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The Influence of Behavior and Exposure to Molding Materials on the Incidence of Occupational Diseases in the Concrete Industry in North Sumatra

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ABSTRACT

Irritant contact dermatitis is one of the most common occupational diseases among concrete industry workers due to exposure to irritants during the production process. This study aims to analyze the influence of personal hygiene, the use of personal protective equipment (PPE), and exposure to molding materials on the incidence of irritant contact dermatitis among workers. The study employed a quantitative, cross-sectional design involving 60 workers selected using total sampling and purposive sampling techniques. Data were collected via a questionnaire and analyzed using the chi-square test and multiple logistic regression. The results showed that 55% of workers had irritant contact dermatitis, 58.3% had good personal hygiene, 98.3% used PPE properly, and 51.7% had high exposure to molding materials. Bivariate analysis showed that personal hygiene (p=0.025) and exposure to printing materials (p=0.010) were significantly associated with the incidence of irritant contact dermatitis, whereas the use of PPE was not significantly associated (p=0.326). Multivariate analysis showed that exposure to printing materials was the most dominant factor (p=0.014; OR=4.135; 95% CI=1.331–12.845). It was concluded that personal hygiene and exposure to printing materials are associated with the incidence of irritant contact dermatitis, with exposure to printing materials being the dominant factor

INTRODUCTION

Occupational diseases remain a significant issue in the field of occupational health and safety. According to Presidential Regulation of the Republic of Indonesia No. 7 of 2019, an occupational disease is a disease caused by work and/or the work environment. Globally, the International Labor Organization (ILO) estimates that approximately 2.78 million workers die each year from work-related accidents and illnesses, with the majority of these deaths caused by work-related illnesses (ILO, 2021). This situation indicates that controlling risk factors in the workplace remains a challenge across various industrial sectors.

One of the most commonly encountered work-related diseases is work-related skin disease. Skin disorders are estimated to account for approximately 30–34% of all work-related disease cases (Chakravarthi & Sethy, 2017). Among the various types of work-related skin diseases, irritant contact dermatitis (ICD) is the most common form resulting from direct skin contact with irritants. Ricardo et al. (2023) reported that ICD accounts for 66.3% of all cases of work-related contact dermatitis. This condition can cause itching, redness, inflammation, and even a decrease in worker productivity.

The incidence of DKI is influenced by various factors, both individual and workplace-related. Poor personal hygiene can increase the risk of DKI because irritants remaining on the skin are not immediately washed off (Wardani et al., 2018). In addition, the use of inappropriate personal protective equipment (PPE) can increase direct contact between the skin and hazardous substances in the workplace (Saputra et al., 2024). The duration of exposure to irritants is also known to play a role in increasing the risk of DKI due to the accumulation of continuous exposure during work (Aurellia & Haqi, 2022).

The precast concrete industry is one sector with potential exposure to irritants, such as cement, cement dust, and mold oil.

Exposure to these substances can cause skin irritation, particularly among workers directly involved in the production process. A preliminary survey at PT Wika Beton PPB SUMUT revealed that 30 out of 60 interviewed workers reported skin complaints consistent with irritant contact dermatitis. Although numerous studies on risk factors for irritant contact dermatitis (ICD) have been conducted, most have focused on personal hygiene, PPE use, or worker characteristics in isolation and have been carried out in industrial sectors other than precast concrete. Research that simultaneously analyzes the effects of personal hygiene, the use of PPE, and exposure to printing materials on the incidence of DKI among precast concrete industry workers remains limited.

Based on the above discussion, this study aims to analyze the effects of personal hygiene, the use of personal protective equipment (PPE), and exposure to printing materials on the incidence of irritant contact dermatitis among workers at PT Wika Beton PPB SUMUT.

METHODS

This study is a quantitative, cross-sectional study aimed at analyzing the effects of personal hygiene, the use of personal protective equipment (PPE), and exposure to printing materials on the incidence of irritant contact dermatitis among workers at PT Wika Beton PPB SUMUT. The study was conducted from April to May 2026 at PT Wika Beton PPB SUMUT in Medan, North Sumatra. The study population consisted of all 60 production workers directly involved in the process of using printing materials. The study sample comprised 60 respondents selected using total sampling and purposive sampling techniques based on predetermined inclusion and exclusion criteria.

Data were collected using a structured questionnaire and an observation sheet. The variables studied included personal hygiene, PPE use, exposure to casting materials, and irritant contact dermatitis. Personal hygiene was measured using 13 questions, PPE use using 7 questions, and irritant contact dermatitis using 10 questions with “yes” and “no” response options. Exposure to casting materials was measured based on the duration of workers’ exposure to these materials during work. Prior to use, the research instruments were tested for validity and reliability among 30 workers at PT Wika

Beton's Tembung site. All questionnaire items were found to be valid (calculated r > 0.361) and reliable, with Cronbach's Alpha values of 0.811 for personal hygiene, 0.776 for PPE use, and 0.845 for irritant contact dermatitis.

Data analysis was conducted using univariate, bivariate, and multivariate methods. Univariate analysis was used to describe the frequency distributions of respondent characteristics and study variables. Bivariate analysis employed the chi-square test or Fisher's exact test to determine the relationship between independent and dependent variables. Variables with p-values $\leq$ 0.25 in the bivariate analysis were subsequently included in the multivariate analysis using multiple logistic regression to determine the most dominant factors associated with the occurrence of irritant contact dermatitis. The results of the analysis are presented in the form of frequency distribution tables, cross-tabulations, and logistic regression tables with a 95% confidence level (α = 0.05).

RESULTS AND DISCUSSION

Worker Characteristics

Based on the worker characteristics in Table 1, the majority of workers were aged $\geq$40 years, totaling 34 people (56.7%), while 26 workers (43.3%) were aged <40 years. Based on educational level, the majority of workers had a high school diploma or equivalent (51 workers, 85.0%), followed by junior high school graduates (6 workers, 10.0%), college graduates (2 workers, 3.3%), and elementary school graduates (1 worker, 1.7%). Based on length of service, 33 workers (55.0%) had been employed for $\geq$14 years, and 27 workers (45.0%) had been employed for <14 years.

Table 1. Frequency Distribution of Worker Characteristics

Characteristics	n=60	%
Worker Age		
< 40 years	26	43,3
$\geq$ 40 years	34	56,7
Employee Education		
Elementary School	1	1,7
Junior High School	6	10,0
Senior High School	51	85,0
University (Bachelor's Degree)	2	3,3
Working Period		
< 14 years	27	45,0
$\geq$ 14 years	33	55,0

Irritant Contact Dermatitis (ICD)

The results of the univariate analysis in Table 2 show that 33 workers (55.0%) had irritant contact dermatitis, while 27 workers (45.0%) did not. These results indicate that more than half of the workers experienced skin conditions leading to irritant contact dermatitis, suggesting that this condition remains an occupational health issue at PT WIKA Beton PPB SUMUT.

Table 2. Frequency Distribution of Irritant Contact Dermatitis

Contact Dermatitis	n=60	%
Experiencing ICD	33	55
Not Experiencing ICD	27	45

Personal Hygiene and Irritant Contact Dermatitis

In this study, analysis of the personal hygiene variable was conducted using univariate analysis to describe the distribution of workers' personal hygiene and bivariate analysis to determine its association with the incidence of irritant contact dermatitis.

1. Frequency Distribution of Personal Hygiene

The results of the univariate analysis of personal hygiene in Table 3 show that the majority of workers had good personal hygiene, namely 35 people (58.3%), while 25 people (41.7%) had poor personal hygiene. These findings indicate that most workers practiced reasonably good personal hygiene during and after work, although there were still some workers who did not practice optimal personal hygiene.

Table 3. Frequency Distribution of Personal Hygiene

Personal Hygiene	n=60	%
Good	35	58,3
Poor	25	41,7

2. The Effect of Personal Hygiene on Irritant Contact Dermatitis

The results of the bivariate analysis of personal hygiene showed a significant association between personal hygiene and the incidence of irritant contact dermatitis (p=0.025). A total of 72.0% of workers with poor personal hygiene experienced irritant contact dermatitis, whereas 42.9% of those in the group with good personal hygiene experienced irritant contact dermatitis. The results of the bivariate analysis are shown in Table 4.

Table 4. Results of the Bivariate Analysis of Personal Hygiene

Personal Hygiene	Irritant Contact Dermatitis (ICD)				Total	%	*p-value*
	Yes		No				
	n	%	n	%			
Good	15	42,9	20	57,1	35	100	0,025
Poor	18	72,0	7	28,0	25	100	

The results of this study indicate that personal hygiene practices play a crucial role in preventing irritant contact dermatitis. Workers who do not immediately clean their hands, bodies, or work clothes after contact with cement, cement dust, and molding materials risk retaining irritant residues on their skin's surface. Prolonged contact can damage the skin's protective barrier and trigger an inflammatory response. These findings align with the concept of industrial hygiene, which identifies personal hygiene as a key strategy for controlling exposure to hazardous substances. A study by Defani et al. (2025) showed that workers with poor personal hygiene have a higher risk of developing irritant contact dermatitis compared to workers who practice good personal hygiene.

Exposure to Formwork Materials and Irritant Contact Dermatitis

Exposure to formwork materials is one of the occupational environmental factors that can potentially contribute to the development of irritant contact dermatitis among concrete industry workers. In this study, exposure to formwork materials was measured based on the duration of workers' exposure while on the production floor. Univariate analysis was conducted to describe the distribution of formwork material exposure, and bivariate analysis was performed to determine its association with the incidence of irritant contact dermatitis.

1. Frequency Distribution of Exposure to Printing Materials

The results of the univariate analysis of exposure to printing materials in Table 5 show that 31 workers (51.7%) fell into the high exposure category (≥12 years), while 29 workers (48.3%) fell into the low exposure category (<12 years). These findings indicate

that the majority of workers have been exposed to printing materials for a relatively long period, which potentially increases the risk of work-related skin disorders.

Table 5. Frequency Distribution of Exposure to Printing Materials

Exposure to Printed Materials	n=60	%
Low Exposure (<12 years)	29	48,3
High Exposure(≥12 years)	31	51,7

2. The Effect of Exposure to Printing Materials on Irritant Contact Dermatitis

The results of the analysis indicate a significant association between exposure to printing materials and the incidence of irritant contact dermatitis (p=0.010). A total of 71.0% of workers with high exposure (≥12 years) developed irritant contact dermatitis, compared to only 37.9% in the low-exposure group. The results of the bivariate analysis of exposure to printing materials are shown in Table 6.

Table 6. Results of the Bivariate Analysis of Exposure to Printing Materials

Personal Protective Equipment	n=60	%
Good	59	98,3
Poor	1	1,7

The results of this study indicate that exposure duration is a key factor in the development of irritant contact dermatitis. The longer workers are exposed to printing materials, the greater the likelihood of cumulative damage to the skin's protective barrier due to repeated contact with cement, cement dust, and other chemicals. These findings are consistent with the dose-response relationship theory, which explains that an increase in exposure duration raises the risk of health problems. A study by Defani et al. (2025) reported that duration of exposure is a factor associated with the incidence of irritant contact dermatitis among workers exposed to irritants.

Personal Protective Equipment (PPE) and Irritant Contact Dermatitis

The use of personal protective equipment (PPE) is a risk control measure aimed at protecting workers from exposure to hazardous substances in the workplace. In this study, analysis of the PPE usage variable was conducted using univariate analysis to describe the distribution of PPE usage among workers and bivariate analysis to determine its relationship with the incidence of irritant contact dermatitis.

1. Frequency Distribution of Personal Protective Equipment (PPE)

The results of the univariate analysis of PPE in Table 7 show that 59 workers (98.3%) used PPE properly, and only 1 worker (1.7%) fell into the category of inadequate PPE use. These results indicate that PPE use at PT WIKA Beton PPB SUMUT has been implemented very well and is supported by the company's adequate supply of PPE.

Table 7. Frequency Distribution of Personal Protective Equipment

Exposure to Printing Materials	Irritant Contact Dermatitis (ICD)				Total	%	*p-value*
	Yes		No				
	n	%	n	%			
Low	11	37,9	18	62,1	29	100	0,010
High	22	71,0	9	29,0	31	100	

2. The Effect of Personal Protective Equipment (PPE) on Irritant Contact Dermatitis

The results of Fisher's Exact Test indicate that the use of PPE is not significantly associated with the incidence of irritant contact dermatitis (p=1.000). Of the 59 workers who used PPE properly, 32 workers (54.2%) developed irritant contact dermatitis. The results of the bivariate analysis of personal protective equipment are shown in Table 8.

Table 8. Results of the Bivariate Analysis of Personal Protective Equipment (PPE)

PPE	Irritant Contact Dermatitis (ICD)				Total	%	*p-value*
	Yes		No				
	n	%	n	%			
Good	32	54,2	27	45,8	59	100	1,000
Poor	1	100,0	0	0,0	1	100	

The lack of a significant association is likely due to the low variation in PPE use among respondents, as nearly all workers used PPE properly (98.3%). According to the Hierarchy of Controls theory, PPE is the last line of defense that serves to reduce contact with hazards but does not eliminate the hazard source itself. Therefore, irritant contact dermatitis can still occur even when workers use PPE if exposure to irritants is continuous over the long term. These findings are consistent with the study by Hakim et al. (2025), which stated that PPE use is not always significantly associated with irritant contact dermatitis.

Dominant Variables Associated with Irritant Contact Dermatitis

The logistic regression analysis in Table 9 shows that personal hygiene and exposure to printing materials are significantly associated with the incidence of irritant contact dermatitis. However, exposure to printing materials is the most dominant factor, with an OR of 4.135 (95% CI = 1.331–12.845; p = 0.014). Furthermore, the regression model indicates that workers with poor personal hygiene and high exposure to printing materials have an 84.3% probability of developing irritant contact dermatitis.

Table 9. Multivariate Analysis Test Results

Variable	B	*p-value*	*Odds Ratio*	95% CI	
				Lower	*Upper*
Stage 1					
Personal Hygiene	1,271	0,033	3,563	1,106	11,481
Exposure to Printed Materials	1,420	0,014	4,135	1,331	12,845
Constant	-1,013	0,034	0,666		

The high OR value indicates that workplace environmental factors contribute more significantly than individual behavioral factors to the incidence of irritant contact dermatitis among workers at PT WIKA Beton PPB SUMUT. Years of exposure lead to the accumulation of irritant effects on the skin, thereby increasing susceptibility to irritant contact dermatitis. Therefore, prevention efforts should focus on controlling exposure to printing materials by reducing direct contact, implementing job rotation, monitoring the use of PPE, and improving workers' personal hygiene.

CONCLUSION

Personal hygiene and exposure to molding materials were found to be associated with the incidence of irritant contact dermatitis among workers at PT WIKA Beton PPB SUMUT, whereas the use of personal protective equipment (PPE) did not show a significant association. Exposure to molding materials was the most dominant factor with an odds ratio of 4.135, indicating that the duration of exposure to irritants plays a

significant role in the development of work-related skin disorders. Therefore, prevention efforts should focus on controlling exposure to printing materials and improving the practice of personal hygiene in the workplace. Further research is recommended to examine other environmental and occupational factors that may influence the incidence of irritant contact dermatitis among industrial workers.

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