RESEARCH PAPER

Effect of Nasal Saline Irrigation Compared with Baseline Condition on Interleukin-5 Levels and Total Nasal Symptom Score in Workers with Occupational Rhinitis

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ABSTRACT

Background and Aim: Occupational rhinitis (OR) is an inflammatory airway disease caused by workplace irritants like wood dust. Chronic exposure triggers type-2 inflammatory responses with elevated cytokines, including interleukin-5 (IL-5), and nasal symptoms. Nasal saline irrigation is recommended for inflammatory nasal conditions, but evidence of its effect on inflammatory biomarkers in occupational rhinitis remains limited. This study aimed to evaluate the effectiveness of nasal saline irrigation on plasma IL-5 levels and Total Nasal Symptom Score (TNSS) among workers with occupational rhinitis.

Methods: A one-group pretest–posttest experimental study was conducted among 34 workers exposed to wood dust at a wood-processing factory in Takalar, Indonesia. Participants performed nasal irrigation using isotonic saline for four weeks. Plasma IL-5 levels were measured using ELISA, and nasal symptom severity was assessed using TNSS before and after the intervention. Statistical analysis included paired sample tests and Spearman correlation analysis.

Results: After four weeks of intervention, plasma IL-5 levels significantly decreased from 4365.5 pg/mL to 3427.0 pg/mL ($p < 0.001$). Clinical symptoms also improved significantly, with mean TNSS decreasing from 7.32 ± 0.53 to 2.8 ± 1.5 ($p < 0.001$). Nasal obstruction showed the greatest improvement among symptom components. Correlation analysis revealed a significant positive association between the reduction in IL-5 levels and improvement in TNSS scores ($r = 0.341$; $p = 0.049$).

Conclusions: Nasal saline irrigation reduced inflammatory biomarkers and improved nasal symptoms in workers with occupational rhinitis. This simple, low-cost intervention may benefit individuals exposed to occupational respiratory irritants.

Keywords: *Rhinitis, Occupational, Nasal Lavage, Interleukin-5, Symptom Assessment, Wood Dust*
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INTRODUCTION

Occupational rhinitis (OR) is defined as an inflammatory condition of the nasal mucosa that develops as a consequence of exposure to specific agents present in the workplace among individuals who were previously asymptomatic.[1,2]. The European Academy of Allergy and Clinical Immunology describes OR as nasal inflammation characterized by symptoms such as nasal obstruction, rhinorrhea, nasal itching, and sneezing that occur intermittently or persistently due to occupational exposure rather than environmental stimuli outside the workplace.[1,3] OR is considered one of the most common occupational airway diseases and has been reported to affect approximately 15% of workers globally. [2]

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Occupational exposure to allergens or irritants can induce inflammatory responses in the nasal mucosa through immunological or non-immunological mechanisms.[2,4] Sensitization-induced OR is commonly associated with exposure to high-molecular-weight proteins derived from plant or animal sources or low-molecular-weight chemical agents such as reactive chemicals, metals, and wood dust.[5,6] These exposures trigger mast cell degranulation and the release of inflammatory mediators, including histamine, leukotrienes, tryptase, and cytokines, which increase vascular permeability, mucus secretion, and recruitment of inflammatory cells within the nasal mucosa.[7,8]

Interleukin-5 (IL-5) plays a critical role in allergic airway inflammation and is closely associated with eosinophilic responses in the respiratory mucosa.[1,9] IL-5 regulates eosinophil maturation, activation, and survival, making it an important biomarker of allergic inflammation in respiratory diseases.[1,10] Clinically, the severity of nasal symptoms in rhinitis can be assessed using the Total Nasal Symptom Score (TNSS), a validated scoring system that quantifies nasal obstruction, rhinorrhea, itching, and sneezing.[11]

Nasal saline irrigation has been recommended as a supportive therapy for inflammatory nasal diseases because it improves mucociliary clearance and helps remove inflammatory mediators and irritants from the nasal mucosa.[12,13] Previous studies have also shown that nasal irrigation can enhance mucociliary transport and reduce nasal inflammatory responses.[14] Therefore, this study aimed to evaluate the effectiveness of nasal saline irrigation on IL-5 levels and TNSS in patients with occupational rhinitis.

MATERIALS AND METHODS

Study Design

This study employed an experimental design using a one-group pretest–posttest approach to evaluate the effectiveness of nasal saline irrigation on inflammatory biomarkers and clinical symptoms in patients with occupational rhinitis. Primary data were collected through the TNSS questionnaire and immunoserological examination of interleukin-5 levels before and after the intervention.

Study Setting, Period, Study Population, and Sampling

The study was conducted between April and December 2025. Participant recruitment was carried out among workers in a wood processing facility located in South Sulawesi, Indonesia. Laboratory analysis of IL-5 levels was performed at an accredited medical research laboratory. Nasal cytology examinations for eosinophil identification were conducted at a certified clinical microbiology laboratory.

The target population consisted of workers employed in the wood processing area who met the eligibility criteria. Participants were recruited using a consecutive sampling technique, in which all eligible workers presenting with symptoms consistent with occupational rhinitis were included until the required sample size was achieved.

Eligibility Criteria

Participants were included if they were workers at the wood powder factory with symptoms suggestive of rhinitis, including nasal obstruction, rhinorrhea, or nasal itching; had plasma IL-5 levels were increased; were aged above 20 years; had been exposed to wood dust for at least one year; and provided informed consent to participate in the study. Individuals were excluded if they had severe pulmonary diseases such as tuberculosis, chronic bronchitis, or chronic obstructive pulmonary disease, had immunocompromised conditions or a history of long-term corticosteroid therapy, or provided incomplete questionnaire data.

Study Instruments

Plasma IL-5 levels were measured using an enzyme-linked immunosorbent assay (ELISA) technique with the Magnetic Luminex Performance Assay Human IL-5 High Sensitive kit (catalog number HUEB0028). Nasal saline irrigation was performed using isotonic saline solution. Clinical symptom severity was assessed using the validated TNSS questionnaire.

Laboratory Procedures

Venous blood samples of approximately 1.5–3 mL were collected using EDTA tubes. Samples were centrifuged at 1000 rpm for 15 minutes to obtain plasma, which was subsequently analyzed for IL-5 levels using the ELISA method according to the manufacturer’s protocol. The assay involved the addition of reagents and plasma samples to microplate wells, incubation at room temperature, washing procedures, addition of conjugate solution and substrate, and colorimetric detection. Optical density was measured using a microplate reader to determine IL-5 concentrations.

Study Procedures

Workers with symptoms suggestive of occupational rhinitis were screened and assessed for eligibility. Baseline data including age, sex, work duration, and smoking history were collected. Clinical evaluation was performed through history taking and ear, nose, and throat examination to support the diagnosis of occupational rhinitis. Blood samples were collected to determine baseline IL-5 levels. Participants then received education on performing nasal irrigation using isotonic saline solution. TNSS assessment and IL-5 measurements were conducted before the intervention and repeated after four weeks of nasal saline irrigation combined with standard therapy.

Statistical Analysis

Data processing included data cleaning, coding, tabulation, and entry into the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive analysis was performed to summarize demographic and clinical characteristics of participants. Continuous variables were presented as mean and standard deviation, while categorical variables were expressed as frequencies and percentages. The effectiveness of nasal saline irrigation was evaluated using a paired sample t-test to compare pre- and post-intervention IL-5 levels and TNSS scores. Statistical significance was defined as a p-value of ≤0.05.

RESULTS

Participant Characteristics

A total of 34 subjects were included in this study. The mean age of participants was 50.1 ± 10.12 years. All participants were male and were employed as workers in the wood powder production area of PT Bumi Runut Bersama, Takalar Regency, South Sulawesi, Indonesia. All subjects received nasal irrigation using isotonic saline as the intervention. The demographic and occupational characteristics of the study participants are presented in Table 1.

Table 1: Characteristics of Study Participants

Variable	Value (n = 34)
Age, Mean ± SD	50.1 ± 10.12
Sex, n (%)	
Male	34 (100)
Female	0 (0)
Occupation, n (%)	
Wood Dust Factory Workers	34 (100)
Therapy, n (%)	
Nasal saline irrigation (isotonic solution)	34 (100)

Distribution of IL-5 Levels and Total Nasal Symptom Score

Descriptive analysis was conducted to describe the distribution of plasma IL-5 levels and TNSS before proceeding to hypothesis testing. This step provided an overview of the variability of the study variables and informed the selection of appropriate statistical analysis based on the distribution of the data.

As shown in Table 2, both IL-5 levels and TNSS demonstrated considerable variability before and after the intervention. Baseline IL-5 levels ranged from 3990.3 pg/mL to 4917.2 pg/mL, with a median value of 4381.5 pg/mL and a mean of 4365.5 ± 216.7 pg/mL. After the intervention, IL-5 levels ranged from 1537.3 pg/mL to 6535.9 pg/mL, with a median value of 3166.9 pg/mL and a mean of 3427.0 ± 835.5 pg/mL.

Similarly, TNSS values also demonstrated changes following the intervention. Prior to treatment, TNSS ranged from 7 to 9 with a median score of 7.0 and a mean of 7.3 ± 0.5. After nasal saline irrigation, TNSS values ranged from 1 to 9 with a median score of 3.0 and a mean of 2.8 ± 1.5, indicating an overall reduction in nasal symptom severity. The detailed descriptive statistics of IL-5 levels and TNSS before and after the intervention are summarized in Table 2.

Table 2: Descriptive Statistics of IL-5 Levels and Total Nasal Symptom Score

Variable	Min	Max	Median	Mean	SD
IL-5 Level (pg/mL) Pre	3990.3	4917.2	4381.5	4365.5	216.7
IL-5 Level (pg/mL) Post	1537.3	6535.9	3166.9	3427.0	835.5
TNSS Pre	7	9	7.0	7.3	0.5
TNSS Post	1	9	3.0	2.8	1.5

Comparison of Plasma IL-5 Levels

Plasma interleukin-5 levels were measured to evaluate changes in inflammatory response before and after the nasal saline irrigation intervention. As presented in Table 3, a significant reduction in plasma IL-5 levels was observed following four weeks of regular nasal irrigation. The mean IL-5 level decreased from 4365.5 pg/mL before the intervention to 3427.0 pg/mL after the intervention. Similarly, the median IL-5 level declined from 4381.5 pg/mL in the pre-intervention measurement to 3166.9 pg/mL after the intervention (see Table 2). Statistical analysis demonstrated that this reduction was highly significant ($p < 0.001$), indicating a significant decrease in plasma IL-5 levels following nasal saline irrigation. The detailed comparison of IL-5 levels before and after the intervention is presented in Table 3.

Table 3. Comparison of Plasma IL-5 Levels Before and After the Intervention

Variable	n	Mean	SD	p-value
IL-5 Level (pg/mL) Pre	34	4365.5	216.7	
IL-5 Level (pg/mL) Post	34	3427.0	835.5	< 0.001*

*Wilcoxon Signed Ranks Test.

Comparison of Total Nasal Symptom Score

The clinical effectiveness of nasal saline irrigation was evaluated by comparing the TNSS before and after four weeks of intervention. As shown in Table 4, a significant reduction in TNSS was observed following the intervention ($p < 0.001$). The mean TNSS decreased from 7.32 ± 0.53 before treatment, indicating moderate symptom severity, to 2.8 ± 1.5 after four weeks of nasal saline irrigation. Most participants (94.1%) experienced an improvement in symptom severity, transitioning to the mild category after the intervention.

Table 4. Comparative Analysis of TNSS Scores Before and After the Intervention

Variable	n	Mean	SD	p-value
TNSS Pre	34	7.32	0.53	< 0.001*
TNSS Post	34	2.82	1.55	

*Wilcoxon Signed Ranks Test.

Table 5. Comparison of TNSS Components Scores Before and After the Intervention (n=34)

Components	Mean	SD	p-value
Sneezing Pre	1.15	0.359	< 0.001*
Sneezing Post	0.29	0.462	
Rhinorrhea Pre	1.44	0.561	< 0.001*
Rhinorrhea Post	0.35	0.646	
Nasal Obstruction Pre	2.91	0.514	< 0.001*
Nasal Obstruction Post	1.41	0.701	
Nasal Itching Pre	1.82	0.387	< 0.001*
Nasal Itching Post	0.76	0.496	

*Wilcoxon Signed Ranks Test.

Further analysis of individual symptom components, including sneezing, rhinorrhea, nasal obstruction, and nasal itching, also demonstrated significant reductions across all domains ($p < 0.001$). Nasal obstruction was the most prominent symptom at baseline with a mean score of 2.91 ± 0.51, which decreased to 1.41 ± 0.70 after the intervention. Similar improvements were observed for sneezing, rhinorrhea, and nasal itching, with mean scores declining to below 1.0 at the end of the observation period. The detailed comparison of TNSS scores and their individual components before and after the intervention is presented in Tables 4 and 5 or Figure 1.

Correlation between Plasma IL-5 Levels and TNSS

Correlation analysis was performed to evaluate the relationship between changes in plasma IL-5 levels and changes in TNSS following the intervention. The differences between pre- and post-intervention values (Δ) were used for this analysis. As presented in Table 6, Spearman correlation analysis demonstrated a significant positive correlation between the reduction in IL-5 levels and the reduction in TNSS scores ($r = 0.341$; $p = 0.049$). This finding indicates that greater decreases in plasma IL-5 levels were associated with greater improvements in nasal symptoms among the study participants.

DISCUSSION

Occupational rhinitis is an inflammatory condition of the nasal mucosa caused by exposure to workplace agents such as wood dust, which is commonly encountered in the woodworking industry. [1] In this study, all participants were male workers with a mean age of 50.1 ± 10.12 years, reflecting the demographic profile of labor-intensive industrial sectors where occupational exposure to dust particles is common. Previous studies have reported that occupational rhinitis is more frequently observed among male workers due to higher exposure to irritants and sensitizing agents in industrial environments.[6] Chronic exposure to wood dust can induce persistent airway inflammation through both IgE-mediated and non–IgE-mediated mechanisms and may disrupt the epithelial barrier of the nasal mucosa, facilitating immune activation and inflammatory responses.[4,15]

The present study demonstrated a significant reduction in plasma IL-5 levels after four weeks of nasal saline irrigation. IL-5 is a key cytokine involved in type-2 inflammatory responses and plays an important role in eosinophil activation and survival in airway inflammation.[16] The reduction in IL-5 observed in this study may be attributed to the mechanical clearance of irritants, allergens, and inflammatory mediators from the nasal cavity through saline irrigation, thereby reducing ongoing antigenic stimulation and Th2-mediated inflammatory responses.[4] In addition, nasal saline irrigation may improve mucociliary clearance and help restore epithelial barrier function, both of which are essential for maintaining airway defense mechanisms.[15] Similar findings have been reported in previous studies demonstrating that nasal irrigation can reduce inflammatory mediator levels and improve mucociliary function in inflammatory nasal conditions.[17]

In parallel with the immunological findings, a significant improvement in clinical symptoms was observed as reflected by the reduction in TNSS. Nasal obstruction was the most prominent symptom at baseline and showed the greatest improvement after intervention. Saline irrigation may reduce mucosal edema, improve mucosal hydration, and enhance mucociliary clearance, thereby alleviating nasal congestion and improving airflow.[18] Improvements were also observed in other symptoms such as rhinorrhea, sneezing, and nasal itching, which are mediated by inflammatory mediators including histamine and leukotrienes.[19] The TNSS instrument has been widely used as a reliable tool for evaluating symptom severity and treatment response in rhinitis.[20]

Furthermore, a significant positive correlation was observed between the reduction in plasma IL-5 levels and the improvement in TNSS scores. This finding indicates that clinical symptom improvement was accompanied by measurable reductions in inflammatory activity. IL-5 is closely associated with eosinophilic inflammation in the airway mucosa, and its reduction may reflect decreased inflammatory burden within the nasal tissues.[16] Although the correlation strength was moderate, the significant association supports the role of nasal saline irrigation not only as a mechanical cleansing intervention but also as a potential modulator of inflammatory pathways in occupational rhinitis.

LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. First, the study used a one-group pretest–posttest design without a control group, which limits the ability to attribute the observed improvements solely to nasal saline irrigation. Second, the relatively small sample size and the inclusion of workers from a single industrial setting may limit the generalizability of the results to other occupational populations. Third, the follow-up period was limited to four weeks, preventing evaluation of the long-term effects of nasal saline irrigation on inflammatory biomarkers and clinical outcomes. Future studies with larger sample sizes, controlled designs, and longer follow-up periods are needed to further confirm the effectiveness of this intervention in occupational rhinitis.

CONCLUSION

Nasal saline irrigation significantly reduced plasma IL-5 levels after four weeks among workers exposed to wood dust, indicating a potential role in modulating inflammatory responses associated with occupational rhinitis. The reduction in IL-5 levels was significantly correlated with improvement in nasal symptoms as measured by the TNSS. Overall, participants experienced marked clinical improvement, with symptom severity decreasing from moderate to mild, particularly in nasal obstruction. These findings suggest that nasal saline irrigation may represent a simple and effective intervention for managing occupational rhinitis.

Ethic approval: The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from an appropriate institutional health research ethics committee (Protocol No. UH25050301; Approval No. 409/UN4.6.4.5.31/PP36/2025; 14 June 2025). Written informed consent was obtained from all participants prior to their inclusion in the study.

Conflict of Interest: The authors declare that they have no competing interests.

Authors Contribution: MAB conceptualized and designed the study, collected the data, and drafted the manuscript. MFP, YA, SPR, and AQP contributed to the study design, data analysis and interpretation, and critically revised the manuscript for important intellectual content. All authors provided final approval of the version to be published and agreed to be accountable for all aspects of the work.

Declaration on the use of AI: ChatGPT (OpenAI) was used minimally for language polishing and improvement of wording only. No AI was used for data generation, analysis, interpretation, or scientific writing. The authors take full responsibility for the final content.

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