ORIGINAL ARTICLE

COMPARISON OF RISK FACTORS USE PERSONAL PROTECTION EQUIPMENT AND EXPOSURE TO SULPHATE CONTENT WITH IRRITANT CONTACT DERMATITIS IN CAR WASHING OFFICERS IN MALANG CITY

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ABSTRACT

Background: Irritant contact dermatitis (ICD) is an occupational disease that involves non-immunological inflammatory mechanisms of the skin, resulting from a response to exposure to irritants, physical, or biological. ICD disease often occurs in car wash employees who are exposed to laundry soap containing sulfate. Most of the factors that cause ICD are the length of exposure to chemicals or from the workers themselves such as knowledge, use of personal protective equipment, and personal hygiene. The purpose of this study was to determine the effect of using personal protective equipment (PPE) and exposure to sulfate content of car wash soap on the incidence of ICD in car wash employees in the city of Malang with and without a history of skin disease.

Method: The research method uses an analytic observational research type with a cross sectional design. The samples studied were 84 respondents who were car wash employees in the city of Malang, both those who had a history of skin diseases (39 respondents) and those who did not have a history of skin diseases (45 respondents). Data were analyzed using univariate and bivariate tests with SPSS application.

Results: The results of the chi square test showed that there were significant differences in risk factors ($p < 0.05$) on the incidence of ICD.

Conclusion: The conclusion of this study is there is an effect of the use of PPE and exposure to sulfate content on the incidence of ICD in car wash employees in the city of Malang with and without a history of skin diseases.

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INTRODUCTION

Irritant contact dermatitis (ICD) is inflammation of the skin, resulting from a response to exposure to an irritant, physical, or biological substances that come into contact with the skin without being mediated by an immunological respons.[1]ICD is a non-specific response of the skin to direct chemical damage that releases inflammatory mediators, especially epidermal cells. [2]Approximately 80% of individuals with occupational contact dermatitis involve hands and irritant contact dermatitis (ICD). Epidemiological studies in Indonesia showed that 97% of 389 cases of dermatitis were contact dermatitis, of which 66.3% were irritant contact dermatitis and 33.7% were allergic dermatitis. [3] Approximately 80% - 90% of cases of irritant contact dermatitis are caused by exposure to irritants in the form of chemicals and solvents. Inflammation can occur after a single exposure or repeated exposure [7].

Irritant contact dermatitis and allergic contact dermatitis can appear with three morphological patterns: acute, subacute, and chronic phases. The acute-phase reaction in ICD usually reaches its peak within minutes to hours after exposure and then begins to heal or is commonly referred to as the de-crescendo. [2]. ICD will appear after the first exposure to a strong irritant. Subacute and chronic ICD is characterized by hyperkeratosis, fissures, and skin blisters with clear lesion boundaries[4].

The risk factors for ICD consist of two factors, endogenous factors and exogenous factors. Endogenous factors include factors in individuals such as genetics, gender, age, ethnicity, skin type, and a history of atopy.[5] While exogenous factors are the properties of irritant chemicals such as physical state, concentration, amount, polarization, ionization, carrier material, and solubility.[6] The types of irritants that usually cause ICD include animal products, cosmetics, detergents, cosmetics, solvents, tear gas, topical medications, and water and work in a wet environment.[9]

Continuous and repeated use of risky materials can cause ICD. Some examples of materials that can cause ICD include soapy water, cleaners, spirits, chemicals and work related to water (wet). Previous research explained that the duration of contact with chemicals also greatly influences the incidence of ICD because the longer the contact with chemicals will further damage skin cells to the deeper layers of cells and cause complaints to get worse. From the results of research that was conducted on workers who were in contact with one of the chemicals, namely acetic acid, for > 3 hours, they had a risk of inflammation or skin irritation that would cause ICD. [19]

Contact dermatitis accounts for 95% of causes of occupational skin disease, 80% of which is irritant contact dermatitis which is often caused by cumulative exposure to weak irritants such as soap and water. Work related to repeated exposure and types of work related to water, one of which is car wash employees who are directly exposed to car wash soap containing chemicals. Chemicals that are often used as soap ingredients are anionic surfactants, where anionic surfactants have superior solubility and cleaning power, therefore these surfactants are often used as detergents and soaps. [10]

One of the jobs related to repeated exposure and types of work related to water is car wash employees who are directly exposed to car wash soap that contains chemicals. Chemicals often used as soap ingredients are anionic surfactants, where anionic surfactants have superior solubility and cleaning power; therefore, these surfactants are

often used as detergents and soaps. In this regard, sulfate is the oldest anionic surfactant that can produce foam as a suitable wetting agent and the main ingredient in detergents.[10]

Factors obtained from work are the length of exposure to chemicals and the work period or from the workers themselves, such as knowledge, use of personal protective equipment, and personal hygiene. Personal Protective Equipment (PPE) is a device designed as a barrier against the penetration of substances, solid, liquid, or air particles to protect the wearer from injury or the spread of infection or disease. [20]From introduction above, a research was made to explain the comprarison of risk factor use personal protection equipment and exposure to sulphate content with irritant contact dermatitis in car Washing employees.

METHODS

The research method uses an analytic observational research type with a cross-sectional design. The study was conducted by distributing questionnaires to 84 car wash employees in Malang City with a history of skin disease (39 respondents) and without a history of skin disease (45 respondents). The research was carried out based on a permit with the number No.E.5.a/260/KEPK-UMM/XII/2019 from the UMM Health Research Ethics Commission, and each respondent had signed an informed consent.

Data analysis processed using using the Statistical Package for the Social Science (SPSS) 25.0 program. Univariate analysis was carried out to describe the characteristics of each variable presented in the form of a frequency distribution because the research data was categorically scaled. Then Bivariate Analysis using data analysis techniques chi-square and old Ratio (OR) (sig. < 0.05) to assess the strength of the relationship between variables

The sulfate level test was conducted using the spectrophotometric method with 200x and 400x dilutions. The dilution depends on the concentration of soap in each sample where the more concentrated the soap, the more dilution so that the results of the concentration are the same; spectrophotometric analysis was carried out at the Laboratory of Analytical Chemistry, State University of Malang.

RESULTS

This research involves 84 car washing employees in Malang city who had history of skin disease 39 respondents and those who didn't have a history of skin disease 45 respondents. The characteristic respondents was show in Table 1.

Table 1: Characteristic of Respondents

No.	Characteristics	n	%
1.	**ICD**		
	Yes		
	Have skin disease history	20	51,3%
	Didn't have skin disease history	27	60%
	No		
	Have skin disease history	19	48,7%
	Didn't have skin disease history	18	40%
2.	**PPE**		
	Yes		
	Have skin disease history	9	23,1%
	Didn't have skin disease history	19	42,2%
	No		

	Have skin disease history	30	76,9%
	Didn't have skin disease history	26	57,8%
3.	**Sulfate content**		
	<1%		
	Have skin disease history	25	64,1%
	Didn't have skin disease history	23	51,1%
	>2%		
	Have skin disease history	14	35,9%
	Didn't have skin disease history	22	48,9%

Based on table 1 the number of respondents who experience ICD mostly have skin disease history 60%. Number of respondents who not experience ICD mostly didn't have skin disease history 48,7%. The number of respondents who use PPE mostly didn't have skin disease history 42,2%. Number of respondents who not use PPE mostly have skin disease history 48,7%. The number of respondents who use car wahing soap with sulfate content < 1% mostly have skin disease history 64,1%. Number of respondents who use car washing soap with sulfate content > 2% mostly didn't have skin disease history 48,9%.

Table 2: Spectrophotometer test results sulfate content

No.	Sample Code	Sulfate (mg/L)	%
1.	Sample A	98,0224	3,9%
2.	Sample B	53,2979	1%
3.	Sample C	7,2827	0,1%
4.	Sample D	115,0602	4,6%
5.	Sample E	14,0269	0,2%

Table 2 shows the results of the spectrophotometric test for the sulfate content of each sample. Samples A and D were tested using a 400x dilution and obtained the percentage of sulfate content in the sample >1%. Samples B, C, and E were tested using a 200x dilution and obtained the percentage of sulfate content in the sample >1%.

Figure 1: The palms of a car wash employee

Figure 1 shows polymorphic efflorescence (erythema, edema, papules, vesicles, scales, lichenification) and complaints of itching.

Table 3: Relationship between Use of Personal Protective Equipment (PPE) and Incidence of ICD in Employees with No History of Skin Diseases

Based on the results of the chi-square test in table 3, it is obtained sig = 0.007 (sig < 0.05), which concludes that there is a significant relationship between the use of PPE and the incidence of ICD in car wash employees in Malang City who do not have a history of skin disease. The amount of OR obtained is 5,714 with 95% CI (1,551 – 21,058). This means that car wash employees who do not have a history of skin disease and do not wear PPE have 5,714 times more likely to experience ICD than those who use PPE at work. An OR value > 1 can also mean that employees who do not use PPE increase the risk of ICD even though they have no history of skin disease.

Table 4: The Relationship between the Use of Personal Protective Equipment (PPE) with ICD Incidence in Employees with a History of Skin Diseases

Use of Personal Protective Equipment (PPE)	Incidence of ICD						P value	OR (CI 95%)
	ICD		No ICD		Total			
	f	%	f	%	f	%		
Not using PPE	20	74.1%	6	33.3%	26	57.8%	0.007	5.714 (1.551-21.058)
Using PPE	7	25.9%	12	66.7%	19	42.2%		
Total	27	100.0%	18	100.0%	45	100%		

Use of PPE	Incidence of ICD						P value
	ICD		No ICD		Total		
	f	%	f	%	f	%	
Not using PPE	17	85%	13	68.4%	30	76.9%	0.273
Using PPE	3	15%	6	31.6%	9	23.1%	
Total	20	100%	19	100.0%	39	100%	

Based on the results of the chi-square test in table 4, it is obtained sig = 0.273 (sig > 0.05), which concludes that there is no significant relationship between the use of PPE and the incidence of ICD in car wash employees in Malang City who have a history of skin diseases. Although there is no statistically significant relationship, clinically, it can be seen that more employees who use PPE do not have ICD (31.6%) than had ICD (15%).

Table 5: The Relationship between Exposure to Sulfate Content with ICD Incidence in Employees with No History of Skin Diseases

Exposure to Sulfate Content	Incidence of ICD						P value
	ICD		No ICD		Total		
	f	%	F	%	f	%	
<1%	12	44.4%	11	61.1%	23	51.1%	
>2%	15	55.6%	7	38.9%	22	48.9%	0.273
Total	27	100.0%	18	100.0%	45	100%	

Based on the results of the chi-square test in table 5, it was obtained sig = 0.273 (sig > 0.05) which concluded that there was no significant relationship between exposure to sulfate content and the incidence of ICD in car wash employees in Malang City who did not have a history of skin disease. Although there is no statistically significant relationship, it can be seen clinically that employees exposed to sulfate >2% tend to have more ICD and vice versa. These employees exposed to sulfate <1% tend to be more likely not to have ICD.

Table 6 : The Relationship between Exposure to Sulfate Content with ICD Incidence in Employees with a History of Skin Diseases

Exposure to Sulfate Content	Incidence of ICD						P value	OR (CI 95%)
	ICD		No ICD		Total			
	f	%	f	%	f	%		
<1%	9	45%	16	84.2%	25	64.1%		
>2%	11	55%	3	15.8%	14	35.9%	0.011	0.153 (0.034 – 0.698)
Total	20	100.0%	19	100.0%	39	100%		

Based on the results of the chi-square test in table 6, it was obtained sig = 0.011 (sig < 0.05) which concluded that there was a significant relationship between exposure to sulfate content and the incidence of ICD in car wash employees in Malang City who had a history of skin diseases. The OR obtained is 0.153 with 95% CI (0.034 – 0.698). Car wash employees who have a history of skin disease and are exposed to sulfate <1% have 0.153 times more likely to experience ICD than those exposed to sulfate >2%

DISCUSSION

This study showed that out of 84 respondents, there were 45 respondents who had no history of skin diseases and there were 39 who had a history of skin diseases. Of the 45 respondents who did not have a history of skin diseases employees who experienced the occurrence of ICD, 27 respondents, the remaining 18 people were not affected by ICD. For those who had a history of

skin diseases from 39 car wash employees, the ICD incident was 20 respondents and 19 people were not affected by ICD.

Research by Zania et al (2018) which concluded that there was no significant relationship between a history of skin disease and the incidence of ICD. The results of observations made in Latambaga District

Kolaka Regency said that this could happen because previously, employees who had a history of skin diseases had completely recovered either using treatment or not at all. [11] However, these results are not following the theory presented by Lurati (2015) which states that workers with a history of skin diseases will be at higher risk of developing ICD because workers with a history of skin disorders have skin disorders where the epidermal barrier in the skin is disrupted. , there is increased transepidermal water loss and increased permeability of allergens and irritants. [12]

The results of this study were seen in several car wash workers where the condition of the hands showed an efflorescence in the form of polymorphism, namely erythema, edema, papules, vesicles, scales, lichenification (figure 1). This condition is by Nedorost (2019) statement that skin efflorescence in ICD is characterized by scales, mild erythema, blisters, or erosions limited to the manus and fingers; this usually occurs in someone who works in wet work. [14]

Based on table 3 concludes that there is a significant relationship between the use of PPE and the incidence of ICD in car wash employees in Malang City who do not have a history of skin disease. The amount of OR obtained is 5,714 with 95% CI (1,551 – 21,058). This means that car wash employees who do not have a history of skin disease and do not wear PPE have 5,714 times more likely to experience ICD than those who use PPE at work. Research by Chafidz et al (2018) which states that there is a relationship between the use of PPE with the incidence of contact dermatitis on tofu workers. This happens because of the skin about cooking process workers in the filtering section is in direct contact with the tofu coagulation solution causing each employee to have a high risk of contact dermatitis because they do not use PPE. [15]

But the results of this study contradict the results of research from Prakoso, 2018 which states that the use of PPE is not associated with the incidence of irritant contact dermatitis in motorized vehicle steam workers in East Ciputat District. One of the factors that contributed to this study when it was associated with age and work experience was that younger workers had less experience than older workers, so older workers were more experienced and knew the irritants used and paid more attention to safety and health. [16]

Table 4 showed there is no relationship between the use of Personal Protective Equipment (PPE) with the incidence of ICD in employees who have a history of skin diseases; this result is supported by Lurati (2015)**,** factors that cause ICD risk, such as a history of previous skin diseases that cause workers with a history of skin diseases will be at higher risk of developing ICD because of the disruption of the epidermal barrier in the skin, increased transepidermal water loss and increased permeability of allergens and irritants. Another factor is the age and work experience of the employee, where the longer the employee's work experience, the more experienced the employee will be and know the irritant materials used and pay more attention to their safety and health.[12]

Table 5 showed there is no relationship between exposure to sulfate and the incidence of ICD in employees who do not have a history of skin

disease, but this result is not by the theory; we know that sulfate is the oldest anionic surfactant that can produce foam, as a suitable wetting agent and as the main ingredient is detergent. The use of soap containing sulfate should not be used every day with long exposure because it has a negative effect on cosmetics, such as skin irritation In contact with the skin for a long time, it will be safe if the concentration is < 1%.[17,18]

Table 6 shows there is relationship between exposure to sulfate and the incidence of ICD in employees with a history of skin disease. These results are consistent with the theory that irritants are physical and chemical agents that can cause cellular damage if they contact the skin for a long time and in high concentrations. Detergents, surfactants, disinfectants, and antiseptics are the substances that most often cause occupational dermatitis, both irritant contact dermatitis (ICD) as much as 42% and allergic contact dermatitis 26.3%. [39]

CONCLUSION

The conclusion obtained is that the use of PPE is known to reduce the intensity of sulfate exposure to the incidence of ICD in car wash employees in the city of Malang with and without a history of skin disease.

CONFLICT OF INTEREST

The author started there is no conflict of interest.

REFERENCES

1. PERDOSKI. Panduan Praktik Klinis bagi Dokter Spesialis Kulit dan Kelamin. Jakarta: Indonesia; 2017. 207–209 p.
2. Litchman G, Nair P, Atwater A. Contact Dermatitis [Internet]. StatPearls. 2020 [cited 2021 Jan 16]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459230/#_NBK459230_pubdet_
3. PERDOSKI. Majalah Ilmiah Dermato-Venerologica Indonesian. Majalah Ilmiah Dermato-Venerologica Indonesia. 2019;
4. Novak-Bilić G, Vučić M, Japundžić I, Meštrović-štefekov J, Stanić-Duktaj S, Lugović-Mihić L. Irritant and allergic contact dermatitis – skin lesion characteristics. Acta Clin Croat. 2018;57(4).
5. Djuanda A, Suriadiredja A, Sudharmono A, Wiryadi B, Kurniati D, Daili E. Ilmu Penyakit Kulit dan Kelamin. Jakarta: Indonesia: Fakultas Kedokteran Universitas Indonesia; 2016.
6. Hudyono J. Dermatitis Akibat Kerja. Majalah Kedokteran Indonesia; 2002.
7. Nofiyanti A. L., D. I. Anggraini, and A. Miftah, "Dermatitis Kontak Iritan Kronis pada Pegawai Laundry," J. Medula Unila, vol. 7, no. 3, pp. 1–5, 2017.
8. Wijaya I, Darmada I, Rusyati L. Edukasi dan Penatalaksanaan Dermatitis Kontak Iritan Kronis di RSUP Sanglah Denpasar Bali Tahun 2014/2015. E-Journal Medika. 2016;5(8).
9. Sonia NB, Pembroke N, Luz F. Irritant Contact Dermatitis. Clin Rev Allergy Immunol. 2019;
10. Okasaka M, Kubota K, Yamasaki E, Yang J, Takata S. Evaluation of anionic surfactants effects on the skin barrier function based on skin permeability. Pharm Dev Technol. 2019;24(1).
11. Zania E, Junaid, Ainurafiq. Faktor-Faktor yang Berhubungan dengan Kejadian Dermatitis Kontak pada Nelayan di Kelurahan Induha Kecamatan Latambaga

Kabupaten Kolaka Tahun 2017. Jurnal Ilmiah Mahasiswa Kesehatan Masyarakat. 2018;3(3).

12. Lurati AR. Occupational risk assessment and irritant contact dermatitis. Workplace Health Saf. 2015;63(2).
13. Wharf C. Background review for sodium lauryl sulfate used as an excipient. Committee for Human Medicinal Products. 2015;44(July).
14. Nedorost ST. Irritant Dermatitis. In: Fitzpatrick's Dermatology. 7th ed. United States: McGrawHill; 2019.
15. Chafidz M, Dwiyanti E. Hubungan Lama Kontak, Jenis Pekerjaan dan Penggunaan APD dengan Kejadian Dermatitis Kontak pada Pekerja Tahu, Kediri. The Indonesian Journal of Occupational Safety and Health. 2018 Mar 22;6(2):156.
16. Prakoso HD. Hubungan lama kerja dengan dermatitis kontak pada karyawan cuci mobil. SKRIPSI-2017. 2018.
17. Azarmi, R., Ashjaran, A., 2015, Review article: Type and application of some common surfactants, J. Chem Pharm Res., Vol.7(2), 632-40
18. Cline A, Uwakwe LN, McMichael AJ. No sulfates, no parabens, and the "no-poo" method: A new patient perspective on common shampoo ingredients. Cutis. 2018;101(1).
19. Pradaningrum S, Lestantyo D, Jayanti S, 2018, Hubungan Personal Hygine, Lama Kontak, dan Masa Kerja Dengan Gejala Dermatitis Kontak Iritan Pada Pengrajin Tahu Mrican Semarang, Jurnal Kesehatan Masyarakat, Volume 6, No.4 ISSN: 2356-3346.
20. KEMENKES RI, 2020, Petunjuk Teknis Alat Pelindung Diri (APD) dalam Menghadapi Wabah Covid-19.
21. Lodde B, Paul M, Roguedas-Contios AM, Eniafe-Eveillard MO, Misery L, Dewitte JD, 2012, Occupational dermatitis in workers exposed to detergents, disinfectants, and antiseptics. Skinmed 10(3):144–150