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## Article Title

### **Association between Personal Hygiene, Personal Protective Equipment Usage, and Exposure Duration with the Occurrence of Allergic Contact Dermatitis among Seaweed Farmers**

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## **ABSTRACT**

*Seaweed farmers in coastal areas face a high occupational risk of allergic contact dermatitis due to persistent exposure to aquatic environments. This study aimed to analyze the determinants of this skin disease by evaluating its association with personal hygiene levels, compliance with personal protective equipment (PPE) usage, and exposure duration. A quantitative, analytical cross-sectional design was employed, involving 47 respondents selected via simple random sampling based on strict inclusion and exclusion criteria. Primary data were collected through a validated questionnaire and physical examinations, followed by Chi-square analysis at a 0.05 significance level. The results indicated a dermatitis prevalence of 55.32% among the sample. Poor personal hygiene ( $p = 0.003$ ) and inadequate compliance with PPE usage ( $p = 0.016$ ) were identified as significant determinants of the disease. Interestingly, analysis of the work duration revealed an anomaly: the group with less than 8 hours of daily contact exhibited the highest morbidity rate ( $p < 0.001$ ), suggesting a potentially strong influence of individual genetic susceptibility and seawater contamination. Based on these findings, local primary healthcare authorities should implement targeted educational programs on behavioral modification and facilitate the construction of clean-water rinsing facilities to effectively interrupt the pathogen transmission chain.*

*Keywords:* Allergic Contact Dermatitis; Personal Hygiene; Personal Protective Equipment; Seaweed Farmers.

## **INTRODUCTION**

The maritime sector and coastal areas are economic drivers with considerably high occupational health risks. One of the primary commodities extensively cultivated by coastal communities is seaweed. Work activities in this sector require continuous physical interaction with the marine environment and various biological agents. This intensive occupational exposure places seaweed farmers at significant vulnerability to various skin health disorders due to the wet working environment ([Wahyuni et al., 2023](#)).

The most frequent clinical manifestation among workers in this aquatic environment is allergic contact dermatitis. This disorder is an inflammatory skin reaction triggered by repeated contact with specific workplace allergens. Constant exposure to seawater and organic materials accelerates the inflammatory process in the skin, thereby reducing workers' health quality ([Pane et al., 2022](#)). The severity of this hazard is confirmed by the [Riskesdas \(2019\)](#) data, which ranks dermatitis as the third most common condition among the top twelve comorbidities in Indonesia. Overall, the national prevalence of dermatitis reached 97%, with the highest regional prevalence in West Java (92.7%) and Aceh (68.8%), and a high prevalence in South Sulawesi at 53.2%.

A review of previous literature and research consistently confirms the high threat in this wet work sector. Empirical evidence indicates that the prevalence of skin problems among coastal worker communities, particularly among seaweed farmers, consistently accounts for the majority of occupational morbidity across various

production centers (Irma et al., 2023; Kaderiah et al., 2024). The literature also demonstrates that dermatitis complaints among seaweed farmers have persisted for over a decade without a comprehensive epidemiological resolution (Azhar & Hananto, 2011).

One variable contributing to this clinical manifestation is the level of awareness of personal hygiene practices. Workers who do not properly maintain personal hygiene standards tend to leave seawater residue, salt particles, and organic sediments on their skin for extended periods. This uncleared occupational residue facilitates the penetration of allergens into the epidermal layer. Consequently, the skin's tolerance threshold decreases, accelerating the onset of irritation and allergic reactions (Safriyanti et al., 2016).

In addition to personal hygiene, compliance with personal protective equipment (PPE) usage serves as the primary physical defense layer in daily work activities. The use of protective gear, such as waterproof gloves and protective clothing, functions to isolate the skin from direct contact with exposure sources. Field practices frequently reveal low compliance rates due to operational discomfort while moving in the water. The absence of this physical protection directly allows pathogens to compromise the workers' natural skin barrier integrity (Risal, 2020).

Exposure duration, or the length of contact with the work environment, is also a determinant variable that exacerbates skin risk burdens. The intensity of seaweed cultivation, from seeding and maintenance to harvesting, requires workers to remain submerged in water at a sustained pace. This repetitive and prolonged work process exerts cumulative stress on skin integrity (Kaderiah et al., 2024).

Although previous studies have documented the high risk associated with this occupational exposure, the gap between the magnitude of the disease threat and the low rate of preventive behavior remains a central issue in coastal areas (Humaerah et al., 2024). This contradictory condition is clearly evident in seaweed cultivation activities in the coastal area of North Belopa. Records from the Luwu Regency Health Office confirm this escalating threat, with dermatitis cases fluctuating from 1945 in 2021, 1603 in 2022, and 1379 in 2023, to 3569 in 2024. This increase officially places dermatitis among the top 10 diseases with the highest regional incidence rates. A similar critical trend is documented at the micro-level in the Barana Primary Health Center (*Puskesmas*) Annual Report, which documented a surge in dermatitis patient complaints from 10 cases in 2022 to 201 cases in 2023, then to 226 cases in 2024, and 128 cases in 2024 (Arif et al., 2024). Despite these concerning local morbidity trends, no empirical studies have specifically examined the association between hygiene factors, protective equipment use, and work duration and the high incidence of dermatitis in this location.

This study aims to analyze the determinants of allergic contact dermatitis among seaweed farmers. Specifically, this research aims to identify and test the statistical significance of the associations among personal hygiene levels, compliance with PPE use, and exposure duration with the clinical manifestations of allergic contact dermatitis. By empirically verifying these three occupational exposure proxies, this study aims to formulate specific, effective, and evidence-based preventive intervention strategies for protecting coastal community health.

## **METHOD**

This analytical observational cross-sectional study was conducted from May to June 2025 in the working area of the Barana Puskesmas, Luwu Regency. This location was purposefully selected because it is a seaweed cultivation center with a high prevalence of persistent skin disease. Independent variables (personal hygiene, personal protective equipment (PPE) use, and exposure duration) and the dependent variable (allergic contact dermatitis) were measured simultaneously.

The study population comprised all actively working seaweed farmers in the area. A sample of 47 respondents was selected using simple random sampling from the village worker registration data frame (Notoatmodjo, 2018). Inclusion criteria included workers who had been active for at least the past year. Exclusion criteria included subjects with congenital skin diseases, non-occupational systemic allergies, or those undergoing clinical treatments that could obscure the diagnosis of dermatitis.

Primary data were collected through interviews using a validated questionnaire and physical field observations (Sugiyono, 2019). Secondary data, comprising daily medical records and environmental health profiles, were obtained from the local primary health center. The dermatitis variable was categorized as present or absent; personal hygiene as good or poor; PPE usage as complete or incomplete; and exposure duration as  $\leq 8$  hours/day or  $> 8$  hours/day.

Data analysis using statistical software included univariate analysis of frequency distributions and bivariate analysis with the chi-square test (5% significance level) (Dahlan, 2020). Fisher's exact test was used as an alternative if any cell in the cross-tabulation had an expected count of less than 5. This research adhered to public health ethical principles, including the requirement for informed consent and guarantees of participant anonymity and data confidentiality.

## **RESULTS**

The field data collection successfully gathered responses from 47 seaweed farmers who strictly met all inclusion and exclusion criteria. The measurement

results for the independent and dependent variables were systematically tabulated to describe the frequency distributions and test for statistical significance through bivariate analysis. The presentation of these primary data focused on cross-tabulation results for personal hygiene levels, compliance with personal protective equipment, and exposure duration, as well as the prevalence of allergic contact dermatitis among the observation subjects.

**Table 1. Relationship Between Personal Hygiene and Allergic Contact Dermatitis among Seaweed Farmers**

| Allergic Contact Dermatitis | Personal Hygiene |              |           |              | Total     |               | p-value |
|-----------------------------|------------------|--------------|-----------|--------------|-----------|---------------|---------|
|                             | Poor             |              | Good      |              | n         | %             |         |
|                             | n                | %            | n         | %            |           |               |         |
| Present                     | 20               | 42.55        | 6         | 12.77        | 26        | 55.32         | 0.003   |
| Absent                      | 7                | 14.90        | 14        | 29.78        | 21        | 44.68         |         |
| <b>Total</b>                | <b>27</b>        | <b>57.45</b> | <b>20</b> | <b>42.55</b> | <b>47</b> | <b>100.00</b> |         |

Source: Primary Data, 2025.

Based on the factual presentation in Table 1, the prevalence of allergic contact dermatitis in the sample population was the majority. A total of 26 workers, representing 55.32% of the respondents, were identified as having clinical manifestations of the skin disease. Examination of the distribution of personal hygiene revealed that the worker group with poor personal hygiene had a substantially higher prevalence. Of the 27 workers with poor hygiene, 20 (42.55%) had dermatitis. Conversely, in the worker group with good hygiene comprising 20 individuals, the dermatitis prevalence was considerably lower, affecting only 6 individuals (12.77%). The statistical test results for this variable yielded a p-value of 0.003. This probability value, being below the 0.05 significance threshold, mathematically confirmed a statistically significant association between personal hygiene levels and allergic contact dermatitis.

**Tabel 2. Relationship Between PPE Usage and Allergic Contact Dermatitis among Seaweed Farmers**

| Allergic Contact Dermatitis | PPE Usage  |              |           |              | Total     |               | p-value |
|-----------------------------|------------|--------------|-----------|--------------|-----------|---------------|---------|
|                             | Incomplete |              | Complete  |              | n         | %             |         |
|                             | n          | %            | n         | %            |           |               |         |
| Present                     | 20         | 42.55        | 6         | 12.77        | 26        | 55.32         | 0.016   |
| Absent                      | 7          | 14.90        | 14        | 29.78        | 21        | 44.68         |         |
| <b>Total</b>                | <b>27</b>  | <b>57.45</b> | <b>20</b> | <b>42.55</b> | <b>47</b> | <b>100.00</b> |         |

Source: Primary Data, 2025.

The subsequent bivariate data distribution mapped the cross-tabulation between personal protection compliance and workers' skin health status, as detailed

in Table 2. The tabulation described that the majority of respondents, namely 27 workers (57.45%), performed daily work activities with incomplete physical protective attributes. Within this group of workers with substandard protection, the prevalence of dermatitis reached 20 individuals (42.55). An opposite condition was recorded in the worker group with complete compliance with personal protective equipment usage. Of the 20 workers in the complete protection group, only 6 (12.77) presented with dermatitis. Statistical computation of this frequency matrix yielded a p-value of 0.016. This figure provided quantitative evidence that compliance with personal protective equipment use was statistically significantly associated with dermatitis prevalence.

**Table 3. Relationship Between Exposure Duration and Allergic Contact Dermatitis among Seaweed Farmers**

| Allergic Contact Dermatitis | Exposure Duration |              |           |              | Total     |               | p-value |
|-----------------------------|-------------------|--------------|-----------|--------------|-----------|---------------|---------|
|                             | ≤ 8 Hours         |              | > 8 Hours |              | n         | %             |         |
|                             | n                 | %            | n         | %            |           |               |         |
| Present                     | 20                | 42.55        | 6         | 12.77        | 26        | 55.32         | 0.001   |
| Absent                      | 5                 | 10.64        | 16        | 34.04        | 21        | 44.68         |         |
| <b>Total</b>                | <b>25</b>         | <b>53.19</b> | <b>22</b> | <b>46.81</b> | <b>47</b> | <b>100.00</b> |         |

Source: Primary Data, 2025.

The final objective parameter mapping focused on the occupational exposure duration variable. Table 3 presents the distribution of respondents by daily contact duration with the wet aquatic environment. This distribution showed that the worker group with a contact duration of < 8 hours had the highest morbidity rate. Of the 25 workers during this operational time interval, 20 (42.55%) reported experiencing allergic contact dermatitis. This proportion sharply contrasted with that of the worker group, which had a contact duration of ≥ 8 hours. In the long-duration group of 22 individuals, dermatitis was observed in only 6 individuals (12.77%), while the other 16 individuals (34.04%) had no skin disease complaints. The statistical test for this exposure duration cross-tabulation yielded a very low p-value (< 0.001). This absolute result confirmed a strong statistical association between the daily work time dimension and the probability of allergic contact dermatitis in the sample population.

## DISCUSSION

Empirical observations indicate that 55.32% of seaweed farmers in North Belopa experience clinical manifestations of allergic contact dermatitis. This high proportion confirms that worker activities in maritime waters carry a highly persistent occupational vulnerability to skin health problems. [Irma et al. \(2023\)](#) emphasized that dermatological complaints are the primary risk factor, consistently accounting for the

highest morbidity rates among workers interacting directly with marine ecosystems. This prominent prevalence condition also aligns with the epidemiological picture in other coastal island production centers that continue to face similar threats due to exposure to a wet working environment (Kaderiah et al., 2024).

An investigation into the determinants of this high morbidity points to the level of personal hygiene as a determinant. Statistical data show that workers with poor personal hygiene accounted for 20 dermatitis cases, whereas workers with good hygiene did not. Work environment residues, such as seawater remnants, salt particles, and organic sediments left on the skin for prolonged periods, accelerate damage to the skin barrier in the epidermal layer (Pane et al., 2022). Physical damage to this protective layer allows allergens to penetrate more deeply. This causal evidence confirms that poor personal hygiene practices consistently predict allergic contact dermatitis among coastal worker populations (Safriyanti et al., 2016; Irma, 2024).

In addition to the personal hygiene factor, the lack of physical protection during the work process directly triggers inflammation. Quantitative data show that incomplete compliance with personal protective equipment usage is strongly associated with an accumulation of 20 dermatitis cases. Wahyuni et al. (2023) reported that low compliance with safety attributes is a consistent finding across seaweed farmer communities in different regions. Workers who do not wear protective clothing expose their skin directly to aquatic pathogens. Risal (2020) underscores the urgency of wearing waterproof gloves as a vital means of preventing direct contact between workers' skin and chemical or biological irritants.

The examination of the occupational exposure duration dimension reveals a statistical anomaly that is highly intriguing for academic analysis. Field data show that the worker group with a daily contact duration of 8 hours or less accounted for 20 cases, while those submerged for more than 8 hours accounted for only 6 cases. This empirical fact straightforwardly refutes the classical assumption stating that the longer a person works in water, the higher their allergy risk. Azhar and Hananto (2011) explained that the work process of seaweed cultivators possesses a highly specific exposure and vulnerability pattern; thus, a high number of cases is not always directly proportional to the daily cumulative time count.

The anomaly regarding this short work duration can be explained through a pathophysiological approach related to individual vulnerability. The worker group with a duration of less than eight hours is highly likely to be dominated by new individuals whose skin layers have not yet undergone thickening or physical adaptation to the harsh marine environment. The rapid inflammatory reaction over this short period is also substantially influenced by a history of atopy or by congenital genetic mutations affecting the workers' skin barrier function (Gregory et al., 2022; Fatahillah, 2024).

Workers with an atopic history will immediately manifest hypersensitivity reactions even if physical contact with seawater occurs within a very limited timeframe.

A further argument regarding the high number of cases within this short duration is a re-examination of the allergy-triggering subject itself. The exposure that most likely damages workers' skin does not originate from the seaweed commodity. [Kim et al. \(2024\)](#) elaborated on recent medical findings that seaweed extract contains active compounds that act as anti-inflammatory agents and are efficacious in alleviating dermatitis symptoms. This medical fact provides strong justification that the primary trigger for skin irritation is not the seaweed plant, but rather the deteriorating seawater quality, aquatic microorganism contamination, and work practices that neglect the use of waterproof equipment.

Epidermal inflammation resulting from poor personal protection and hygiene requires serious, ongoing clinical attention. Persistent exposure to aquatic allergens that penetrate the skin's defense system can cause more than just localized itching or redness. Chronic dermatitis conditions left without adequate medical treatment potentially trigger abnormal immune system activation and increase the risk of future autoimmune disorder complications ([Wang et al., 2025](#)). Therefore, the surge in skin disease prevalence among this worker group can no longer be viewed as a mild health issue.

Based on the synthesis of all these exposure determinants, formulating intervention strategies must focus on worker behavior modification and operational environment engineering to break the disease transmission chain. [Humaerah et al. \(2024\)](#) recommended strengthening occupational safety literacy through a cultural approach within the coastal community. The implementation of integrated health education programs demonstrating the correct way to wash off seawater residue and the use of waterproof gloves has proven effective in reducing morbidity rates among marine workers ([Dwiseli & Rahmadani, 2024](#); [Hatimi et al., 2025](#)). The integration of daily physical protection education and the provision of clean-water rinsing facilities along the coast represent the most rational preventive measures for the primary health center to protect workers' health in North Belopa.

## **CONCLUSIONS AND SUGGESTIONS**

The prevalence of allergic contact dermatitis among seaweed farmers on the coast of North Belopa is concerning. Empirical evidence indicates that poor personal hygiene and incomplete compliance with PPE are the primary determinants of the severe clinical manifestations of this skin disease. Furthermore, the examination of the work-time dimension revealed an anomalous finding: workers with shorter contact duration had a higher morbidity rate. This fact proves that individual genetic

vulnerability, the skin tissue adaptation process, and poor seawater quality play a far more dominant pathophysiological role than merely the cumulative duration of exposure to the seaweed commodity itself.

Based on these conclusions, the local primary healthcare authority must implement strategic, measurable interventions. The primary health center needs to design an integrated health education program focused on behavioral modification among coastal workers. This education must technically demonstrate the procedures for cleaning seawater residue from the skin surface and the absolute urgency of wearing physical protective equipment, such as waterproof gloves. These health promotion efforts must also be accompanied by operational environment engineering interventions. The village government and relevant stakeholders need to facilitate the construction of easily accessible, clean-water rinsing infrastructure around the seaweed production area to break the aquatic pathogen transmission chain directly.

As an academic recommendation, expanding the scope of observations is necessary for future research. Subsequent epidemiological investigations are advised not to rely solely on observational questionnaire instruments. Future studies need to integrate clinical patch tests on workers' skin to absolutely and specifically identify the allergen agents. Laboratory testing of seawater quality standards at the cultivation sites is also highly crucial. The integration of these medical examinations and environmental health approaches will yield a more comprehensive occupational exposure risk map to protect maritime public health better.

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