J Prima Med Sains (2024) 6(1):29-36
doi.org/10.34012/jpms.v6i1.4970

ORIGINAL ARTICLE

Associated risk factors with incidence of irritant contact dermatitis among the cleaning worker in Santa Elisabeth Medan Hospital

Joice Sonya Gani Panjaitan[1*], Donal Nababan[2], Frida Lina Tarigan[2], Wisnu Hidayat[2], Mido Ester J. Sitorus[2]

Abstract

Occupational irritant contact dermatitis (ICD) accounts for approximately 20% of work-related skin diseases, with 80% of cases affecting the hands. Cleaning staff are particularly susceptible to ICD. This study aimed to identify risk factors for ICD among cleaning staff at Santa Elisabeth Medan Hospital. A cross-sectional observational study was conducted involving 60 cleaning staff (total population) at the hospital in October-November 2023. The study investigated three groups of factors: host factors (age, gender, work duration, work stress, and personal protective equipment (PPE) use), agent factors (type of cleaning solution, duration and frequency of use), and environmental factors (perceived organizational support). The results showed that 8 of 60 cleaning staff (13.3%) had ICD. Statistical analysis revealed no significant association between ICD and host, agent, or environmental factors among cleaning staff ($p > 0.05$). Host, agent, and environmental factors were not found to be significant risk factors for OICD among cleaning workers at Santa Elisabeth Medan Hospital.

Keywords: irritant contact dermatitis, cleaning worker, host, agent, environment

Introduction

Contact dermatitis is a term that refers to the condition of dermatitis caused by chemical substances or substances that stick to the skin. Meanwhile, dermatitis itself refers to inflammation of the skin tissue, including the epidermis and dermis, in response to exogenous and endogenous influences that manifest as efflorescence or polymorphic rashes such as erythema, papules, vesicles, squamous, or lichenification) accompanied by itching. There are two types of contact dermatitis: irritant and allergic. Irritant contact dermatitis, which occurs directly without preceding recognition or sensitization, is a non-immunological inflammatory skin reaction to skin damage. Conversely, allergic contact dermatitis occurs through a process of sensitization to an allergenic material or substance.[1,2] Irritant contact dermatitis can occur in people of all ages, races, and sexes. Most cases of irritant contact dermatitis are work-related (occupational irritant contact dermatitis). However, the incidence of irritant contact dermatitis is still underreported because patients who experience irritant contact dermatitis tend not to seek treatment because they do not complain of anything or, in some cases, show a mild clinical picture.[3]

Occupational irritant contact dermatitis (OIC) is an occupational skin disease. Approximately 20% of occupational skin disease cases are occupational irritant contact dermatitis cases, and approximately 80% of these cases have a predilection for the skin of the hands. Irritant contact dermatitis is a more common type of dermatitis experienced by workers than allergic contact dermatitis. The incidence of irritant contact dermatitis can reach 60-80% compared to allergic contact dermatitis, which ranges from 20-40%.[4,5]

Affiliation
[1]Master Programme in Public Health, Universitas Sari Mutiara, Medan, Indonesia
[2]Directorate of Postgraduate Program, Universitas Sari Mutiara, Medan, Indonesia

Correspondence
joicesonyagani@gmail.com

Although the incidence of occupational irritant contact dermatitis is decreasing globally, some patients do not always show typical or disturbing symptoms, leading to unclear reporting rates.[2,6] Occupational skin disease is a health problem that can occur in workers and is caused by work processes, work environment, and worker health behavior.[7] Occupational groups at risk of occupational contact dermatitis include salon workers, metal workers, food industry workers, janitors, and health workers due to frequent exposure to irritants and allergens in the workplace without using adequate PPE and poor personal hygiene.[5]

Cleaning workers are an occupational group at risk of occupational skin diseases, especially irritant contact dermatitis. This is due to the work of cleaners who are exposed to basics and cleaning agents at a high frequency. Behroozy & Keegel[5] reported that more than 45% of occupational diseases are occupational skin diseases, and approximately 80% are related to occupational skin diseases with clinical manifestations, such as dry skin, redness, itching, peeling skin, scaling, cracked skin, water-filled bumps, and pain. Furthermore, Behroozy & Keegel[5] reported that 50-80% of are cases of occupational contact dermatitis. In addition, Douwes *et al.*[8] also reported that 14.8% of occupational irritant contact dermatitis cases and 9.4% of occupational irritant contact dermatitis cases experienced by cleaners from various hospitals in New Zealand. Occupational irritant contact dermatitis in cleaners at several hospitals in Indonesia has been reported in several previous studies. Saftarina et al.[9] reported that about 42 of 102 cleaners at Abdoel Moeloek General Hospital experienced irritant contact dermatitis related to their work. Paendong et al. [10] reported that the incidence of occupational irritant contact dermatitis in janitors at the Prof. Dr. R. D. Kandou Manado Teaching General Hospital was 20.7% of 135 respondents and the majority of janitors who experienced occupational contact dermatitis were women (60.7%) from the age group 36-45 years (39.3%) with the last education of junior high school (57.1%) who had worked between 1-5 years (46.4%).

Patel & Nixon[11] reported that there are several endogenous and exogenous factors that can cause irritant contact dermatitis. Exogenous factors include skin irritants and physical, mechanical, and environmental factors, while endogenous factors include age, gender, race, atopic history, and genetic factors. Both endogenous and exogenous factors play a key role in the pathogenesis of irritant contact dermatitis by causing an inflammatory reaction due to irritation of the damaged skin barrier. When this damage occurs, the epidermal cells in the skin are damaged, destroying the epidermal barrier. This leads to increased permeability of the skin to irritants and aggravates the inflammatory process that has already occurred. Therefore, both endogenous and exogenous factors can influence the occurrence of irritant contact dermatitis in hospital cleaners, considering that cleaners tend to be exposed to irritants, particularly cleaning fluids.[11,12] Saftarina et al.[9] reported that there was a relationship between the habit of using PPE and the occurrence of occupational contact dermatitis in janitors at the Regional General Hospital Dr. H Abdul Moeloek, Lampung province. Another study conducted by Mekonnen et al.[13] on health workers who also work in hospitals, in addition to janitors, has several risk factors that can cause occupational irritant contact dermatitis, including frequency of hand washing, pairs of gloves used per day, personal allergy history, and lack of health and safety training.

Level of skin hydration constitutes an intrinsic factor in the etiopathogenesis of irritant contact dermatitis. As articulated by Purnamawati et al.[14], the judicious application of moisturizers is crucial for preserving epidermal barrier integrity and mitigating transepidermal water loss. The moisturized cutaneous milieu offers several salutary effects, encompassing anti-inflammatory, antipruritic, antimitotic, and wound-healing properties. Consequently, the prophylactic utilization of personal protective equipment (PPE) emerges as a paramount strategy to safeguard the epidermis from deleterious exposures that could compromise its barrier function. Given these considerations, investigation into the correlation between PPE adherence among cleaning worker and the incidence of occupational irritant contact dermatitis is warranted.

Compromised epidermal integrity resulting from exposure to hazardous substances can precipitate diminished cutaneous hydration. Systemic water homeostasis also significantly influences dermal hydration levels. As elucidated by Carretero-Krug et al.. Carretero-Krug et al.[15] the human body exhibits a requisite equilibrium of hydration, manifested in the balanced regulation of water and electrolytes. This equilibrium is maintained through the dynamic interplay of fluid intake and excretion via various

physiological pathways. Disruptions to this delicate balance can engender varying degrees of dehydration, from mild to chronic, with subsequent implications for both physical and cognitive health. Acute manifestations include cognitive deficits, impaired concentration, and visuomotor disturbances, while more severe cases can compromise cardiac and renal function. Given the skin's pivotal role in water balance, the present study seeks to investigate the potential correlation between compromised skin barrier function, as exemplified by irritant contact dermatitis, and the mental health status of hospital cleaning staff..

A preliminary survey was conducted at the research site, Elisabeth Hospital Medan, to assess the study's feasibility. The survey revealed a total of 50 cleaning worker employed at the hospital, with a gender distribution of 40 females and 10 males. The hospital utilizes two primary cleaning agents: Lysol disinfectant and synthetic detergent. Lysol disinfectant is employed for cleaning high-risk areas, while synthetic detergent is used for cleaning dishes, floors, and windows. Lysol disinfectant is diluted to the appropriate concentration based on specific cleaning requirements. Motivated by the aforementioned background information, this study aims to investigate the various risk factors associated with occupational contact dermatitis among cleaning worker at Santa Elisabeth Medan Hospital.

Method

The present study employed a cross-sectional observational design to concurrently examine the influence of a constellation of independent variables on a single dependent variable. Independent variables, encompassing host, agent, and environmental factors, were investigated for their association with the occurrence of irritant contact dermatitis. Host factors included demographic characteristics (age and sex), occupational exposure (length of work), psychosocial factors (work stress), and personal protective equipment usage. Agent factors pertained to the properties of cleaning solutions, including type, duration, and frequency of use. Environmental factors were assessed through the lens of perceived organizational support. The outcome variable of interest was the incidence of irritant contact dermatitis. The study was designed for implementation at Santa Elisabeth Medan Hospital during the October to November 2023 period. The entire cleaning worker of the hospital constituted the target population, with all cleaning worker comprising the accessible population, totaling approximately 60 individuals. A saturated sampling technique was employed, whereby the entirety of the accessible population was included in the research sample.

Primary data were acquired for this study through an online questionnaire disseminated via Google Forms to the entire population of cleaning workers at Elisabeth Hospital Medan, as determined by the pre-established sample size and sampling technique. Prior to questionnaire distribution, informed written consent was obtained from all potential participants, and detailed instructions for completing the online survey were provided. The research instrument comprised a questionnaire structured into four sections: participant demographics, Perceived Stress Scale (PSS) 10, Perceived Organizational Support (POS), Personal Protective Equipment (PPE) utilization, and Chemical Cumulative Index. The PSS-10, a standardized measure, assessed participant stress levels through ten statements rated on a Likert scale of 0 to 4. To enhance scale reliability, items 4, 5, 7, and 8 were reverse-coded. Total scores were categorized as either 'no stress' (0-20) or 'stress' (21-40). The POS instrument evaluated participants' perceptions of organizational support using an eight-item Likert scale ranging from 0 to 6. Similar to the PSS-10, reverse scoring was applied to items 2, 3, 5, and 7. Total scores were dichotomized into 'good' support (>32) and 'sufficiently good' support (≤32). PPE utilization was measured by assessing the frequency of use for masks, head protectors, gloves, and safety shoes on a Likert scale of 1 to 5. The Chemical Cumulative Index was calculated based on the type, frequency, and duration of cleaning product use. Unlike other variables, this index was treated as a continuous numerical variable.

Descriptive statistics were employed to summarize the primarily categorical data, including age, gender, PPE use, job stress, perceived organizational support, cleaning product type, and incidence of irritant contact dermatitis. The relationship between these categorical variables and the occurrence of irritant contact dermatitis was examined using the chi-square test. To quantify the risk associated with various factors, logistic regression analysis was conducted, generating both unadjusted and adjusted odds ratios. Given its continuous nature, the Chemical Cumulative Index was represented as median (minimum-

maximum) and compared between groups with different irritant contact dermatitis status using the Mann-Whitney test.

Results

An analysis of the tabulated data reveals that 8 out of 60 individuals, representing 13.3%, were diagnosed with irritant contact dermatitis. Conversely, the remaining 52 individuals, accounting for 86.7%, did not exhibit signs of irritant contact dermatitis. The study additionally explored various contributing factors, including host, agent, and environmental factors.

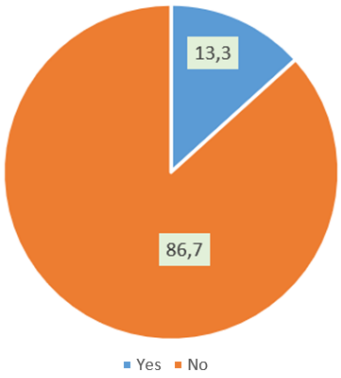

Figure 1. Incidence rate of contact dermatitis in cleaning worker

Most of the cleaning workers were young adults (26-35 years old), as many as 24 people (40.0%), while the least came from the early elderly age group (46-55 years old), which was only 5 people (8.3%) (see Table 1). In terms of gender, cleaning workers are dominated by men, as many as 48 people (80.0%), while the remaining 12 people are women (20.0%). The length of employment tends to be 7 years, with the shortest being around 1 month and the longest being around 29 years. In addition, the majority of cleaning workers used PPE properly, with 58 people (96.7%). Finally, regarding work stress, the majority of cleaning workers didn't experience stress, namely 46 people (76.7%).

Table 1. Characteristics of cleaning worker based on host, agent, and environment factors

Characteristics		n	%	Median (Min-Max)
Host factor	Age			
	Late adolescence (17-25 years)	23	38.3	
	Early adult (26-35 years)	24	40.0	
	Late adults (36-45 years)	8	13.3	
	Early elderly (46-55 years)	5	8.3	
	Sex			
	Male	12	20.0	
	Female	48	80.0	
	Length of service (years)			7.00 (0.08-29.00)
	Usage of PPE			
	Fairly good	2	3.3	
	Good	58	96.7	
	Work stress			
	No	46	76.7	
	Yes	14	23.3	
Agent factor	Type of cleaning product			
	Floor cleaner	60	100.0	
	High risk area cleaner	15	25.0	
	Glass cleaner	60	100.0	
	Cutlery cleaner	60	100.0	
	Length of cleaning product use (months)			
	Floor cleaner			15 (1-348)
	High risk area cleaner			0 (0-84)
	Glass cleaner			15 (1-348)
	Cutlery cleaner			15 (1-348)
	Length of cleaning product use (months)			
	Floor cleaner			2 (1-3)
	High risk area cleaner			0 (0-3)
	Glass cleaner			1 (1-2)
	Cutlery cleaner			1 (1-3)
	Chemical Index			
	Floor cleaner			900 (60-20,880)
	High risk area cleaner			0 (0-7,560)
	Glass cleaner			450 (30-10,440)
	Cutlery cleaner			720 (30-10,440)
	Chemical Cumulative Index (CCI)			3,240 (120-41,760)
Environment factor	Perceived organization support			
	Good	21	35.0	
	Fairly good	39	65.0	

Four types of cleaning products are commonly used by cleaners: floor, glass, cutlery, and high-risk area cleaners. All the cleaners used floors, glass, and cutlery cleaners. Only 45 people used high-risk area

cleansers. Meanwhile, to measure how often these products are used, the exposure index to cleaning products is assessed through the chemical index of each cleaning product, and then the chemical index values of each cleaning product are accumulated to obtain the chemical cumulative index value. The trend of the highest chemical index value was found in floor cleaning products which amounted to 1,170 (60-70,560), followed by cutlery cleaning products of 720 (30-35,280), glass cleaning products of 585 (30-35,280), and the lowest was the chemical index in high-risk area cleaning products which was 0 (0-7,560). Furthermore, these chemical index values were accumulated into a chemical cumulative index value with a median value of 3,240, with the lowest (minimum) value of 120 and the highest (maximum) value of 141,120. Most cleaning worker have good perceived organization support, namely 39 people (65%) and the remaining 21 people (35%) have a fairly good perception of organizational support.

Table 3. Association of host factors with the incidence of irritant contact dermatitis among cleaning workers

Host factor	Irritant Contact Dermatitis n (%)		p	OR (95%CI)	
	Yes	No		Unadjusted	Adjusted
Age					
Late adolescent- Early adult	8 (13.3)	39 (65.0)	0.110	NA	NA
Late adult- Early elderly	0 (0)	13 (21.7)			
Sex					
Male	2 (3.3)	10 (16.7)	0,704	0.714 (0.125-4.080)	0.351 (0.025-5.022)
Female	6 (10.0)	2 (3.3)			
Length of service					
≤ Median	6 (10.0)	26 (43.3)	0.264	0.333 (0.061-1.807)	1.148 (0.140-9.414)
> Median	2 (3.3)	26 (43.4)			
Usage of PPE					
Fairly good	7 (11.7)	51 (85.0)	0.251	0.137 (0.008-2.450)	0.181 (0.007-4.628)
Good	1 (1.7)	1 (1.7)			
Work stress					
No	8 (13.3)	38 (63.3)	0.094	NA	NA
Yes	0 (0)	14 (23.3)			

NA: Not Available; OR: Odds ratio

Based on the data in the table 3, there was no significant relationship between individual factors (age, sex, length of work, use of PPE, and work stress) and the incidence of irritant contact dermatitis in janitors. This is evidenced by the p-value obtained from the chi-square test, which is higher than 0.05. In addition, the analysis of individual factors on the incidence of irritant contact dermatitis also showed that the upper limit value of the Odds Ratio (OR) was greater than 1 and the lower limit value of the OR was smaller than 1. This finding further strengthens the conclusion that there is no relationship between individual factors and the incidence of irritant contact dermatitis.

Table 4. Association between type of cleaning product and incidence of irritant contact dermatitis among cleaning workers

Type of cleaning product	Irritant Contact Dermatitis n (%)		p	OR (95%CI)	
	Yes	No		Unadjusted	Adjusted
Floor cleaner	8 (13.3)	52 (86.7)	NA	NA	NA
High risk area cleaner	3 (5.0)	12 (20.0)	0.380	2 (0.416-9.613)	1.521 (0.184-12.599)
Glass cleaner	8 (13.3)	52 (86.7)	NA	NA	NA
Cutlery cleaner	8 (13.3)	52 (86.7)	NA	NA	NA

All cleaners always use floor, glass and cutlery cleaners at work. This made it impossible to analyze the relationship between the use of floor, glass and cutlery cleaning products and irritant contact dermatitis in cleaning staff. Statistical analysis could only be performed on certain types of cleaning products, namely high-risk area cleaners. The results of the analysis showed no association between the use of high-risk area cleaning products and irritant contact dermatitis in cleaning staff ($p > 0.05$) (see table 4).

In addition to the type of cleaning product, this study also examined the effect of the length and frequency of cleaning product use, described by the 'chemical index' value, on irritant contact dermatitis in cleaning staff. Statistical analysis for the relationship between the 'chemical index' of each cleaning product and irritant contact dermatitis was performed using the Mann-Whitney test. This is because the 'chemical index' value of each cleaning product has a ratio measurement scale with non-normal data

distribution. The analysis of each cleaning product's 'chemical index' and 'chemical cumulative index' against irritant contact dermatitis can be seen in the following table.

Table 5. Association between the type of cleaning product and the incidence of irritant contact dermatitis in cleaning workers

Type of cleaning product	*Chemical Index*, Median (Min-Max)		p
	ICD	No ICD	
Floor cleaner	720 (720-5,040)	1,440 (60-70,560)	0.818
High risk area cleaner	0 (0-3,240)	0 (0-7,560)	0.693
Glass cleaner	360 (360-2,520)	720 (30-35,280)	0.330
Cutlery cleaner	360 (360-2,520)	720 (30-35,280)	0.375
Chemical Cumulative Index	3,420 (120-141,120)	1,800 (1,440-10,080)	0.777

There was no significant difference in chemical index values between floor, high-risk area, glass, and cutlery cleaning products in the group of cleaners with and without irritant contact dermatitis ($p > 0.05$). Similar findings were also seen in the chemical cumulative index of all cleaning products. There was no significant difference between the chemical cumulative index values in the group of cleaning staff who experienced and did not experience irritant contact dermatitis. The analysis did not reveal a statistically significant association between perceived organizational support and the occurrence of irritant contact dermatitis in cleaning workers ($p > 0.05$).

Table 6. Association between perceived organization support with the incidence of irritant contact dermatitis among cleaning workers

Perceived organization support	Irritant Contact Dermatitis n (%)		p	OR (95%CI)	
	Yes	No		Unadjusted	Adjusted
Good	3 (5.0)	18 (30.0)	0.873	1.133 (0.243-5.293)	0.910 (0.153-5.413)
Fairly good	5 (8.3)	34 (56.7)			

Discussion

This study was conducted at Elisabeth Hospital Medan, a fully accredited private general hospital located in Medan City. Founded in 1929 by the Congregation of Franciscan Sisters of Elisabeth (SFE) in the Netherlands, the hospital has developed into a modern comprehensive health care center. The hospital provides health services supported by specialist and sub-specialist doctors and adequate medical facilities. The health services provided included inpatient and outpatient care. In this study, the prevalence of irritant contact dermatitis among the cleaning workers was 13.3%. Recent studies indicate that irritant contact dermatitis (ICD) is prevalent among hospital cleaning workers and healthcare professionals. The prevalence of ICD in hospital cleaning staff ranges from 10.6% to 21.6%.[16,17] In a study in Manado, the prevalence of irritant contact dermatitis in cleaning service workers was 20.7%.[10]

In this research, the influence of host factors on the incidence of irritant contact dermatitis among cleaning staff was not statistically significant. The factors analyzed comprised age (0.110), sex (0.704), length of service (0.264), use of personal protective equipment (0.251), and work-related stress (0.094). While some studies found no significant relationship between host factors like age, sex, length of service, use of personal protective equipment (PPE), and work-related stress, others identified significant associations. Type of work, PPE use, and atopy history were found to be significantly related to ICD.[18] Factors such as contact with chemicals, exposure duration, age, and gender were also associated with ICD incidence.[19] Female workers showed a higher prevalence of occupational contact dermatitis.[16] Low skin hydration levels were observed in cleaning staff with ICD.[20] These findings highlight the complex nature of ICD risk factors among cleaning workers and emphasize the need for preventive measures. There are several host factors that may theoretically be influential, but were not examined in this study, including genetic factors, race, other additional occupations, history of both systemic and skin diseases that have the potential to affect the course of the disease, as well as other occupations that are part-time jobs of cleaning workers.

Agent factors in the form of cleaning products include the type of cleaning product, frequency, and duration of use of cleaning products, which do not affect the incidence of contact dermatitis in janitors. However, in this study, the description of the frequency and duration of use of cleaning products is calculated as a chemical index, which is then accumulated into a chemical cumulative index. This approach

has not been found in previous studies, which are still limited to categorizing the use of cleaning products into the types of cleaning products used. Chairunnisa et al.[20] reported that the frequency of hand washing with soap per day, the frequency and duration of contact with toilet and floor cleaning products per day and the use of personal protective equipment (PPE) affect the incidence of irritant contact dermatitis in cleaning worker. Alluhayyan et al.[21] reported that hand sanitizers were the substances most involved in worsening skin changes. Cleaning worker who are frequently exposed to hand, toilet and floor sanitizers are more at risk of contact dermatitis. However, compliance in carrying out the SOP (Standard Operating Procedure) that has been made by the hospital can minimize this risk.

The results also showed no significant association between POS and irritant contact dermatitis. Research analyzing POS as a risk factor remains limited. Previous studies have generally focused on the work atmosphere, which includes interpersonal interactions, workplace appropriateness, and availability of accommodation. Janitors' perception of hospital support did not significantly affect the incidence of irritant contact dermatitis in this study, and the level of job satisfaction did not affect the incidence of occupational skin diseases. However, there are environmental factors that were not evaluated in this study, including room temperature (low air humidity and cold temperatures reduce the composition of water in the stratum corneum, which makes the skin more permeable to chemicals), and mechanical factors that can be in the form of pressure, friction, or abrasions. Park et al.[22] reported that there was no significant relationship between the work environment, such as upper and client workplaces, and accommodation on the incidence of occupational skin diseases among workers in Korea, which was analyzed using the 4th Korean Working Condition Survey data. Another study conducted by Mekonnen et al.[13] also reported that the level of job satisfaction did not affect the occurrence of occupational contact dermatitis in health workers in Gondar City, Northwest Ethiopia.

Conclusion

Overall, it can be concluded that the incidence of contact dermatitis among cleaning worker was 13.3%. Further analysis revealed that neither host, agent, nor environmental factors significantly influenced the occurrence of occupational irritant contact dermatitis among cleaning worker ($p > 0.05$). Further analysis is needed to analyze and explore other factors that also have the potential to influence the occurrence of irritant contact dermatitis from various aspects, such as genetics, race, other side jobs, and history of other skin diseases.

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