

Factors Related to Contact Dermatitis in Metal Industrial Workers 2022

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ABSTRACT

Introduction: The metal industry plays an essential role in rapid economic growth. The growth is straight with the worker increment and high occupational disease risk. Various materials, especially in the metal industry, can initiate contact dermatitis in the workplace. Skin is the organ that exposes frequently, and skin disease is the most common disease among occupational dermatitis. Allergens and irritants exposure contribute to contact dermatitis. In Indonesia, occupational skin diseases are 97%, and Irritant Contact Dermatitis (ICD) is the most case, around 66.3%. This study aims to describe the influencing factors of contact dermatitis in metal industries workers. **Methods:** The study is a literature review using the electronic database search, namely Google Scholar, Research Gate and Garuda. The keywords occupational contact dermatitis and metal contact dermatitis are applied. The inclusion criteria are online databases from 2017 to 2022, completed articles, relevant titles and abstracts. Exclusion criteria include not completed articles, not relevant titles and abstracts. **Results:** The twelve articles use the same method, namely cross-sectional design. The questionnaire, observation, and interview were applied for the data collection method. This literature review presents factors influencing contact dermatitis: work duration, contact duration, wearing personal protective equipment (PPE), and personal hygiene. The articles reviewed collection are obtained through descriptive tests and analytical. **Conclusion:** As the review result that there are affected factors to contact dermatitis: contact duration, frequency duration, PPE usage, and personal hygiene. PPE is the dominant influencing factor to metal contact dermatitis.

Keywords: literature review, metal industry, occupational contact dermatitis

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INTRODUCTION

For a decade, the metal industry played a national economic growth. In 2017 the Indonesian ministry of industry stated that the metal industry had the highest growth, around 12.45% (Ministry of Industry, 2018). The growth in industrial development is aligned with the increased number of workers and is accompanied by a reasonably considerable risk of occupational diseases. Occupational contact dermatitis (OCD) is one of the risks caused by metal contact.

Occupational contact dermatitis is one of the skin diseases triggered by various materials in work environments, such as material exposure to the body. Exposure enters the body through inhalation, ingestion, mucosa membrane absorption, and skin. Skin is the most frequently exposed organ since it is

the outermost and widest part of the body. Hence, skin is one of the toxic substances' entrances.

Occupational contact dermatitis is the second most diseased next to musculoskeletal, 22% of all occupational disease incidents. It shares half of the total occupational diseases, around 80% non-allergic or irritant and about 20% allergic. In Indonesia, the case reached 97% of 389 total occupational dermatitis cases which 66,3% is irritant contact dermatitis (ICD) and 33.7% is allergic contact dermatitis (ACD) (Budianti, Widyasari, and Miranda, 2020).

In 2019, Britannia statistics recorded around 1016 new cases with occupational dermatitis. 876 workers (86%) are contact dermatitis, 22 workers (2%) are non-cancer dermatitis, and 121 workers (12%) are dermatitis cancer. 58% of 876 workers identified as contact dermatitis are female, and 42% are male. In 2020, around 334 diagnoses as new cases, with 293 workers being contact dermatitis (Health and Safety Executive, 2021).

Irritant contact dermatitis (ICD) is mostly found in wet worker types, such as food industry, metal, hairstyles, paramedic, and stone stacker. All those workers type often work with wet hands.

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There are two kinds of dermatitis contact, allergic dermatitis contact (ACD) and irritant contact dermatitis (ICD). Allergic contact dermatitis (ACD) is allergic to the specific immune system, while the nonimmunologic reaction instigates irritant contact dermatitis (ICD). Exposure to allergens and irritants contributes to contact dermatitis. In addition, individuals and environments have a role and contribution to contact dermatitis. Humidity, temperature, friction, and occlusion are among the environmental factors. Both bring out the cell-mediated or slow type (Hypersensitivities' type IV) (Sularsito and Soebaryo, 2017). Contact dermatitis diagnoses are itching, burning, redness, crusting, vesicles, and papulovesicular.

Skin disorders such as irritant contact dermatitis can result in physical or chemical cell damage. Irritant material will enter the skin by destroying horn cells, keratin denaturation, removing horn cells fat layers, and weakening the water-binding power to the skin. In general, irritant materials will damage the keratinocyte fat membrane, penetrate the cells membrane, and destroy the lysosome and mitochondria. Edema, erythema, fever, and soreness will arise when the cell is damaged. Furthermore, weak irritant contact and contact frequency will damage the stratum corneum and easily damage the cells below.

In occupation contact dermatitis (OCD), the skin condition can impact skin health, especially not treated skin disease. Skin disease influences public health: skin disease itself, which commonly happens in the community, lousy prognosis due to untreated skin diseases, and social-economic. It will affect life quality and family. Furthermore, it will cause secondary effects, such as emotional, health, social and financial (Higaki *et al.*, 2017).

The research for metal coating industry workers in CV. M and CV. N Desa Burung Banjar found that age, working time, previous history of skin disease, and personal hygiene correlate the contact dermatitis (Alvira and Budi, 2020).

Endogen and exogen are two influence factors to contact dermatitis. Endogen includes age, race, sex, and atopy history. In comparison, exogen includes irritant type, direct contact with irritant material, environment, etc. Workers with an atopy history will easily affect irritant contact dermatitis (ICD) twice compared to workers without an atopy history (Nakajima *et al.*, 2014).

Dermatitis analysis to the metal worker in Sidoarjo has described the strong correlation between age, work period, and PPE usage (Fasya, 2018).

Some research stated that one of the solutions to decrease occupational contact dermatitis numbers is PPE usage during work. PPE protects the body from outer exposure. PPE can be work clothing, gloves, masks, and boots. Personal hygiene is another action that needs to be considered. Personal hygiene aims to maintain cleanliness, physical health, and prevent disease. Personal hygiene reduces irritant exposure, which prevents contact dermatitis.

Based on the research above, the author prepares the literature review to comprehend the similarities and differences in an article that describes and relates to contact dermatitis in workers with metals. Thus, prevention can be made as early as possible by knowing the associated factors to occupational contact dermatitis.

METHODS

This research uses the literature review method using electronic databases, namely Google Scholars Research Gate, and Garuda with "occupational contact dermatitis" and "factors related to contact dermatitis in metal workers" as the keyword and 2017 to 2022 for the publication period.

As shown in table 1, 152 articles were found in Google Scholars, 41 articles matched the keywords in Research Gate, and 72 articles were collected from Garuda. The following step filters correlate research content and reach 23, 9, and 23 papers from Google Scholars, Research Gate, and Garuda, respectively. The further step is selecting and screening the articles to match the inclusion and exclusion criteria, as shown in table 1.

Figure 1 shows that twelve articles are selected using a cross-sectional method and clustered

Table 1. Inclusion and Exclusion Criteria

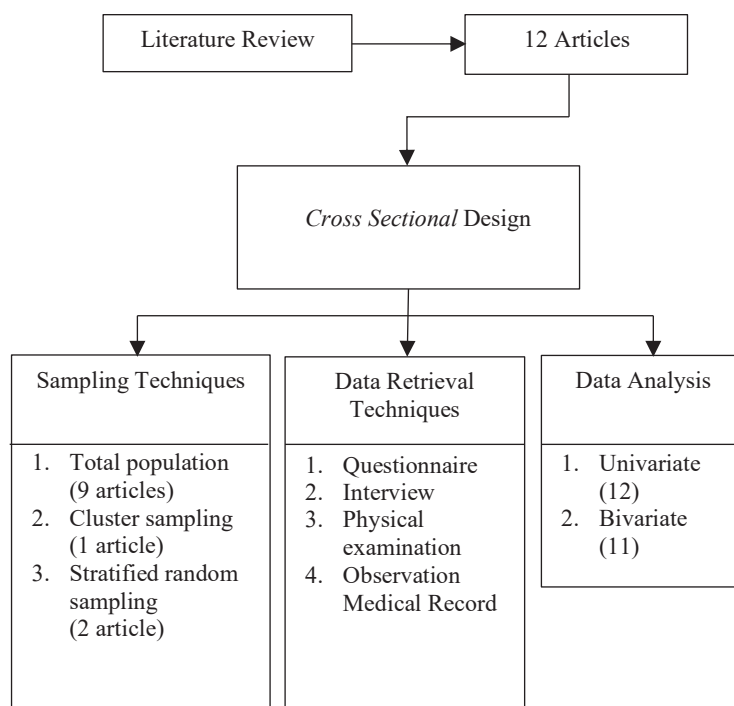
Inclusion Criteria	Based on the online database from 2017 to 2022. Relevance articles with the title and abstract. Full-text articles.
Exclusion Criteria	Incomplete articles. Not relevant articles with the title and abstract.

Table 2. Literature Search Result

Database	Keywords relevancy to title and abstract	Full-text articles	Final Criteria
Google Scholar	152	23	4
Research Gate	41	9	3
Garuda	72	23	5
Total	265	55	12

Table 3. Summary of PICOC

Population	Scientific and academic literature are from Google Scholars, Research Gate, and Garuda.
Intervention	Factors characteristic is using literature pros and cons.
Comparison	n/a
Outcomes	Factors specific scope is related to contact dermatitis literature.
Context	Study in industry, academic and database online literatures.

**Figure 1.** Articles Research Step

based on sampling, data retrieval, and analytical techniques.

The sampling techniques used in those twelve articles are using population total (9 articles), cluster sampling (1 article), and stratified random sampling (2 articles). All of them do direct research using interviews and questionnaires. Some articles conduct physical examinations on the respondents and observe medical records. Analytical univariate is a standard data analytical used in all twelve articles. Among twelve articles, 12 use univariate analysis, and 11 use bivariate data analysis.

The first identification in this review uses research questions and population, intervention,

comparison outcomes, and context (PICOC) approach (Kitchenham and Charters, 2007).

RESULTS

Chafidz and Dwiyantri (2018) explained contact duration relation, working type and PPE usage with contact dermatitis occurrence in home industry. Another point of view from Putri, Nirmala and Akifah (2017) is that working duration and PPE are related to contact dermatitis while personal hygiene is not. In addition, Yuliana, Asnifatima and Fathimah (2021) also describe that temperature and humidity trigger contact dermatitis.

Table 4. Literature Review Table

Researcher	Title	Research Design	Respondents	Research Variable	Research Step	Result
Putri, Nirmala and Akifah, (2017)	Related Factors to Contact Dermatitis in motorcycle workshop in Kendari at 2016	Cross sectional	The population is 459 people and 58 are sample.	Contact dermatitis is as dependent variable, and as independent variables are age worker, working period, history of skin disease, PPE usage and personal hygiene.	The collected data was using a self-completion questionnaire. The questionnaire's filtering system used self-administration.	There is a correlation between working duration, contact duration and PPE. Personal hygiene has no correlation skin disease.
Chafidz and Dwiyantri, (2018)	Correlation between Contact Duration, Working Type and PPE Usage with Contact Dermatitis Cases in Tofu Workers, KEDIRI	Cross sectional	Total population is 25 people.	Contact dermatitis as dependent variable and duration, PPE usage, working type and awareness as independent variable.	Data collected from questionnaire interview.	Stated the Correlation between long-term contact, working type and PPE.
Pradaningrum, Lestanyo and Jayanti (2018)	Symptoms Irritant Dermatitis Contact Correlation with Personal Hygiene, Contact Duration and Working Duration in Tofu Worker Mrican Semarang.	Cross sectional	Total sampling is 33 people.	Dependent variable is contact dermatitis and independent variable including contact period work period, and personal hygiene.	The data collected from questionnaire and physic examination.	There is a correlation between work period, contact period, personal hygiene, and contact dermatitis.
Fasya (2018)	The Incidence of Dermatitis Analysis Based on Individual Characteristics of Metal Plating Workers in Sidoarjo	Cross sectional	The population is all the respondents in the industry which is 10 people.	Contact dermatitis as dependent variable and age, working type, working time and PPE are independent variable.	The prime data collected from the interview, questionnaires, and physical examine	There is a correlation between, age, type of work, period of work, PPE, and contact dermatitis.
Wijayanti and Sumardiyono (2019)	Influence Coloring Material Exposure to Contact Dermatitis in Batik Worker Surakarta.	Cross sectional	The research used consecutive sampling and 40 workers with minimum 1 year working duration and 20 years old criteria.	Occupational contact dermatitis as a dependent variable and independent variable are age, sex, work duration, and PPE discipline.	The Data collection came from the questionnaire interview, medical record, and work environments observation.	Coloring material exposure, contact duration, age, sex, and PPE are correlate to contact dermatitis.
Alifariki, Kusnan and Saida (2019)	Contact Occurrence Determinant of Workers Workshop in Kendari.	Cross sectional	The population sampling is 459 people and the sample is 58 people.	Occupational contact dermatitis as a dependent variable and independent variable are contact duration, history of skin disease, personal hygiene, and using PPE.	The Data collection came from the questionnaire interview.	Contact duration, personal hygiene, and PPE are correlation with contact dermatitis. A history of skin disease has no correlation to contact dermatitis.

Advance Table 4. Literature Review Table

Researcher	Title	Research Design	Respondents	Research Variable	Research Step	Result
Fauziyyah (2020)	Incident Dermatitis Contact to Laundry Workers	Cross sectional	This research was use incidental selected purposive sampling with 100 sample.	Dermatitis contact is the dependent variable, while the independent variables are atopy history and personal hygiene.	The primer data collected from questionnaire.	Atopy history and personal hygiene correlated to contact dermatitis.
Alvira and Budi (2020)	The Relationship Between Endogenous Factors and Contact Dermatitis on Electroplating Workers in Durungbanjar	Cross sectional	Sample population is 28 people which collected from 2 coating metal industries	Contact dermatitis as dependent variable and dermatitis spread, age, working period, disease history, and personal hygiene are independent variable.	The primer data collected from the questionnaire, observation, and medical records.	The influence of age, work period, disease history, and personal hygiene to contact dermatitis.
Budi (2020)	Relations between Contact Duration, type Work Use Personal Protective Equipment and Contact Dermatitis among Electroplaters	Cross sectional	The sample population is 28 people.	Contact dermatitis as dependent variable and dermatitis spread, contact duration, contact frequency, working time, and PPE usage are independent variable.	They collected the prime data from the questionnaire, interview, medical record, and medical check-up.	There is a significant correlation between contact duration, frequency, type of work, PPE, and contact dermatitis.
Edytya and Sulistyorini (2020)	Overview of Worker Characteristics, Use of PPE, Hygiene of Individuals, and Contact Dermatitis on Metal Coating Household Industry Workers	Cross sectional	Total sample population is 20 people.	Contact dermatitis as dependent variable and age, working duration, contact frequency, personal hygiene, and PPE are independent variable.	They collected the prime data from the questionnaire and interview.	Worker who are wearing PPE and perform individual hygiene are around 50%. The typical worker age is 26-35 year old. Duration period average is 2-3 year. Exposure duration is 3.25 hours/day, exposure length is 5 -8 hours/day. Exposure frequent contact below 150 time/day and above 150 are identical.
Fitriah <i>et al</i> (2021)	Contact dermatitis risks related factors in PT Wijaya Karya workers.	Cross sectional	Population sample are 62 workers.	Contact dermatitis as dependent variable and contact duration, working duration and PPE usage are independent variable.	They collected the prime data from the observation, questionnaire, and interview.	There is correlation between contact duration, working period and PPE with contact dermatitis.

Advanced Table 4. Literature Review Table

Researcher	Title	Research Design	Respondents	Research Variable	Research Step	Result
Eka Yuliana, Asnifatima and Fathimah (2021)	Contact Dermatitis Subjective Symptoms Related Factors of Tofu Worker in Citeureup District, Bogor 2020	Cross sectional	Total sample population is 68 people.	Contact dermatitis is the dependent variable and contact duration, temperature, humidity, age, dermatitis history, working duration, personal hygiene, and PPE usage are independent variables.	They collected the prime data from the observation, questionnaire, and interview.	Contact duration, temperature, humidity, age, dermatitis history, working duration, personal hygiene and PPE usage are correlate to contact dermatitis.

The research conducted by Putri, Nirmala and Akifah, (2017), Fasya (2018), Wijayanti and Sumardiyono (2019), Alvira and Budi (2020), Budi (2020), Fitriah *et al.* (2021) describe that contact duration, working type, personal hygiene, and PPE have stimulated the dermatitis occurrent. Total 6 articles from 12, discuss the contact dermatitis relationship with PPE usage and one article Edytya and Sulistyorini (2020) describes worker characteristic, PPE usage and personal hygiene.

As the literature review table above, age, atopy history, irritant contact duration, contact frequency, personal hygiene, and PPE usage influence dermatitis contact for metal industries workers.

DISCUSSION

Contact dermatitis is an occupancy skin disease that affect local inflammation reaction non-immunologic. Direct contact with irritant causes irritant dermatitis contact that damage the skin chemically. Anyone can experience contact dermatitis, the most frequent places are the hands, face, neck and thighs. Symptoms are including itching, redness, swelling, papules (solid bumps), vesicles (fluid-filled bumps <5mm), dry skin, cracked skin, pain and soreness. Metal contact can affect contact dermatitis due to age, contact duration, contact frequency, personal hygiene, and PPE. Contact dermatitis history in the family is significantly influence.

Age

Age factor cannot be separated from a person and affects contact dermatitis. Discussion about age that affect to contact dermatitis some researcher has

different result. Wijayanti and Sumardiyono (2019) research's impact explained that age > 33 is more vulnerable to contact dermatitis than ≤ 33 with 82% to 52.2%. Article published by Alvira and Budi (2020) has the same result that old workers are more prone to contact dermatitis than young workers. It describes that age more than 45 and 17-25 affected contact dermatitis at 32.1% and 25% respectively. The rest 42.9% is affected to group age 26-35 and 36-45.

On the other hand, Fasya (2018) describes that age has weak affection to contact dermatitis. Nuraga, Lestari and Kurniawidjaja (2008) have the same result, which describes that age factor not significantly affected contact dermatitis. Regardless of workers age, workers have same possibility of affecting to contact dermatitis. In addition, some research papers described that skin degenerating is align with the increasing age. Skin degenerating causes lose fat layer on top and skin becomes drier. As the result, the drier skin is susceptible significantly to dermatitis.

Contact dermatitis occurrence can affect to all ages. It means that age is not a significant risk factor to contact dermatitis.

Contact Duration

Contact duration is a duration of contact between worker and exposure. Every worker has different contact duration depend on working process. Hence, the longer contact with the irritant material, skin inflammation will follow and skin abnormalities will arise. Skin damage, irritation, and hair fall can result from mucosa response to exposure. Acute reaction begin from skin surface, finger and foot that will develop to skin disorder

(perifolliculate papules). In some cases, it can be skin sensitization. Furthermore, long term frequent exposure (chronic) will affect to dermatitis and it similar to acute exposure (Sularsito and Soebaryo, 2017).

Normally, workers have to work 8 hours daily. Extend it will not make working effective, efficient, and not optimum productivity. Quality and result will lessen that initiate to fatigue and health disorder. It is supported by researches Chafidz and Dwiyanti (2018); Alifariki, Kusnan and Saida (2019); Alvira and Budi, (2020) and Pradaningrum, Lestantyo and Jayanti (2018) that duration contact correlated to contact dermatitis. One articles Alifariki, Kusnan and Saida (2019) said that working > 8 hours per day more exposed to contact dermatitis 94.6% than normal working hours. This result is similar to the research conducted by Chafidz and Dwiyanti (2018) that 60% of workers who work ≥ 5 hours are vulnerable to contact dermatitis compared to workers who work < 5 hours per day.

Accordingly, company can manage the risk control. Some risk control methods can be applied, namely occupational exposure limit (OELS) and threshold limit values (TLVs). Occupational exposure limit (OELS) is time limit or time recommendation, more or lesser, workers exposed to exposure. Threshold limit values (TLVs) is numbers chemical concentrate allowed in the air to expose frequently and has no side effect to human body Both of the methods are able to be implemented for average 8 hours exposure contact per day (Kurniawidjaja, 2015).

Frequent Contact

Frequent irritant materials contact affect to the external skin damage and followed by inner skin damage. Skin becomes vulnerable and it will affect contact dermatitis. Repeated contact frequency has sensitization affects to contact dermatitis (Cohen, 2019). The frequency counts from worker first contact with the exposure until the job is done. In their research, Alvira and Budi (2020) describe a strong relationship between frequent contact and dermatitis. In addition, in his study, Budi (2020) stated that 57.1% of electroplaters have exposure contact 100 times a day with frequent contact 78 times/day. As a result, regular contact significantly

affect to electroplaters dermatitis occurrence. A research by Fitriah *et al* (2021) is justify that workers contact frequency with exposed 3.25 hours/day are prone to contact dertmatitis.

Law No. 13 2013 concerning workforce stipulates 7 hours a day and 40 hours a week (Ministry of Manpower, 2003). Contact dermatitis symptoms will appear within weeks, months to years after the contact (Sholeha, Sari and Hidayati, 2021). Therefore, reducing contact dermatitis incidents that affected metal workers is by lowering the contact frequency (Nuraga, Lestari and Kurniawidjaja, 2008).

Atopy History

Endogen and exogen are influence factors to contact dermatitis. The endogen factors include age, race, sex and atopy history. While irritant type, direct contact to irritant materials, environment, etc are exogen factors. Fauziyyah (2020), Alvira and Budi (2020) claimed a correlation between atopy history and contact dermatitis. Workers with atopy history have double risk of contact dermatitis than workers without atopy history (Nakajima *et al.*, 2014). Workers with atopy history will disrupt skin sawar with proof of trans epidermal water loss (TEWL) increment, hydration stratum corneum degradation, which affects irritant material dilatation, and skin inflammation.

Personal Hygiene

Good personal hygiene plays a critical role in contact dermatitis. Personal hygiene is a way to keep clean and it can be done before and after working. 6 articles from 12 articles explain personal hygiene relationship with contact dermatitis. As research's result from Putri, Nirmala and Akifah (2017), personal hygiene had no significant correlation. While, Chafidz and Dwiyanti (2018); Pradaningrum, Lestantyo and Jayanti (2018); Alifariki, Kusnan and Saida (2019); Alvira and Budi (2020); Budi (2020); Yuliana, Asnifatima and Fathimah (2021) explained that good personal hygiene has significant correlation to contact dermatitis.

Personal hygiene is one of the method to diseases prevention and maintain healthy. A good habit, such as washing hand after contacted with irritant material able to reduce contact dermatitis in

the working environment. Knowledge is influence to contact dermatitis. Good knowledge to keep cleanliness in the workplace, such as hand washing to remove a small part of irritant material that stick to skin will affect contact dermatitis. Even though contact dermatitis risk is possibly still affected after doing hand wash (Lestari and Utomo, 2007). It is due to hand wash still not clean enough and hand soap selection that supposed to remove residual chemical material instead damaging the outer skin cell. Moisturizer is needed to avoid external skin cell damage (World Health Organization, 2005).

Use of Personal Protective Equipment (PPE)

PPE is an equipment that help to protect a person from hazards in the workplace (Lestari and Utomo, 2007). It can be work outfit, glasses, gloves, mask, and boot used as their respective functions. Although, PPE is not the only one that control exposure. It indeed can protect from the exposure. For example, a worker who wear gloves should know the nature of exposure and choose the proper gloves. Workers need to understand how to use gloves properly. Hence, workers can identify appropriate gloves as the exposure risk in the workplace (Fasya, 2018).

Most of the research articles (8 articles) explained the PPE correlation to contact dermatitis. Ministry of workforce and transmigration encourages workers to wear the PPE due to potential hazards at work (Ministry of Manpower and Transmigration, 2010). PPE can protect a person from potential hazards in the workplace. In risk management, Occupational Health and Safety Assessment (OHSAS) 18001: 2007, PPE is one of the five hazard minimization stages: elimination, substitution, engineering control, administration, and PPE. PPE proved significantly to reduce contact dermatitis risk. Thus, the company needs to consider and provide PPE properly.

Based on the HL. Bloom's theory, 4 factors affect health status: heredity, environment, behavior, and medical services (Irwan, 2017). Heredity is essential in contact dermatitis since it relates to contact dermatitis history in the family. Contact frequency and contact length are environment factors that lead to contact dermatitis. Worker's behavior, such as discipline using PPE and personal

hygiene, would affect contact dermatitis occurrence in the workplace. The last, medical services have prominent role in knowing to contact dermatitis prevalence in workplace.

Alifariki, Kusnan and Saida (2019) and Budi (2020) are the most comprehension research paper among eight papers that explain the factors relate to contact dermatitis in metal industry.

CONCLUSION

The most significant factor for the contact dermatitis due to the metal material is the PPE usage. The other affected factors include age, atopy history, contact duration, contact frequency, and personal hygiene. The importance of knowledge about exposures and their impact on health should be known to workers. Therefore, the contact dermatitis treatment can be holistic, since it requires company management to meet the PPE necessity and the workers knowledge in the metal exposure to the skin. As a result, the awareness of contact dermatitis during work will increase.

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