

## The Role of Environmental Pollutants in the Incidence of Contact Dermatitis: A Prospective Cohort Study

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### Abstract:

**Background:** Visakhapatnam, a rapidly industrialising city in Andhra Pradesh, India, provides a unique setting for investigating the impact of environmental contaminants on health due to its diversified industrial activities, which include substantial port operations, steel industry, and heavy traffic congestion. The aim of this study is to determine the relationship between exposure to environmental contaminants and the prevalence of contact dermatitis in the local community.

**Methods:** A prospective cohort study enlisted 100 participants from Visakhapatnam's urban and semi-urban districts, with a balanced gender distribution and a wide age range (18-65 years). Based on the distance between residential areas and industrial zones as well as occupational exposure, three levels of exposure to environmental contaminants were classified: low, moderate, and high. The incidence of contact dermatitis was tracked over a 6-month period, with specific pollutants such as port-related emissions, steel factory emissions, and traffic emissions analysed for their relative risk (RR).

**Results:** 42 individuals from the group experienced contact dermatitis, indicating a significant correlation with the amount of pollution they were exposed to (Chi-square test,  $p < 0.05$ ). A 73.3% incidence rate was associated with high exposure. High exposure was verified by multivariate logistic regression as a significant, independent predictor of contact dermatitis (adjusted odds ratio [aOR] = 3.5; 95% CI: 2.0-6.1), after local factors were taken into account.

**Conclusion:** The study found a high link between ambient pollutant exposure and the prevalence of contact dermatitis in Visakhapatnam. It emphasises the necessity of focused measures to lower exposure to particular pollutants, especially in regions with a high concentration of industry and congested roads.

**Keywords:** Environmental Pollutants, Contact Dermatitis, Industrial Emissions, Public Health.

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### Introduction

Environmental pollution is a growing global concern, with industrialization and urbanisation contributing considerably to poor air quality and the discharge of countless chemicals into our environment [1].

Among the numerous health hazards associated to environmental pollution, dermatological diseases, particularly contact dermatitis, have surfaced as major concerns [2]. An inflammatory skin response to foreign chemicals is known as contact dermatitis [3]. It can be allergic or irritating in nature and it is more common in populations exposed to environmental toxins [4]. Visakhapatnam, a thriving metropolis in the Indian state of Andhra Pradesh, sits at the intersection of rapid industrial

growth and environmental sustainability issues. The city makes a large contribution to the area economy with its huge port, steel industry, and several manufacturing sectors. However, this economic expansion comes at the expense of rising environmental pollution caused by port-related emissions, industrial discharges, and vehicle traffic. In addition to lowering air quality, these pollutants are harmful to the general public's health, especially when it comes to dermatological disorders like contact dermatitis [5].

The aim of this study is to look at the relationship between exposure to environmental pollutants in Visakhapatnam and the prevalence of contact dermatitis in the local population. The study aims

to provide knowledge about the environmental drivers of contact dermatitis by categorising participants based on their exposure levels and analysing the occurrence of the condition in connection to certain contaminants. Comprehending the correlation between environmental contamination and contact dermatitis is vital in order to formulate focused public health initiatives and guide policy determinations aimed at alleviating these health consequences.

## Methodology

**Study Design and Setting:** This prospective cohort study was carried out from September 2023 to January 2024 at Andhra Medical College in Visakhapatnam, India. The purpose of the study was to assess the relationship between the incidence of contact dermatitis and exposure to environmental pollutants in the local population of Visakhapatnam, Andhra Pradesh, India's industrial and urban centre.

**Participant Recruitment:** Participants were recruited from Visakhapatnam's urban and semi-urban districts to ensure a representative sample of the population afflicted by varied degrees of environmental pollution. Adults between the ages of 18 and 65 who had lived in Visakhapatnam for at least a year before the study's start were eligible to participate. Individuals with a history of chronic dermatological disorders other than contact dermatitis were excluded, as were those on immunosuppressive therapy and those who refused to participate in the study [6].

**Exposure Assessment:** Environmental contaminant exposure was divided into three categories: low, moderate, and high. The participants' residential closeness to recognised industrial zones, traffic jams, and occupational exposure to pollutants were taken into consideration while classifying them. The instruments used for the assessment included maps of Visakhapatnam's traffic density, questions on occupational exposure<sup>7</sup>, and environmental monitoring data from regional authorities.

**Outcome Measures:** The primary result was the incidence of contact dermatitis, which was diagnosed by dermatologists at Andhra Medical College using clinical examination and American Contact Dermatitis Society standards. For a duration of 6 months, the participants underwent monthly check-ins to document any emergence of symptoms related to contact dermatitis.

**Data Collection:** At baseline, structured interviews were used to gather data on pre-existing skin problems, food habits, lifestyle factors, and demographics. Both direct measurements and self-reported data on residential and occupational

exposure were used to gather environmental exposure data.

**Statistical Analysis:** The Chi-square test was used to investigate the relationship between pollutant exposure levels and the development of contact dermatitis in different exposure groups. For particular contaminants, relative risks (RR) with 95% confidence intervals (CI) were computed. In order to find independent predictors of contact dermatitis, multivariate logistic regression was used to account for relevant confounders such as age, gender, dietary habits, and pre-existing skin disorders.

**Ethical Considerations:** The study was carried out in compliance with norms and recommendations for ethics. We acquired informed consent from each individual. The protocol for the study was examined, and the relevant authorities were consulted for prior authorization.

## Results

**Participant Demographics:** The study included 100 participants from Visakhapatnam's urban centres and semi-urban fringes, with 50 males and 50 females distributed equally. The age range of the participants was 18 to 65 years, with a mean age of 35.4 years. This wide age distribution is representative of the diversified population in Visakhapatnam.

**Exposure to Environmental Pollutants in Visakhapatnam:** Visakhapatnam's industrial activities, which include a significant port, a steel mill, and several manufacturing sectors, contribute to a distinct pollution profile. Thus, based on factors like proximity to industrial locations, traffic congestion, and occupational exposure within these sectors, the participants' exposure levels to environmental toxins were classified. There were thirty individuals with minimal exposure, forty with moderate exposure, and thirty with high exposure.

**Incidence of Contact Dermatitis:** 42 subjects developed contact dermatitis over the course of the 6-month monitoring period. A strong association was found between the incidence of contact dermatitis and the level of exposure to environmental contaminants in Visakhapatnam (Chi-square test,  $p < 0.05$ ).

Low Exposure: 6 out of 30 participants (20%)

Moderate Exposure: 14 out of 40 participants (35%)

High Exposure: 22 out of 30 participants (73.3%)

**Specific Pollutants and Risks in Visakhapatnam:** The study's pollutant-specific analysis in Visakhapatnam identified elevated hazards related with: Port-Related Emissions: RR

of 3.2 (95% CI: 1.9-5.4), taking industrial products handling and shipping into consideration.

Emissions from Steel Plants: RR of 2.8 (95% CI: 1.6-4.7) as a result of emissions from the processes involved in making steel.

Traffic Emissions: reflecting the heavy urban traffic, the RR is 2.5 (95% CI: 1.5-4.3).

**Multivariate Analysis:** After accounting for Visakhapatnam-specific characteristics such as food habits, the congested urban environment, and prevalent skin disorders, the multivariate logistic regression indicated that high exposure to environmental contaminants was a significant, independent predictor of contact dermatitis. Indicating a substantial connection, the adjusted odds ratio (aOR) was 3.5 (95% CI: 2.0-6.1).

**Table 1: Participant Demographics**

Demographic Factor	Description
Total Participants	100
Gender Distribution	50 males, 50 females
Age Range	18 to 65 years
Mean Age	35.4 years
Location	Urban centers and semi-urban outskirts of Visakhapatnam

**Table 2: Exposure to Environmental Pollutants in Visakhapatnam**

Exposure Level	Number of Participants	Description
Low	30	Proximity to industrial areas, traffic congestion, and occupational exposure within less polluted sectors
Moderate	40	Moderate proximity to industrial zones and moderate traffic congestion
High	30	Close proximity to major industrial activities, high traffic congestion, and high occupational exposure

**Table 3: Incidence of Contact Dermatitis**

Exposure Level	Number of Participants	Percentage	Incidence of Contact Dermatitis
Low	30	20%	6 participants
Moderate	40	35%	14 participants
High	30	73.3%	22 participants

Note: A significant correlation was found between the incidence of contact dermatitis and the level of exposure to environmental pollutants (Chi-square test,  $p < 0.05$ ).

**Table 4: Specific Pollutants and Risks in Visakhapatnam**

Pollutant Source	Relative Risk (RR)	95% Confidence Interval (CI)
Port-Related Emissions	3.2	1.9-5.4
Steel Plant Emissions	2.8	1.6-4.7
Traffic Emissions	2.5	1.5-4.3

**Table 5: Multivariate Analysis Adjusted for Local Factors**

Factor	Adjusted Odds Ratio (aOR)	95% Confidence Interval (CI)
High Exposure to Environmental Pollutants	3.5	2.0-6.1

## Discussion

The analysis was carried out at Andhra Medical College in Visakhapatnam between September 2023 to January 2024. The results of the study provide a glimpse into the significant relationship between the local population's incidence of contact dermatitis and exposure to environmental pollutants. By contrasting these results with prior research and exploring their implications for preventative and health policy, our discussion seeks to offer a thorough interpretation of these findings. The apparent increase in the prevalence of contact dermatitis in those with higher levels of environmental exposure highlights the critical role that vehicle and industry emissions have in the health of dermatologists [8].

The identification of particular pollutants, such as those from steel plants, ports, and traffic, is noteworthy because it provides a clear image of Visakhapatnam's industrial landscape and its implications for air quality. These pollutants' relative hazards are in line with the theory that long-term or intensive contact to certain chemicals and particles might damage skin integrity and cause allergic or irritating dermatitis [9].

Our findings are consistent with previous research, which has found that environmental pollution has a negative impact on skin health. Research carried out in similar industrial settings has also revealed that individuals exposed to heavy metals, volatile chemical compounds, and particulate matter had higher rates of dermatological problems [10,11,12].

The lessons from Visakhapatnam add value to this body of knowledge by emphasising the need for customised interventions in areas with high industrial activity.

The increased incidences of contact dermatitis in subjects with higher exposure levels are consistent with results from similar studies carried out in industrial and urban environments across the globe [13,14]. Nonetheless, the unique focus on the unique industrial landscape of Visakhapatnam, especially its port and steel mill, offers fresh perspectives on the regional effects of industrial activity on skin health. The creation of tailored public health guidelines and actions depends on this geographical nuance.

### Public Health Implications

The strong association discovered between environmental pollutant exposure and contact dermatitis incidence emphasises the importance of comprehensive environmental and health policy solutions<sup>15</sup>. Stricter industrial emission regulations, increased air quality monitoring, and public education campaigns explaining the possible health risks associated with environmental pollutants should all be part of this. In order to properly treat and prevent contact dermatitis, medical professionals in Visakhapatnam and similar locations need also develop a keen understanding of the environmental factors that contribute to the illness.

### Limitations

This study has certain limitations even if it makes significant contributions. The use of self-reported data to estimate exposure levels may add bias, and the length of the study may prevent thorough understanding of the long-term health consequences. Moreover, the results can't be applied to other areas with different industrial profiles due to the study's narrow emphasis on Visakhapatnam.

### Future Research Directions

Future research should aim to longitudinally study the health effects of environmental pollutant exposure in order to uncover its long-term impacts. Furthermore, it would be very helpful to conduct studies on the effectiveness of specific interventions meant to reduce exposure and reduce health hazards. Extending the scope to include comparative studies conducted in various industrial environments may provide a more comprehensive understanding of the relationship between environmental contamination and skin health.

### Conclusion

This study provides a significant contribution to the growing corpus of literature explaining the health effects of environmental pollution,

particularly highlighting the relationship between pollutant exposure and contact dermatitis in Visakhapatnam. The results highlight the need for coordinated approaches to public health and environmental governance that minimise the risks associated with emissions from vehicles and industry. Visakhapatnam and similar urban-industrial settings can promote sustainable development goals and protect public health by addressing these environmental health imperatives.

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