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Personal Protective Equipment (PPE) and Personal Determinants related to Dermatitis Contact in Tofu Industry Workers: Case study in Kuningan, Indonesia

Dewi Laelatul Badriah¹, and Cecep Heriana²

¹Majalengka University, ²Institute of Health Sciences Kuningan, Jl. Lingkar Kadugede No.2 Kuningan, West Java 45561, Indonesia

*cecepheriana@gmail.com

Abstract. Contact Dermatitis is reported as the most common occupational skin disease. It is a pathological event in non-infectious skin that occurs because workers have contact with irritants or allergens. This study aimed to determine analysis Personal Protective Equipment and Personal Determinants associated with symptoms of contact dermatitis in tofu industry workers in Kuningan, Indonesia. This study was an observational analytic study with cross sectional design. The study was conducted in Kuningan District Indonesia in July 2019. Study population was all informal tofu industry workers in Kuningan District Indonesia with a total sample of 149 workers taken using proportionate stratified random sampling. The independent variables were use of Personal Protective Equipment (PPE), personal determinants (working period, contact duration, personal hygiene practices, history of skin disease) and the dependent variable were symptoms of contact dermatitis. Interviewed and observation were done using structured questionnaires. Analysis of the data used was the Chi-square test using Prevalence Ratio (PR). The Result of this study showed that workers who experienced symptoms of contact dermatitis were 95 workers (63,8%). Data analysis obtained use of PPE (PR = 4.285; 95% CI = 2,097-8,757; p = 0.001) and personal determinants were working period (PR = 2,733; 95% CI = 1,364-5,436; p = 0.004), contact duration (PR = 2,322; 95% CI = 1,088-4,958; p = 0.027), personal hygiene (PR = 5,146; 95% CI = 2,488-10,645; p=0.001), history of skin diseases (PR = 3,518; 95% CI = 1,621-7,637; p = 0.001). There is a relationship between the use of PPE and personal determinants were working period, contact duration, personal hygiene, and history of skin disease with the symptoms of contact dermatitis among informal workers in the tofu industry in Kuningan District, Indonesia. Improvement on awareness as well as practices on personal hygiene and occupational health need to be concerned by related sectors.

1. Introduction

Informal and formal work poses health and safety risks, one of the risks that may occur is occupational dermatomes. According to Ansar et al (2017)[1] occupational skin disease is an inflammation of the skin caused by a person's work. The most common occupational skin disease is contact dermatitis. Contact dermatitis is a pathological event in non-infectious skin that occurs because workers have contact with irritants or allergens. Contact dermatitis accounts for 50% of all occupational diseases that are mostly non-allergic or irritant. In epidemiological studies, Indonesia showed that 97% of 389 cases were contact dermatitis, of which 66.3% were irritant contact dermatitis and 33.7% were allergic contact



dermatitis. The incidence of occupational contact dermatitis is estimated at 0.5 to 0.7 cases per 1000 workers per year [2].

According to data from the West Java Provincial Health Office in 2016, skin diseases are occupational diseases that ranked second (30.26%) after respiratory disorders in the first rank (31.40%). Generally reporting on the incidence and prevalence of occupational skin diseases is incomplete due to the effects of chemical exposure or the impact of workers' behaviour on industrial processes manifesting only in months or years after exposure occurs [3]. According to Kuningan District Health Office data in 2017 regarding skin diseases and subcutaneous tissue there were 4,908 cases of contact dermatitis [4]. Contact dermatitis can occur in informal workers who generally pay little attention to sanitation and self-protection for themselves. One of the informal industries that has developed in the community is the tofu industry [5]. Tofu is an Indonesian traditional food which basically made from soybean. Tofu production process yields both solid and liquid wastes. If these are not handled properly, they may cause environmental contamination[6]. In general, tofu industry workers have not received health services or insurance in the event of health problems related to their work. Potential hazards that often occur in tofu workers are non-ergonomic work attitudes, hot workplace temperatures, hot tofu spill spills, exposure to acid vinegar on the skin, sanitation, lighting and poor air circulation. This can lead to several occupational diseases such as contact dermatitis disorders, musculoskeletal disorders, dehydration, burns, skin diseases and respiratory disorders [7]. The dermatologist should be aware of the many facets of occupational skin diseases, which can be caused by physical, chemical, and biological insults. The most common manifestation of occupational skin diseases is contact dermatitis (both irritant and allergic)[8].

The process of making tofu has several stages, namely immersion, grinding, cooking, filtering, agglomerating, molding / hardening, cutting and frying tofu. Work process in this tofu industri is divided into two, odd section and milling section. Based on research some hazard potentials are learned. Those are cramp, slip, process tools wedge, process tools struck down, mold, hot soybean extract, combustion fumes, electric shock, noise and fire[9]. The tofu workers can experience direct contact with chemicals in the production process, namely clumping. Clotting substances that can be used include vinegar, lactic acid, tofu ingredients and tofu stones, which have an average acid content of 90%[10]. Based on a preliminary study conducted through interviews with 10 workers, it was found that 6 workers experienced complaints of skin disorders in the form of itching on the palms, the skin feels hot, sore and the skin becomes reddish. Most workers know that they have poor hand washing habits and do not use personal protective equipment. In addition, other factors that might cause symptoms of contact dermatitis are length of service, duration of contact and history of skin disease in informal workers in the tofu industry. This study was conducted to determine the use of personal protective equipment (PPE) and personal determinants with symptoms of contact dermatitis in informal workers in the tofu industry in Kuningan District

2. Meterial and Methods

This research was an observational analytic study with cross sectional design. This research was conducted in 15 sub-districts in Kuningan District in July 2019. The population in this study were all tofu industry informal workers with a total sample of 149 workers taken using a sampling technique that is proportionate stratified random sampling. The independent variable is the use of Personal Protective Equipment and Personal Determinants including length of service, duration of contact, personal hygiene, and history of skin diseases and the dependent variable is a symptom of contact dermatitis. The instruments used were questionnaire sheets and observation sheets. Data collection is done by interviewing and observing each worker. Analysis of the data used is the Chi-square test

3. Research result

3.1. Univariate analysis

Table 1. Distribution of Frequency of Length of Work, Length of Contact, Use of PPE, Personal Hygiene, History of Skin Disease and Symptoms of Contact Dermatitis in Informal Industry Workers in Kuningan District in 2019.

Variable		Category	N	%
Personal Protective Equipment	Use of PPE	No	80	53,7
		Yes	69	46,3
Personal Determinant	Work Periode	≤3 Years	84	56,4
		>3 Years	65	43,6
	Length of Contact	>8 Hours per day	112	75,2
		≤8 Hours per day	37	24,8
<i>Personal hygiene</i>	Less	81	54,4	
	Good	68	45,6	
History of Skin Disease	Yes	56	37,6	
	No	93	62,4	

Based on table 1, it can be seen that the majority of workers have masa3 years of work, namely 84 workers (56.4%), most workers work for > 8 hours / day, as many as 112 workers (75.2%), most workers do not use Personal Protective Equipment as many as 80 workers (53.7%), most workers have poor personal hygiene, namely 81 workers (54.4%), most workers do not have a history of skin disease, as many as 93 workers (62,4%) and most of the workers experienced symptoms of contact dermatitis due to work as many as 95 workers (63.8%)..

3.2. Bivariate analysis

Table 2. Relationship between Work Period, Length of Contact for the Use of PPE, Personal Hygiene and History of Skin Disease with Symptoms of Contact Dermatitis in Informal Industry Workers in Kuningan Regency in 2019

Variable	Symptoms of Contact Dermatitis				Number		RP (CI 95%)	P value
	Yes		No		N	%		
	N	%	N	%				
Use of PPE								
No	63	78,8	17	21,2	80	100	4,285	0,000
Yes	32	46,4	37	53,6	69	100	(2,097-8,757)	
Personal Determinant								
a. Work Periode								
≤3 Years	62	73,8	22	26,2	84	100	2,733	0,004
>3 Years	33	50,8	32	49,2	65	100	(1,364-5,436)	
b. Length of Contact								
>8 Hours per day	77	68,8	35	31,2	112	100	2,322	0,027
≤8 Hours per day	18	48,6	19	51,4	37	100	(1,088-4,958)	
c. Personal Hygiene								
Less	65	80,2	16	19,8	81	100	5,146	0,000
Good	30	44,1	38	55,9	68	100	(2,488-10,645)	
d. History of Skin Disease								
Yes	45	80,4	11	19,6	56	100	3,518	0,001
No	50	53,8	43	46,2	93	100	(1,621-7,637)	

Based on table 2, it can be seen that there is a significant relationship between work period with symptoms of contact dermatitis in informal tofu industry workers in Kuningan District (p value = 0.004) with a prevalence ratio (RP) of 2.73. Furthermore, there is a significant relationship between contact duration with symptoms of contact dermatitis in tofu industry informal workers in Kuningan District (p value = 0.027) with an RP value of 2.32. Then, there is a significant relationship between the use of PPE with symptoms of contact dermatitis in informal tofu industry workers in Kuningan District (p value = 0,000) with an RP value of 4.28. Furthermore, there is a significant relationship between personal hygiene with symptoms of contact dermatitis in informal workers in the tofu industry in Kuningan District (p value = 0,000) with an RP value of 5.14, and there is a significant relationship between the history of skin diseases with symptoms of contact dermatitis in workers informal tofu industry in Kuningan District (p value = 0.001) with an RP value of 3.51.

4. Research Result

4.1. Use of personal protective equipment

Based on the results of the study it can be seen that more workers who do not use personal protective equipment and experience symptoms of contact dermatitis that is as many as 63 workers (78.8%) of 80 workers. Based on the statistical test results in table 5.9 it can be seen that the obtained p value = 0,000 ($p < 0.05$) so that H_0 is rejected, meaning that there is a significant relationship between the use of personal protective equipment with symptoms of contact dermatitis in tofu industry informal workers in Kuningan Regency.

According to Suma'mur in Prasetyo (2014) personal protective equipment is a device used to protect themselves or the body from the dangers of work accidents. Personal protective equipment does not eliminate or reduce existing hazards, this equipment only reduces the amount of contact with hazards by placing a barrier between workers and existing hazards. The use of personal protective equipment is one way to prevent occupational contact dermatitis, because by using PPE can avoid the dangers that exist in the workplace and avoid direct contact with chemicals [11].

The results of this study are in line with research conducted by Daulay (2016)[12], it is known that workers with contact dermatitis do not use PPE in full as many as 16 workers (57.1%) and obtained p -value = 0.044 ($p < 0.05$) so that they can it was concluded that there was a significant relationship between the use of personal protective equipment with the incidence of contact dermatitis in tofu making workers with an RP of 2. This means that respondents who used incomplete PPE twice would experience dermatitis when compared to respondents who used PPE complete. Prick and patch tests showed a positive skin reaction to soybean [13].

However, this study is not in line with research conducted by Prasetyo (2014) which shows that there is no relationship between the use of PPE and irritant contact dermatitis. In this study, the use of PPE is likely to be related to low employee discipline in using PPE [11]. Based on the results of the study it can be seen that more workers with masa3 years of service and experiencing symptoms of contact dermatitis are 62 workers (73.8%) of 84 workers. Based on the results of the statistical tests in table 2 it can be seen that the obtained p value = 0.004 ($p < 0.05$), meaning that there is a significant relationship between the length of work with symptoms of contact dermatitis in tofu industry informal workers in Kuningan Regency.

According to Putri et al (2016)[14] working bekerja 3 years can be one of the factors that indicate that the worker does not have enough experience in doing his work. If this worker is still frequently found to make mistakes in his work procedures, then this has the potential to increase the incidence of contact dermatitis in workers. Furthermore, workers with > 3 years of work may be able to have resistance to chemicals used in the work process. This resistance is known as the hardening process, which is the ability of the skin to become more resistant to chemicals due to continuous chemical exposure. That is why workers with > 3 years less work experience contact dermatitis.

The results of this study are in line with research conducted by Garmini (2018)[15] which shows that there is a statistically significant relationship between years of service and the incidence of irritant contact dermatitis with p value = 0.019. Prevalence Ratio (RP) = 3,750 means that workers with masa3 years of service have a risk of being exposed to irritant contact dermatitis 3,750 times greater than workers with > 3 years of service. This occurs because the longer workers who come in contact with tofu

liquid waste, plus the long working period will aggravate the incidence of contact dermatitis in workers. However, this study is not in line with research conducted by Prasetyo (2014)[11] that there is no relationship between work period and the incidence of irritant contact dermatitis (p value = 0.083). In this study, the length of service variable is not a major risk factor for the cause of irritant contact dermatitis.

4.2. Personal determinant

4.2.1 Years of service

Based on the results of the study it can be seen that more workers with contact duration > 8 hours / day and experiencing symptoms of contact dermatitis are 77 workers (68.8%) of 112 workers. Based on the statistical test results in table 5.2 it can be seen that the obtained p value = 0.027 ($p < 0.05$) so that H_0 is rejected, meaning that there is a significant relationship between contact duration with symptoms of contact dermatitis in tofu industry informal workers in Kuningan District.

According to Chafidz and Dwiyaniti (2018)[16] workers who come into contact with chemicals cause damage to the outer layer of skin cells. The longer contact with chemicals will further damage the skin cells in the deeper layers and make it easier for dermatitis. Contact with irritant chemicals or allergens continuously will cause the skin of workers to experience vulnerability from mild to severe stages. In irritants, skin disorders arise due to cell damage through chemical or physical work. Irritants damage the horn lining, denaturing keratin, getting rid of the horn lining fat and changing the skin's water binding capacity. Most irritants damage the keratinocyte lipid membrane, but some can penetrate the cell membrane and damage the lysosomes, mitochondria or core components. When cell damage occurs, inflammation will occur in the skin. As a result of the inflammation will cause skin disorders accompanied by symptoms of contact dermatitis [17].

The results of this study are in line with research conducted by Daulay (2016) showing that p -value = 0.003 means that there is a significant relationship between contact duration and the incidence of contact dermatitis in tofu factory workers. In this study workers who had an average contact time with longer tofu tended to suffer more contact dermatitis more than workers who had shorter contact times. This can occur due to the longer workers contact with allergen liquid waste, so that skin disorders arise after repeated contact or in a longer duration [12]. However, this study is not in line with Sholehah (2017) which states there is no relationship between length of work with dermatitis. In this study, dermatitis in workers caused by chemicals during soybean soaking process is the presence of vinegar acid chemicals. The length of work with dermatitis has no relationship because the workers in the tofu factory have work times depending on consumer demand [18].

4.2.2. personal hygiene

Based on the results of the study it can be seen that workers who have poor personal hygiene and experience symptoms of contact dermatitis that is as many as 65 workers (80.2%) of 81 workers. Based on the statistical test results in table 5.2 it can be seen that the obtained p value = 0,000 ($p < 0.05$) so that H_0 is rejected means that there is a significant relationship between personal hygiene with symptoms of contact dermatitis in tofu industry informal workers in Kuningan District.

Personal hygiene is care / personal hygiene that is done to maintain health, both before, during and after work. Worker hygiene can prevent the spread of germs, reduce exposure to chemicals and contamination, as well as prevent skin allergies, skin conditions and chemical sensitivity. One of the personal hygiene measures to prevent contact dermatitis is by maintaining skin hygiene [19].

In order to avoid occupational skin diseases, workers should pay attention to personal hygiene while in the work environment, such as washing hands before and after doing work processes using soap and running water, using clean clothes during the work process and bathing after work. According to Garmini (2018) personal hygiene can be described by washing hands, because the hands are the most frequent body contact with chemicals. Poor hand washing habits will worsen skin damage [15].

Washing hands under running water can only reduce chemicals on the surface of the skin. It is better when washing hands under running water and using appropriate soap in order to remove chemicals

that stick to the surface of the skin. The soap used should be chosen that cannot irritate the skin and worsen the symptoms of irritant contact dermatitis. The soap used has a pH of 4.5 to 6.5. After that, dry your hands with a dry towel and moisturize the skin. These things can reduce skin contact with chemicals. The selection of hand sanitizer is very important because it is needed to remove the chemical content but not damage the skin by protecting the oil layer [10]. However, Personal Hygiene and clean production planning needs to be conducted in order to bring out an environmental friendly industry for increasing productivity, increasing efficiency of raw materials and reducing wastes [6].

The results of this study are in line with research conducted by Sarfiah (2017), namely that there is a relationship between personal hygiene and the incidence of irritant contact dermatitis in workers with $p\text{-value} = 0,000$. From the research results obtained correlation test results of 0.610 (strong correlation) which states that personal hygiene has a strong relationship with irritant contact dermatitis. That is because the work environment is not clean and the facilities available are inadequate, so workers do not care about their personal hygiene. The habit of bathing and washing hands and feet is very important because this part of the body is the most frequent direct contact with irritants, whereas poor hand and foot washing habits can worsen the condition of the skin especially those already affected by dermatitis [20].

However, this study is not in line with the study of Garmini (2018) which shows that there is no relationship between personal hygiene and the incidence of irritant contact dermatitis. This is due to the fact that industrial owners have provided hand washing facilities, but not hand washing soap in all places. Workers who have good personal hygiene experience less irritant contact dermatitis compared to workers who have bad personal hygiene [15].

4.2.3. *History of skin disease*

Based on the results of the study it can be seen that workers who have a history of skin disease and experience symptoms of contact dermatitis are as many as 45 workers (80.4%) out of 56 workers, and workers who have no history of skin disease and experience symptoms of contact dermatitis as many as 50 workers (53, 8%) of 93 workers. Based on the statistical test results in table 5.2 it can be seen that the value of $p = 0.001$ ($p < 0.05$) is obtained so that H_0 is rejected meaning that there is a significant relationship between the history of skin diseases and symptoms of contact dermatitis in tofu industry informal workers in Kuningan District.

A history of skin disease increases the susceptibility to dermatitis due to damage to the skin barrier function which causes the skin to have changed. Workers who have previously suffered from occupational dermatitis are more susceptible to occupational contact occupational dermatitis (repeated history). Workers who work in more than one workplace are at risk of experiencing dermatitis in a previous job then carried over to the new workplace [21]. Workers who previously or are suffering from occupational dermatitis are more likely to get occupational dermatitis, because the protective function of the skin has been reduced due to previous skin diseases. The reduced protective functions include loss of layers of skin, damage to the sweat glands and oil glands and changes in skin pH [2].

The results of this study are in line with research conducted by Daulay (2016), it is known that there is a significant relationship between the history of skin diseases and the incidence of contact dermatitis in tofu making workers with a Prevalence Ratio (RP) of 1.9. This shows that workers who have a history of skin disease 1.9 times will experience dermatitis when compared to workers who have no previous skin history [12].

But it is not in line with research conducted by Sarfiah (2017) which shows that there is no history of skin disease with irritant contact dermatitis. This can occur because previously workers who have a history of skin diseases have completely healed either by treatment or not at all [20]

5. Conclusions and suggestions

5.1. *Conclusion*

There is a relationship between the use of PPE and personal determinants which include length of service, duration of contact, personal hygiene and history of skin diseases with symptoms of contact dermatitis in informal workers in the tofu industry in Kuningan District.

5.2. Suggestion

Informal workers in the tofu industry are advised to have awareness in improving personal hygiene and using PPE. Business owners are advised to provide personal protective equipment in sufficient quantities for workers. For local governments to conduct health and safety guidance in the tofu industry in Kuningan Regency.

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