that might also influence their learning capacity and health-related behaviors are difficult to observe, such as genetics, preferences, or intelligence (Dursun et al., 2018).

The exposure to irritative or allergenic substances in the dry and wet work sections is mostly different. In the dry work section, some examples of the irritative substances are hot melted wax and wax fumes, while the material used for *canting* such as nickel, copper, or other metals might induce allergic contact dermatitis. The irritants in the wet work section are excessive water, hot water, detergent, caustic soda, natural and synthetic dyes, chloride acid, sulfates, sodium nitrite, and diazonium salt. Natural and synthetic dyes might cause sensitization. Synthetic dyes including indigo, indigosol, naphthol, brenta soga, and many more are frequently used for dyeing batik. A cross-sectional study found that 7 out of 48 batik workers showed positive patch tests for naphthol (Malte et al., 2020). Another study also found 1 positive patch test for natural brown soga and 1 positive patch test for indigosol (Febriana et al., 2020)

Other factors that influence contact dermatitis are the duration of exposure, wet/dry cycles, cold seasons with low humidity, rubbing/stretching of the skin, and individual factors such as the history of atopic dermatitis and genetics (Agner & Menne, 2001; Kang et al., 2019). A longer duration of exposure to harmful substances induces more risk of developing skin problems. Exposure to wet work for 2 hours or more has a significant association to contact dermatitis (Malte et al., 2020). In this study, most of the subjects worked more than 6 hours/day (64%) and 3 to 6 hours/day (20%) which could increase their risk of developing contact dermatitis if not properly prevented.

Genetic skin barrier dysfunction is presented in patients with atopic dermatitis. This is caused by a mutation that results in a faulty filaggrin, which weakens the protein that binds corneocytes together in the stratum corneum and reduces the natural moisturizing factor. Some studies had shown significant relation between atopic dermatitis patients and the development of irritant contact dermatitis (Agner & Menne, 2001; Kang et al., 2019). Many of the subjects of this study had skin complaints before working as a batik worker with dry skin (26%) as the most complained symptoms, followed by a feeling of thickness on the skin (18%), and scaly skin (10%). These symptoms are commonly associated with skin barrier dysfunction in atopic dermatitis. A study in Indonesia ( $n = 70$ ) showed that batik workers with a history of atopic dermatitis had 5,37 times more chance to develop occupational irritant contact dermatitis (Sulistiyani et al., 2010).

Hand washing is one of the factors that can aggravate contact dermatitis in some conditions. Frequent wet/dry cycles are a common aggravating factor of irritant

contact dermatitis, especially for those with atopic dermatitis predisposition (Kang et al., 2019; Malte et al., 2020). The use of water and soap or detergents to wash hands might be beneficial to easily remove debris, however, soap can also harm proteins in the stratum corneum layer of the skin by removing essential intracellular lipids. The stratum corneum is disrupted when these essential lipids and proteins are lost, which causes skin damage, dryness, skin sensitivity, and irritation (Rundle et al., 2020; WHO, 2009). Irritants will enter the epidermis, causing damage to the keratinocyte plasma membrane and disrupting the release of lipids from lamellar bodies into intercellular lipid bilayers, causing irritant contact dermatitis. Meanwhile, allergic contact dermatitis is caused by sensitization to allergens and results in delayed-type hypersensitivity reaction by antigen-specific T-cell activation (Kasemsarn et al., 2016).

Studies also showed that hand hygiene products, especially soaps and other detergents, are a leading cause of chronic irritant contact dermatitis among healthcare workers (WHO, 2009). The risk for skin irritation caused by detergents varies greatly, and it can be decreased by adding humectants. Irritation caused by antimicrobial/antiseptic soaps might be attributed to the antimicrobial agent or other components. Antiseptic agents commonly associated with irritant contact dermatitis are iodophors, followed by chlorhexidine, chloroxylenol, triclosan, and alcohol-based ingredients (Nopriyati et al., 2020; WHO, 2009). According to the American Contact Dermatitis Society, hand soap products with antibacterial are not necessary for proper hand hygiene. Hand hygiene products without added preservatives, fragrances, colorings, or allergenic surfactants, and containing moisturizing agents are recommended (Rundle et al., 2020).

Frequent and repeated exposure to soap or detergents disrupt the skin barrier and make the skin more prone to irritation by antiseptic agents (WHO, 2009). A study of hand dermatitis in 113 healthcare workers in the US showed that a handwashing frequency of greater than or equal to 10 times/day was associated with hand dermatitis (Callahan et al., 2013). Meanwhile, a few subjects in this study admitted to washing their hands more than 10 times/day (6%) and even more than 20 times/day (8%) which might result in contact dermatitis, especially in the group that used antiseptic soap (72%).

Elimination or substitution of causative factors, engineering controls, and personal protective equipment (PPE) can help prevent occupational contact dermatitis (Ginting et al., 2021; Prakoeswa et al., 2021). According to a study, the use of gloves in batik workers had significant results including lower transepidermal water loss (TEWL) and better skin hydration, but there was no significant difference between neoprene gloves and the worker's personal gloves made of a thermoplastic polymer of vinyl (PVC). In this study, there were only 34% of the subjects confessed to using gloves during work. The use of gloves while working should be encouraged for batik workers, however, the inappropriate use of gloves and incompatible glove materials could aggravate the risk of contact dermatitis (Prakoeswa et al., 2021).

Other intervention to prevent the impairment of the skin barrier as well as to avoid occupational contact dermatitis is the use of skin barrier cream and moisturizers. Moisturizers protect the skin against irritative substances



(Kasemsarn et al., 2016). Double-blind clinical trials evaluating the use of common moisturizer components, such as *Aloe vera*, *Centella Asiatica*, and ceramide, showed that they were beneficial in improving the skin barrier function and lowering the risk of contact dermatitis in the Indonesian batik worker population (Anggraeni et al., 2021; Damayanti et al., 2021; Umborowati et al., 2022). Daily use of moisturizers is not common among the subjects with only 46% and thus encouraging the use of moisturizers as one of the preventions of occupational contact dermatitis is recommended.

Mathias criteria have been used to diagnose and distinguish occupational contact dermatitis from other causes of contact dermatitis. The criteria consist of 7 questions and a minimum of 4 criteria must be met to establish the diagnosis. To ensure that the contact dermatitis is related to the patient's working environment, it is important to assess some information such as the history of exposure that preceded the onset or aggravation, onset or aggravation within 6 months of exposure, improvement when away from work exposure, and re-exposure causes exacerbation (Mathias & Ohio, 1989). In this study, the diagnosis of occupational contact dermatitis is difficult to determine as the answers from the participants might be subjective. However, according to the questionnaire results, 40% of the batik workers had dry skin, 24% experienced a stinging or burning sensation on the skin, and 18% experienced a feeling of thickness on the skin and scaly skin. As many as 62% of the subjects answered that the symptoms improved after being away from work. This data should be analyzed further and physical examination must be conducted in the future study to be able to know whether the skin complaints of batik workers were caused by occupational hazards (Houle et al., 2021; Mathias & Ohio, 1989). Occupational contact dermatitis has a considerable effect on the patient's quality of life (QoL). Occupational skin disease might raise problems in social life and cause sleep disturbance, which might lead to sick leave or even resignation from the job and affect the economic status of the patient. Many factors might result in low QoL in hand dermatitis patients, including severe hand dermatitis, older age, female, low socioeconomic status, history of atopic dermatitis, and history of allergic contact dermatitis (Malte et al., 2020). Although the assessment of QoL was not conducted in this study, as many as 62% of the subjects confessed to sleeping disturbances related to their skin problems. A thorough clinical assessment and the QoL of batik workers are encouraged in further study. There were only 38% of the subjects who would consult their skin problems with medical professionals and this could result in many undiagnosed cases (Malte et al., 2020).

## **Conclusion**

The knowledge about occupational contact dermatitis related to the batik industry's work environment can be beneficial to prevent the incidence of the disease and raise awareness about the importance of maintaining a safe and healthy work environment among batik workers. Early detection and treatment of occupational contact dermatitis in batik workers are encouraged to prevent the worsening of the symptoms and improve the QoL.

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