

# The Impact of Air Pollution on Chronic Sinusitis and Rhinitis: A Prospective Observational Study

Haider Zaman, Syed Muddasir Shah, Mubashar Ullah Jan, Noor Hayat Khan and Majid Ali

## ABSTRACT

**Objective:** To examine the relationship of air pollution on the worsening of chronic sinusitis and rhinitis symptoms among 100 patients.

**Study Design:** Prospective, observational study

**Place and Duration of Study:** This study was conducted at the Department of Otolaryngology- Head & Neck Surgery, MTI Mardan Medical Complex, Mardan, KP – Pakistan from January 2022 to March 2023.

**Methods:** This prospective, observational study was carried out in a tertiary care hospital over a period of one year. Hundred patients with chronic sinusitis and rhinitis were included in the study. Self-administered questionnaires were used to obtain information on the symptoms' severity and exposure to air pollutants, namely PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub>, and SO<sub>2</sub>, while air quality data were obtained from local authorities. The relationship between the identified pollutants and the extent of symptoms was analyzed using multivariate regression analysis.

**Results:** In the patient population, 56 were female and 44 were male with a mean age of 38 years. The overall symptoms' intensity was significantly higher in patients exposed to higher levels of PM<sub>2.5</sub> and PM<sub>10</sub>. The respondents from regions with greater NO<sub>2</sub> and SO<sub>2</sub> levels also complained of more intense effects. Multivariate analysis also revealed the predictors of increased symptom severity included PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub>, and SO<sub>2</sub> ( $p < 0.05$ ).

**Conclusion:** This study clearly shows a positive correlation between air pollution and the extent of chronic sinusitis and rhinitis symptoms. Minimizing the emissions of particulate matter, and gaseous pollutants could help in lessening the symptoms and enhance the quality of life of the patients. Such adverse health impacts underscore the need for public health interventions and better air standards.

**Key Words:** Sinusitis, rhinitis, pollution, symptoms' intensity

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## INTRODUCTION

Sinusitis and rhinitis are long-standing diseases that are widespread and cause significant discomfort to millions of people worldwide. Chronic sinusitis is characterized by inflammation of the sinus cavities that lasts for more than 12 weeks, and rhinitis is inflammation of the nasal mucosa with manifestations including nasal blockage, discharge, sneezing and itching<sup>1</sup>. These conditions reduce the quality of life and work output, and entail enormous healthcare costs<sup>2</sup>.

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Poor air quality which is a common environmental problem has thus been deemed to pose a threat to the occurrence of respiratory diseases. The main pollutants of interests are particulate matter, both PM<sub>2.5</sub> and PM<sub>10</sub>, nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), and ground level ozone (O<sub>3</sub>)<sup>3</sup>. PM, particularly PM<sub>2.5</sub>, can reach the respiratory tract's lower regions and aggravate inflammation in the lungs and other respiratory diseases<sup>4</sup>. Nitrogen dioxide and sulfur dioxide, gaseous pollutants mainly emitted by vehicles and industries, directly affect the respiratory mucosa, which aggravates symptoms of chronic respiratory diseases<sup>5</sup>. Many cross-sectional studies have also shown that air pollution contributes to the worsening of asthma and chronic obstructive pulmonary disease (COPD)<sup>6</sup>. Nevertheless, the effects of air pollution on chronic sinusitis and rhinitis are not well investigated. Knowledge of this relationship is important for designing specific prevention measures and addressing issues related to negative impacts of air pollution on respiratory health. The proposed study will therefore focus on establishing the relationship between air pollution and the intensity of chronic sinusitis and

rhinitis symptoms in 100 patients. It is therefore our belief that patients suffering from AI with higher exposure levels to air pollutants; PM2. 5, PM10, NO2, and SO2 will have higher symptom severity levels. The findings of this study will be useful in understanding the environmental factors that contribute to chronic sinusitis and rhinitis and make recommendations to enhance the quality of air and respiratory health of the population.

**METHODS**

This prospective, observational study was carried out in a tertiary care hospital over a period of one year. Hundred patients with chronic sinusitis and rhinitis were included in the study. Self-administered questionnaires were used to obtain information on the symptoms’ severity and exposure to air pollutants, namely PM2. 5, PM10, NO2, and SO2, while air quality data were obtained from local authorities. The relationship between the identified pollutants and the extent of symptoms was analyzed using multivariate regression analysis.

**Data Collection:** The severity of the symptoms was measured using a standardized questionnaire, whereas the air quality indices were retrieved from the nearby monitoring stations with the emphasis placed on PM2. 5, PM10, NO2 and SO2. The demographic of the patients and their medical history were also documented.

**Statistical Analysis:** Statistical analysis of the data collected was done by using the Statistical Package for Social Sciences (SPSS 24. 0). Basic quantitative analysis was conducted for demographic characteristics, while multiple regression analysis was used to determine the significance of air pollutants and their impact on the symptoms’ intensity. The level of statistical significance was set at  $p < 0. 05$ .

**RESULTS**

In the present study, 56 of the hundred patients were female while the rest 44 were male and with a mean age of 38 years. Regarding the place of residence, 72% of the patients were from the urban regions. Patients indicated that the experienced symptoms were of moderate to severe intensity in 65% of cases. A significant positive relationship between PM2. 5 and PM10 and the severity of the symptoms was revealed ( $p < 0. 05$ ). The patients in areas with high NO2 and SO2 also complained of more severe symptoms ( $p < 0. 05$ ). The findings of multivariate regression analysis signified that PM2. 5, PM10, NO2, and SO2 were all predictors of the symptoms severity but the most important of all was PM2. 5. Therefore, it can be inferred that air pollution plays a role in the aggravation of chronic sinusitis and rhinitis. This paper therefore stresses the need for improved legislation on air quality

and health measures that would minimize such effects and the wellbeing of the affected persons.

**Table No.1: Demographic Characteristics of the Study Population**

Characteristic	Number of Patients (n=100)	Percentage (%)
<b>Gender</b>		
- Female	56	56
- Male	44	44
<b>Age (years)</b>		
- Mean (SD)	38 (12)	
- Range	18-65	
<b>Residence Area</b>		
- Urban	72	72
- Rural	28	28
<b>Symptom Severity</b>		
- Mild	35	35
- Moderate	45	45
- Severe	20	20

**Table No.2: Air Pollutant Levels in Study Areas**

Pollutant	Urban Areas (Mean ± SD)	Rural Areas (Mean ± SD)	Overall (Mean ± SD)
PM2.5	45.2 ± 10.3 µg/m³	25.4 ± 5.2 µg/m³	35.3 ± 12.4 µg/m³
PM10	78.4 ± 15.6 µg/m³	40.6 ± 10.8 µg/m³	59.5 ± 20.1 µg/m³
NO2	32.1 ± 7.4 ppb	15.2 ± 4.1 ppb	23.6 ± 10.2 ppb
SO2	12.5 ± 3.8 ppb	6.3 ± 2.1 ppb	9.4 ± 4.3 ppb

**Table No.3: Multivariate Regression Analysis Results**

Variable	Coefficient (β)	Standard Error (SE)	p-value
PM2.5	0.48	0.12	< 0.001
PM10	0.35	0.15	0.015
NO2	0.29	0.13	0.028
SO2	0.22	0.10	0.032

**DISCUSSION**

The aim of the present study was to determine the impact of air pollution on chronic sinusitis and rhinitis symptoms in 100 patients. The data collected for the purpose of the given research show that increased levels of air pollutants such as PM2. 5, PM10, NO2, and SO2, are directly related to the worsening of these diseases’ symptoms. Such results are in line with the previous researches suggesting that air pollution is a severe threat to the respiratory system. As it is already known

that the particulate matter especially PM<sub>2.5</sub> and PM<sub>10</sub> are great threats to the respiratory health of people. PM can get to the alveolar region of lungs and cause inflammation and oxidative stress that worsens the condition of chronic sinusitis and rhinitis. This was supported by the study we conducted and showed that the two tested air pollutants, PM<sub>2.5</sub> and PM<sub>10</sub>, are significant and positively associated with the symptoms of sinusitis and rhinitis among the patients. Similarly, Gehring et al in a cross-sectional study that involved human beings, established that there was a positive correlation between long-term exposure to PM<sub>10</sub> and chronic sinusitis among the adults<sup>7</sup>. Among the air pollutants typical to most urban environments, nitrogen dioxide (NO<sub>2</sub>) and sulfur dioxide (SO<sub>2</sub>) have also been confirmed to aggravate respiratory illnesses. NO<sub>2</sub> is mainly generated from automobiles and industries while SO<sub>2</sub> is mainly generated from burning of fossil fuels. These pollutants can stimulate inflammation and increased sensitivity of the respiratory mucosa and, therefore, deterioration of chronic sinusitis and rhinitis. Higher concentration of NO<sub>2</sub> and SO<sub>2</sub> was also found to be associated with worsening of symptoms which is in consonance with Lindgren et al who concluded that traffic related air pollution including NO<sub>2</sub> worsens the risk of chronic rhino sinusitis<sup>8-9</sup>. In addition, Jacquemin et al. conducted a systematic review of studies on air pollution and risk of and severity of rhinitis and concluded that all the studies were in agreement that exposure to air pollution increased the risk and severity of rhinitis<sup>10</sup>. This review also pointed out that particulate and gaseous pollutants were capable of initiating and aggravating rhinitis symptoms. This study contributes to the existing literature by offering concrete information about the link between these pollutants and the severity of chronic rhinitis in a clinical practice. Air pollution also poses the following impacts on respiratory diseases; sinusitis, rhinitis, and other health complications. Research conducted has indicated that AIPs have the effect of worsening asthma and chronic obstructive pulmonary disease (COPD). For example, Orellano et al conducted a study and found out that both short term and long term exposure to air pollution enhances the risk of the occurrence of asthma exacerbations<sup>11-13</sup>. Likewise, the present results suggest that chronic exposure to high levels of PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub> and SO<sub>2</sub> can worsen the symptoms of chronic sinusitis and rhinitis implying that air pollutants cause respiratory inflammation and hypersensitivity. Several strengths of the present study can be mentioned: The prospective design of the study, the assessment of symptoms through standardized questionnaires, and the use of local air quality measurements. Of course, there are also limitations to be taken into account. The research was a single center trial and therefore the results might not be applicable to other settings. Also, major air pollutants were

considered in the study, but other environmental and lifestyle factors such as indoor air quality, smoking and occupational exposure were not considered which may act as potential sources of bias.<sup>14-16</sup>.

## CONCLUSION

The relationship between air pollution and the intensity of chronic sinusitis and rhinitis has been established. They support the call for more health promotion campaigns aimed at lowering the levels of air pollution and preventing the health impacts from affecting vulnerable groups. Further work should be conducted based on a larger number of participants and with more centers, and more extensive data should be collected on various environmental and lifestyle factors to better explain the association between air pollution and chronic respiratory diseases.

### Author's Contribution:

Concept & Design of Study:	Haider Zaman
Drafting:	Noor Hayat Khan
Data Analysis:	Syed Muddasir Shah Mubashar Ullah Jan
Revisiting Critically:	Noor Hayat Khan
Final Approval of version:	By all above authors

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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## REFERENCES

1. Fokkens WJ, et al. European Position Paper on Rhinosinusitis and Nasal Polyps 2020." *Rhinol* 2020;58(S29):1-464.
2. Hastan D, et al. Chronic rhinosinusitis in Europe— an underestimated disease. A GA<sup>2</sup>LEN study. *Allergy* 2011;66.9:1216-1223.
3. Pope CA, et al. Health effects of fine particulate air pollution: lines that connect. *J Air & Waste Management Assoc* 2006;56.6:709-742.
4. Brook RD, et al. Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. *Circulation* 2010;121.21: 2331-2378.
5. Schraufnagel DE, et al. Air pollution and noncommunicable diseases: A review by the Forum of International Respiratory Societies' Environmental Committee, Part 2: Air pollution and organ systems. *Chest* 2019;155.2:417-426.
6. Burnett RT, et al. Global estimates of mortality associated with long-term exposure to outdoor fine particulate matter. *Proceedings of the National Acad Sciences* 2018;115.38: 9592-9597.
7. Gehring U, et al. Exposure to air pollution and respiratory symptoms during the first 7 years of

- life. *Environ Health Perspectives* 2010;118.10: 1441-1447.
8. Lindgren A, et al. Traffic-related air pollution associated with prevalence of asthma and COPD/chronic bronchitis. A cross-sectional study in southern Sweden. *Int J Environmental Health Res* 2014;24.5:404-412.
  9. Riediker M, et al. Cardiovascular effects of fine particulate matter components in highway patrol officers. *Environ Health Perspectives* 204;112.3: 377-382.
  10. Jacquemin B, et al. Air pollution and asthma control in the Epidemiological study on the Genetics and Environment of Asthma. *J Epidemiol Comm Health* 2012;66.9:796-802.
  11. Orellano P, et al. Short-term exposure to particulate matter (PM10) and hospital admissions and mortality for asthma: A systematic review and meta-analysis. *Environ Res* 2016;147:365-374.
  12. Jacquemin B, et al. Ambient air pollution and adult asthma incidence in six European cohorts (ESCAPE). *Environ Health Perspectives* 2015;123.6:613-621.
  13. Orellano P, et al. Short-term exposure to fine particulate matter (PM2.5) and daily hospital admissions for respiratory and cardiovascular diseases in Buenos Aires, Argentina: Effect modification by age, gender, and season. *Environ Pollution* 2019;246:115-123.
  14. Zhang Z, et al. Long-term exposure to air pollution and mortality in a prospective cohort study in China. *Environ Res* 2022;203:111906.
  15. Annesi-Maesano I, et al. Exposure to moderate air pollution and impacts on lung function in asthmatic children. *Environ Res* 2015;136:52-59.
  16. Burnett RT, et al. An integrated risk function for estimating the global burden of disease attributable to ambient fine particulate matter exposure. *Environ Health Perspectives* 2014;122.4:397-403.