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The relationship between allergic rhinitis and asthma in patients with rhinosinusitis

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ABSTRACT

Introduction: Allergic rhinitis and asthma are the most common diseases worldwide, and both have interconnected inflammatory processes. Allergic rhinitis, asthma, and rhinosinusitis are closely related, where patients with a history of allergic rhinitis or asthma, or even both, can develop rhinosinusitis. This study aims to determine the relationship between allergic rhinitis and asthma with rhinosinusitis at Ibnu Sina Hospital, Gresik.

Method: A total of 300 patients were enrolled in this study. Using the total sampling method, samples were selected from the entire population of rhinosinusitis patients who received outpatient or inpatient care at the THT-KL Clinic in Ibnu Sina Hospital, Gresik, during the period 2020-2022. Secondary data extracted from the patients' medical records at Ibnu Sina Hospital, Gresik. Subsequently, the collected data was analyzed through Spearman's correlation test and multiple linear regression analysis.

Results: The relationship between allergic rhinitis and rhinosinusitis yielding a p-value of 0.022. The obtained correlation coefficient was 0.132. The relationship between asthma and rhinosinusitis resulting in a p-value of 0.000 with correlation coefficient of 0.587. The relationship between allergic rhinitis and asthma together with rhinosinusitis was examined using multiple linear regression analysis, resulting in a p-value from the F-test of 0.000, with correlation coefficient of 0.599.

Conclusion: Significant relationship has been found between allergic rhinitis and asthma with rhinosinusitis in patients with rhinosinusitis undergoing outpatient or inpatient treatment at Ibnu Sina Hospital, Gresik, during the period of 2020-2022.

Keywords: Allergic Rhinitis, Asthma, Rhinosinusitis.
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INTRODUCTION

Allergic rhinitis is broadly defined as inflammation of the nasal mucosa and is a common disorder that can affect up to 40% of the population's quality of life.[1] Major comorbidities in patients with allergic rhinitis include asthma, sinusitis, allergic conjunctivitis, otitis media, and sleep disturbances.[2] The prevalence of allergic rhinitis in Indonesia is estimated to range from 10-20% and continues to increase.[3] The incidence of rhinosinusitis is also rising in line with the increasing cases of allergic rhinitis. This poses a health problem as the financial burden on rhinosinusitis patients will also increase. Allergic rhinitis disrupts the activities of those affected by causing swelling in the nasal mucosa, particularly at the sinus ostium. This swelling hinders ventilation and results in the retention of mucus and infections.[4] Because the nasal mucosa and sinus mucosa are interconnected, the sinus mucosa becomes inflamed when there is an infection in the nasal mucosa. Patients with allergic rhinitis who also experience rhinosinusitis will exhibit more severe symptoms compared to those who suffer from only one of these diseases.[5]

A number of patients with rhinosinusitis also have a history of asthma. In patients with rhinosinusitis and comorbid asthma, the prognosis of their rhinosinusitis worsens.[6] Histopathological findings in asthma patients show typical features, including an increase in mast cell, eosinophil, and lymphocyte levels. Other characteristic features seen in asthma patients include mucosal edema due to an increase in mucus produced by goblet cells, epithelial cell desquamation, respiratory smooth muscle hyperplasia, and airway constriction.[7] Both diseases also share the same immunological basis, which involves the dominant role of TH2 lymphocytes in the inflammatory process during the sensitization phase to allergens, aiding in the synthesis of IgE by B cells, and leading to the release of several cytokines, including IL-3, IL-4, IL-5, IL-13, and TNF-α.[6]

Allergic rhinitis, asthma, and rhinosinusitis have a close relationship, with patients who have a history of either allergic rhinitis or asthma, or both, being prone to developing rhinosinusitis. In asthma patients, allergic rhinitis symptoms are often found, which may then progress to rhinosinusitis, as these three diseases are part of a group of upper and lower respiratory tract disorders.[8] In Indonesia, 80% of asthma patients are found to have allergic rhinitis, which contributes to the occurrence of rhinosinusitis in 50% of cases.[9]

This study aimed to investigate the relationship between allergic rhinitis and asthma with rhinosinusitis at Ibnu Sina Hospital, Gresik. This research also aimed to provide knowledge about the connection between allergic rhnitis, asthma, and rhinosinusitis, in hope

that clinician could manage allergic rhinitis and asthma effectively to prevent rhinosinusitis complications.

METHOD

This study employed an analytical observational design with a cross-sectional study using secondary data obtained from medical records of patients at Ibnu Sina Hospital, Gresik. The sample size for this study includes all rhinosinusitis patients based on inclusion and exclusion criteria during the period from January 2020 to October 2022.

The inclusion criteria for this study are patients with rhinosinusitis who suffer from allergic rhinitis, patients with rhinosinusitis who suffer from asthma, aged between 5-30 years, and have undergone outpatient or inpatient treatment at Ibnu Sina Hospital, Gresik, during the period from January 2020 to October 2022. The exclusion criteria are the required data is not available and incomplete medical records. The sampling technique used is Total Sampling. The diagnosis of rhinosinusitis and allergic rhinitis were made by an ENT Specialist, while asthma diagnosis was done by a pulmonologist doctor. The independent variables in this study are allergic rhinitis and asthma. The dependent variable is rhinosinusitis, and the confounding variables are autoimmune, therapy, and anatomical structural nasal abnormalities. Anatomical structural nasal abnormalities were found through anterior rhinoscopy by physical diagnostic that was done by an ENT doctor.

Following data collection, an analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software. The data exhibited ordinal scaling, necessitating the application of non-parametric statistical tests. To assess the relationship between the two variables between rhinosinusitis and allergic rhinitis, or rhinosinusitis and asthma, Spearman's rank correlation coefficient was employed. This approach has the advantage of not requiring preliminary tests for normality or homogeneity of variance. Additionally, a multiple correlation analysis, informed by regression analysis principles, was performed to explore the relationship between the three variables.

RESULTS

Out of a total of 300 samples, 33 samples were of allergic rhinitis, 10 samples were of allergic rhinitis and asthma, 90 samples were of allergic rhinitis and rhinosinusitis, 68 samples were of asthma only, 15 samples were of asthma and rhinosinusitis, 75 samples were of rhinosinusitis only, and 9 samples were diagnosed with allergic rhinitis, asthma, and rhinosinusitis.

The relationship between allergic rhinitis and rhinosinusitis yielding a p-value of 0.022, which is smaller than α (alpha) of 0.05. Therefore, it can be concluded that there was a significant relationship between Allergic Rhinitis and Rhinosinusitis. The obtained correlation coefficient was 0.132, indicating a very weak correlation between allergic rhinitis and rhinosinusitis. This was also evident from the cross-tabulation table, which shows the largest proportion of samples having both allergic rhinitis and rhinosinusitis, accounting for 33%, which is nearly balanced with the samples having only rhinosinusitis at 30%.

The relationship between asthma and rhinosinusitis resulted in a p-value of 0.000, which is smaller than α (alpha) of 0.05. Therefore, it can be concluded that there was a significant relationship between asthma and rhinosinusitis. The obtained correlation coefficient was 0.587, indicating a strong correlation between

Table 1. Basic characteristics of the study

Diagnosis	Total sample	Percentage
Allergic rhinitis	33	11
Allergic rhinitis + asthma	10	3
Allergic rhinitis + rhinosinusitis	90	30
Asthma	68	23
Asthma + rhinosinusitis	15	5
Rhinosinusitis	75	25
Allergic rhinitis + asthma + rhinosinusitis	9	3
Total sample	**300**	**100**

Table 2. Results of bivariate analysis on the relationship between allergic rhinitis and rhinosinusitis

Allergic Rhinitis	Rhinosinusitis		Total
	Yes	No	
Yes	99 (33.0%)	43 (14.3%)	142 (47.3%)
No	90 (30.0%)	68 (22.7%)	158 (52.7%)
Total	**189 (63.0%)**	**111 (37.0%)**	**300 (100.0%)**
r = 0.132, p-value = 0.022, α = 0.050, p<α			

Note: **significant if p<0.05*

Table 3. Results of bivariate analysis on the relationship between asthma and rhinosinusitis

Asthma	Rhinosinusitis		Total
	Yes	No	
Yes	24 (8.0%)	78 (26.0%)	102 (34.0%)
No	165 (55.0%)	33 (11.0%)	198 (66.0%)
Total	**189 (63.0%)**	**111 (37.0%)**	**300 (100.0%)**
r = -0.587, p-value = 0.000, α = 0.050, p<α			

Note: * *significant if p<0.05*

Table 4. Results of multivariate analysis on the relationship between allergic rhinitis and asthma with rhinosinusitis

Variable	Correlation Coefficient (R)	p-value	Description
Allergic rhinitis, asthma, and rhinosinusitis	0.599	0.000	strong correlation

Note: * *significant if p<0.05*

asthma and rhinosinusitis. The correlation analysis results in a negative correlation coefficient, indicating an inverse relationship, which can be interpreted as patients with asthma but not with rhinosinusitis, and vice versa.

The relationship between allergic rhinitis and asthma together with rhinosinusitis was examined using multiple linear regression analysis, resulting in a p-value from the F-test of 0.000, which is smaller than α of 0.05. Therefore, it can be concluded that there was a significant relationship between allergic rhinitis and asthma with rhinosinusitis. The obtained correlation coefficient was 0.599, indicating that the relationship between allergic rhinitis and asthma with rhinosinusitis falls into the category of a strong correlation.

DISCUSSION

In this study, the number of samples suffering from allergic rhinitis did not significantly differ from those without allergic rhinitis. The analysis results found that allergic rhinitis has a significant influence on rhinosinusitis. This is supported by research that indicates a relationship between allergic rhinitis and rhinosinusitis, where patients with allergic rhinitis have a 4.4 times greater risk of developing rhinosinusitis compared to normal individuals.[10] Allergic rhinitis causes inflammation in the nose and produces mucus, which can lead to swelling in the nasal cavity and sinus mucosa, resulting in rhinosinusitis.[4] This finding is consistently supported by research stating that allergic rhinitis is the most common predisposing factor for rhinosinusitis due to its association with sinus ostium obstruction caused by mucosal edema.[11] In this study, it can be concluded that the majority of allergic rhinitis patients are female, due to the role of estrogen and progesterone hormones in females. This statement is supported by research indicating that estrogen and progesterone hormones in females have pro-inflammatory effects different from testosterone hormone in males, which has anti-inflammatory effects.[12]

Based on the research results, when looking at the age distribution, allergic rhinitis is most prevalent during productive ages. This can be explained by the fact that at this age, most activities occur in environments that are easily exposed to allergens, such as college campuses, workplaces, or study places that are dusty and have poor ventilation.[13] This theory is supported by a study indicating that allergic rhinitis can occur at any age, with almost 80% of cases developing around the age of 20 or during the productive age due to the highest exposure in young adults.[14] In this study, a significant relationship with weak correlation was found between both conditions, as patients with rhinosinusitis do not necessarily suffer from allergic rhinitis. Conversely, advanced mucociliary clearance damage in allergic rhinitis patients can lead to rhinosinusitis. This statement is supported by research indicating that the inflammatory process caused by allergic rhinitis leads to obstruction in the osteomeatal complex, disruption of mucociliary clearance, and ciliary dysfunction, resulting in paranasal sinus obstruction that progresses to rhinosinusitis.[15]

In this study, despite the higher proportion of rhinosinusitis patients without asthma, a significant and strong correlation was found between asthma and rhinosinusitis indicating that asthma worsens with rhinosinusitis because both are related to the sino-nasal pathway.[16] Other studies have also shown that asthma and rhinosinusitis are two medical conditions that can be interrelated and mutually influence each other. Both involve inflammation in the respiratory tract and share several related risk factors.[17] The research results indicate that patients with asthma can also experience rhinosinusitis, although it may not occur in every asthma patient, as rhinosinusitis can happen without a history of asthma. Aligned with research explaining that risk factors for rhinosinusitis include viruses, fungi, bacteria, allergens, and irritants (animal fur, polluted air, smoke, dust mites).[18] Another study that supports the above theory states that not all asthma patients experience rhinosinusitis, and not all rhinosinusitis patients have asthma. This health condition can occur separately or simultaneously in the same individual.[19]

The research results show that the majority of asthma patients are female. Data from CDC, WHO, and NCHS stating that the prevalence of asthma morbidity is higher in females. Based on the research results, it is known that allergic rhinitis and asthma have a significant relationship with rhinosinusitis, and the correlation between allergic rhinitis and asthma with rhinosinusitis falls into the category of strong correlation. Bachert & Akdis, which found that allergic rhinitis and asthma are significant risk factors in the development of rhinosinusitis.[20] Allergic rhinitis and asthma are two interrelated diseases, and patients can have both conditions simultaneously, exacerbating their conditions. Allergic rhinitis and asthma are chronic inflammatory diseases in which eosinophils, T cells, and mast cells play a role in the inflammatory component, releasing cytokines such as IL-4 and IL-13.[21] The results of this study are supported by research that found that individuals with RA and asthma experience more severe rhinosinusitis symptoms compared to those without these conditions.[22]

The limitation of this study was the relationship between allergic rhinitis and asthma with rhinosinusitis were not specific to the categories of mild, moderate, and severe disease. Further studies with a prospective design are needed to include patients with allergic rhinitis and asthma for a longer period of time, and to monitor the development of rhinosinusitis and other symptoms. Therefore, it is necessary to identify the risk factors associated with the occurrence of rhinosinusitis in patients with allergic rhinitis and asthma.

CONCLUSION

There is a significant relationship between allergic rhinitis and asthma with rhinosinusitis in patients with rhinosinusitis who underwent outpatient or inpatient care at Ibnu Sina Hospital, Gresik, during the period 2020-2022.

DISCLOSURES

Conflict of Interest

The authors declare no conflict of interest regarding this article.

Ethical Statement

This study has been approved by Ethical Committee of University of Surabaya

with No: 143/KE/X/2022 and Ethical Committee of Ibnu Sina Hospital, Gresik with No: 071/078/437.76/2022.

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Authors' Contribution
FH and OP are involved in concepting, designing and supervising the manuscript. EM conducted the study. FH and EM analyzed the data. All authors prepared the manuscript and agreed for this final version of manuscript to be submitted to this journal.

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