

Review Article

Pollution-Induced Rhinitis and Nasal Health in India

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Air pollution-associated respiratory diseases are a major concern among children and adults in India. Online expert round table meetings were recently held to assess the current literature related to pollution-induced upper respiratory tract disorders, explore the current scenario related to the identification and management of pollution-induced Upper Respiratory Tract Disorders in India and create an expert consensus and guidance for the identification and management of pollution-associated Upper Respiratory Tract Disorders and Nasal Hygiene. The outcomes and expert opinions regarding indoor and outdoor pollution and steps to address pollution-induced Allergic Rhinitis have been enumerated in this article.

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Key words : Pollution, Human disorders, Respirable Suspended Particulate Matter, Ambient Air Pollution.

The association between pollution and human disorders is well established. Notably, the risk of adverse health outcomes is the highest with Respirable Suspended Particulate Matter (RSPM) with an aerodynamic diameter of $<10\mu\text{m}$ (PM_{10}). The symptoms of respiratory disease are often aggravated following exposure to air pollutants. Some of the commonly noted upper respiratory symptoms include running or stuffy nose, sinusitis, sore throat, cold head, fever, burning or red eyes and irritation¹.

Air pollution is associated with adverse health outcomes, particularly respiratory diseases and is a major concern among children in India. In a study that compared Urban with Rural children in India, respiratory problems were significantly higher in Urban children¹.

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Editor's Comment :

- Upper respiratory tract disorders are on the rise in India.
- Indoor and Outdoor pollution both contribute to the position.
- Nasal saline spray are cost effective and safe remedy for this condition.

A higher incidence of Asthma has been noted in Urban children compared to Rural children. Furthermore, an increase in incidence of Allergic Rhinitis in general population (40%) and Asthmatics (99.6%) has been noted^{2,3}.

Online Advisory board meetings were held in February and March, 2021 to assess the current literature related to Pollution-induced Upper Respiratory Tract Disorders, explore the current scenario related to the identification and management of pollution-induced upper respiratory tract disorders in India and form guidelines for the identification and management of pollution-associated upper respiratory tract disorders and nasal hygiene. The advisory board included renowned Pulmonologists; Ear, Nose and Throat surgeons; and allergy/immunology experts from different parts of India.

Exposure to Pollutants in Urban and Rural Settings in India :

Household air pollution and Ambient Air Pollution (AAP) in India account for about 6% and 3% of the national burden of diseases, respectively. Household air pollution is considered responsible for 1.04 million premature deaths and 31.4 million Disability-Adjusted Life Years (DALYs) while AAP accounts for 627,000 deaths and 17.8 million DALYs⁴.

A study conducted in Shahdara and Shahzada Bagh, two industrial areas of Delhi has reported a high incidence of Upper Respiratory Tract Infections (URTIs) as well as rhinitis⁵. Another study has shown that there is an increased risk of Acute Respiratory Infections (ARI) in children who lived in homes without a separate kitchen, due to the combined effects of biomass fuels and households⁶.

About 64% of families in India use solid fuels for cooking. The use of this type of biomass fuel is considered responsible for the production of organic compounds such as formaldehyde, benzene-1, 3-butadiene and polyaromatic hydrocarbons. The concentration of these compounds tends to remain higher with indoor cooking, especially when there is a lack of proper smoke outlets⁷. Further, studies have reported alarming levels of Indoor Air Pollution (IAP) in Nepal, Pakistan, Bangladesh and India with the reported levels of PM₁₀ and PM_{2.5}, 2–65-, 3–30-, 4–22-, 2–28- and 1–139-, 2–180-, 3–77-, 1–40-fold higher than World Health Organization (WHO) standards for indoor PM₁₀ (50 µg/m³) and PM_{2.5} (25 µg/m³), respectively⁸.

Elevated temperatures and high Carbon Dioxide (CO₂) levels have increased the pollination cycle of weeds, thereby increasing the pollen load in the air in India. Fungal spores, insects and dust mites have also been considered as major contributors to the aeroallergen load in the indoor environment. Low levels of sanitation, rapid urbanization and deforestation are the other key factors contributing to allergen distributions in ambient environments⁹.

Expert comments/opinion/consensus :

- Both indoor and outdoor pollution increase the risk of adverse effects on upper respiratory health in India.
- Vehicular exhaust is a major source of outdoor pollution in India. Bursting of crackers is also a significant source, especially during festivals.
- The source of indoor pollution in India varies with the region: Rural—burning of biomass; Urban—volatile and semivolatile compounds, dust mites, pollen, etc.
- Lifestyle changes have increased the risk of exposure to indoor allergens.

Impact of Air Pollution on Nasal Health :

Chronic Rhinitis and Rhinosinusitis are among the most common conditions Worldwide with significant morbidity and decreased quality of life. Aeroallergens have been associated with mucosal inflammation in

pathology ranging from reactive airway disease to Allergic Rhinitis¹⁰.

Air pollutants has numerous adverse effects on the nasal mucosa, which includes the structural alterations in the nasal cells by disintegrating the tight junctions and disorganizing the strand network. Drying up of the vocal folds, thereby, leading to the disruption of the epithelial layer of the vocal fold and activation of the chemoreceptors present in the nasal cavity leads to triggering of the respiratory reflexes. This results in coughing, sneezing and laryngospasm and activation of the receptors of the afferent nerves, initiating the symptoms of irritation¹¹.

Some of the common pollutants that can have an impact on nasal health include Carbon Monoxide (CO), Diesel Exhaust Particles (DEP), Nitrogen Oxides (NOx), Particulate Matter (PM), pT-butylstyrene (TBS), Ground-level Ozone (O₃), House Dust Mite (HDM), Internal Air Pollutant (IAP), Ultrafine particles (UFPs), and Volatile Organic Compounds (VOCs)¹². There is an overlap of outdoor and indoor pollutants in the majority of the cases, especially in urban settings.

Indoor Pollution :

Women and children less than five years of age, who spend most of their time at home are primarily effected by the indoor air pollution⁷. Several air pollutants have been recognized to exist indoors, including NOx, SO₂, O₃, CO, volatile and semivolatile Organic Compounds (VOCs), PM, Radon and Microorganisms. Some of these pollutants (eg, NOx, SO₂, O₃, and PM) are common to both indoor and outdoor environments, while a few of them may have originated outdoors¹³.

Numerous combustion products including ETS (COx, NOx, SO₂, PM, wood/coal smoke) can lead to respiratory symptoms. Particularly, VOCs (alkanes, formaldehyde, esters, ketones) can cause upper respiratory tract irritation while allergens (Pollens, Molds, Mites, Cockroaches, Insects, Dander, Feathers) can lead to sensitization (specific/total immunoglobulin E), Respiratory Allergic Diseases, and Rhinitis¹⁴.

Outdoor Pollution :

Pollutants, such as DEP can have varying impacts on the nasal epithelium and Allergic Rhinitis through their effects on nasal epithelial cells/cell surface molecules and nasal fibroblasts¹⁵. Additionally, continuous exposure to air pollutants, such as DEP, residual oil fly ash, cigarette smoke, nanoparticles, and Asian sand dust, can aggravate allergic disorders¹⁶. Further, symptoms of respiratory diseases are often aggravated following exposure to air pollutants¹.

Vulnerable Groups :

Children, elderly patients, individuals with comorbidities, frequent commuters, and individuals at risk of occupational exposure are at a high risk of developing upper airway disorders.

Children are at a high risk as the immune and antioxidant defense mechanisms are in a developing phase. As children have a higher respiratory rate in comparison to the adults, they inhale larger doses of pollutants. Children are also exposed to higher level of pollutants as they spend more time outside in the playground¹¹.

Aged individuals also have increased risk of suffering from chronic respiratory illnesses like asthma, bronchitis and chronic cough on exposure to indoor or outdoor pollution¹¹.

Individuals with co-morbidities are also at increased risk of suffering from the adverse effects on exposure to pollutants¹¹. A high risk of development of allergic disorders has also been noted in frequent commuters, office workers and individuals working in hazardous working conditions due to recurrent exposure to pollutants: Depending upon the mode of transport, individuals travelling in the cities are exposed differentially to particulate matter. People working in high-rise buildings are exposed to ozone¹¹.

Expert comments/opinion/consensus :

- The elderly, women and young children are most affected by pollution in India.
- There is an association between respiratory infection and air pollution—strong agreement.

Management of Pollution-induced Rhinitis :

The management of Pollution-induced Rhinitis must involve a detailed evaluation of the symptoms, history, home/school/office environment, family history, and medical history, followed by a thorough physical evaluation¹⁷.

The treatment for Allergic Rhinitis is mainly symptomatic. The treatment options include avoidance of allergens; use of oral antihistamines, nasal saline irrigation, intranasal corticosteroids, combination of antihistamine sprays and intranasal corticosteroids, leukotriene receptor antagonists and allergen immunotherapy¹⁷. These options can be broadly categorized into nonpharmacological and pharmacological approaches.

Nonpharmacological Approaches :

These include the steps that can be taken to reduce indoor pollutants. Adequate ventilation should be

ensured within the house and the use of nonpolluting sources for cooking should be preferred in rural settings. Individuals who smoke should stop smoking indoors. Another measure that can be useful in regions with low temperatures is ensuring adequate heat in the rooms to prevent the growth of mold. Indoor plants that help in improving air quality can be placed indoors in Urban areas. These plants need to be exposed to sunlight at least once a week¹⁸.

Masks are highly recommended for daily commuters to protect them against environmental pollutants. Masks made of fabrics help in preventing the entry of large particles only. However, for optimal protection, adequate sealing around the edges of the face should be ensured while wearing masks and fabrics¹¹.

Pharmacological Approach :

The pharmacological approach has been enumerated in Fig 1. Second- generation oral anti-histamines are the first line for treatment for Allergic Rhinitis. They have been found to successfully reduce the symptoms like itching, sneezing and rhinorrhea specially during flare of symptoms or on exposure to allergens¹⁷.

In case of mild persistent or moderate/severe symptoms, intranasal corticosteroids are considered as first-line therapeutic options alone or in combination with oral antihistamines¹⁷.

In case of failure of intranasal corticosteroids in controlling the symptoms, a combination of corticosteroid/antihistamine spray can be used¹⁷.

Leukotriene Receptor Antagonists have been considered to be less effective than intranasal

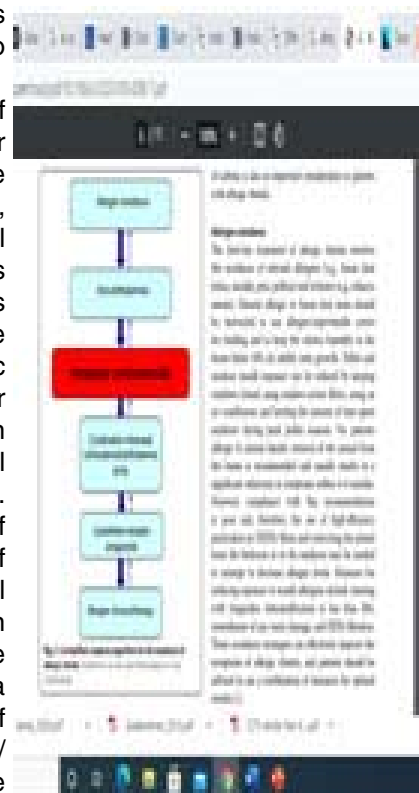


Fig 1

corticosteroids in management of allergic rhinitis¹⁷.

Expert comments/opinion/consensus :

- There are unmet needs in the diagnosis and management of pollution-related URTIs.
- Steps to reduce allergens at home/office include improving ventilation, bedroom hygiene and smart cleaning. Keeping indoor plants is also helpful in improving air quality.
- A detailed evaluation should include checking for the allergic source, recording medical/medication history, and assessing the presence of symptoms, occupation history, and lifestyle.
- Creating public awareness, changing the pattern of fuel use—biogas instead of direct combustion of biomass fuels, and modification of cooking stove designs help reduce indoor pollution at the rural level.
- While the majority of the experts agreed that intranasal corticosteroids can be used as a first-line approach, 25% of the experts noted that intranasal corticosteroids are beneficial, but not as a first-line approach.
- Oral antihistamines could be the first-line approach in pollution-induced upper airway disorders.
- Decongestants could be used as short-term management for symptomatic relief.
- Antitussives should be avoided but may be useful in the management of allergic cough.
- There is no proven efficacy of dietary supplements in the prevention of allergic symptoms.

Role of Nasal Saline Sprays :

Rinsing of nasal cavity with saline (saltwater) helps in thinning the mucus, making it easier to be removed. It also helps in removing allergens, thus decreasing the irritation of nasal mucosa¹⁹.

A recent Cochrane review by Head *et al* evaluated the advantages of nasal saline irrigation in adults and children¹⁹. It has been found that nasal saline irrigation is better than no saline irrigation for relieving allergic rhinitis in both adults and children. No adverse effects has been noted with saline nasal irrigation. However, it was doubtful whether addition of nasal saline irrigation along with pharmacological treatment was useful in improving allergic rhinitis symptomatically as compared to pharmacological treatment alone. Further, there was no clear evidence to suggest that nasal saline irrigation was better, worse, or had the same benefits as

intranasal steroids. There is also a lack of studies which compares nasal saline irrigation against oral antihistamines¹⁹.

Nevertheless, it was suggested that saline nasal irrigation is safe, cheap and acceptable alternative to pharmacological treatment like intranasal steroids and antihistamines. High quality and adequately powered research done in this field could help in improving the acceptability of this approach¹⁹.

Expert comments/opinion/consensus :

- Nasal saline sprays are useful for symptom relief in allergic rhinitis.
- The exact mechanism of action is not known—could be because of thinning of mucus, making it easier to remove.
- Further long-term efficacy studies are necessary to highlight the efficacy of nasal saline sprays in pollution-induced allergic rhinitis.

Conclusion :

Pollution-induced upper airway disorder is a cause of concern among children as well as adults. The avoidance of allergens and pollutants along with the use of an appropriate mask can be a useful approach. The regular use of steroids, antihistamines and other pharmacological measures may not be an appropriate option. saline nasal irrigation is safe, cheap and acceptable alternative to pharmacological treatment like intranasal steroids and antihistamines. High quality and adequately powered research done in this field is warranted.

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