

Association between allergic rhinitis and chronic rhinosinusitis on multislice computed tomography scan paranasal sinuses

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Abstract. Rhinosinusitis is inflammation sinus mucosa, which is generally triggered by rhinitis, therefore it's often called rhinosinusitis. Some predisposing factors include acute respiratory infection due to viruses, various rhinitis, especially allergic rhinitis. As many as 50 patients underwent MSCT-Scan SPN examinations in 2022 at PKU Muhammadiyah Bantul. This research uses quantitative research methods with a cross-sectional analytical approach. The sampling technique in this research used total sampling. The data analysis used is univariate and bivariate analysis with the chi-square statistical test. From 47 samples, 25 people (53.2%) suffered from allergic rhinitis, 42 people (89.4%) suffered from chronic rhinosinusitis. Female patients showed the most chronic rhinosinusitis features on MSCT-Scan Paranasal Sinuses examination as many as 24 people (57.31%), with the highest age being 36-45 years as many as 14 people (33.3%). The highest frequency of chronic rhinosinusitis features was the unilateral maxillary type with 31 cases (18.6%). The calculation results of the relationship between chronic rhinosinusitis show a *P-Value* of 0.352. We highlighted that there is no significant relationship between allergic rhinitis and chronic rhinosinusitis on MSCT-Scan Paranasal Sinuses at PKU Muhammadiyah Bantul for the period January-December 2022.

1 Introduction

Rhinosinusitis is a disease that is often found in daily medical practice and is even considered one of the causes of the most health problems throughout the world [1]. Chronic rhinosinusitis is defined as a clinical syndrome characterized by the presence of two or more symptoms, one of which must be nasal congestion or nasal discharge flowing anteriorly or posteriorly. May

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also be accompanied by additional symptoms such as facial pain, reduction or loss of smell for ≥ 12 weeks[2].

Chronic rhinosinusitis (CRS) is divided into primary and secondary chronic rhinosinusitis. Primary chronic rhinosinusitis is chronic rhinosinusitis whose main cause is inflammation in the nasal cavity, paranasal sinuses or airway mucosa. Secondary chronic rhinosinusitis is chronic rhinosinusitis caused by other pathological disorders that do not originate from inflammation of the nasal cavity and paranasal sinuses. Based on anatomical involvement, primary chronic rhinosinusitis is divided into unilateral and bilateral [3].

CRS has several causative factors including infection, inflammation, or structural factors. Other causative factors such as allergic rhinitis, exposure, structural abnormalities, ciliary dysfunction, immunodeficiency, and fungal infections should be considered. Besides that, asthma, otitis media, cystic fibrosis, AIDS and other medical conditions can also be associated with chronic rhinosinusitis. [4]. In Asia, the prevalence of chronic rhinosinusitis in Malaysia is 12.8% [5]. There are no exact figures regarding the incidence of Chronic Rhinosinusitis in Indonesia, but based on research in 2019 in the 2016-2018 period in the Rhinology division of the Otorhinolaryngology RSUP Dr. Mohammad Hoesin Palembang found that the proportion of chronic rhinosinusitis in adults was 33.3%. CRS places a huge burden on the health and economic burdens of individuals, families, communities and the whole society [3]. Therefore this research aims to make people understand more about CRS so that it can reduce the burden on society.

However, CRS can have a good prognosis if the type is quickly identified and treated appropriately and quickly [6]. Therefore, it is very important for the public, especially medical personnel, to understand CRS so that they can carry out appropriate prevention or management to overcome this problem. Diagnosing chronic rhinosinusitis can be done through history taking, physical examination and other supporting examinations. Supporting examinations that can be carried out are transillumination, radiological examination, and nasal endoscopy examination. Radiological examinations that can be carried out are photos of the paranasal sinuses such as water's, caldwel and lateral, MSCT-Scan Paranasal Sinuses and MRI. MSCT-Scan Paranasal Sinuses is the gold standard for diagnosing rhinosinusitis because it can assess the overall anatomy and extent of the nose and sinuses [7].

2 Material and Methods

This research was an analytical cross-sectional study for the relationship between allergic rhinitis and chronic rhinosinusitis on MSCT-Scan Paranasal Sinuses (SPN) at PKU Muhammadiyah Bantul. The population in this study were all the results of the MSCT-Scan Paranasal Sinus medical records from the Radiology section of PKU Muhammadiyah Bantul. The sample was the entire sample population that meets the inclusion and exclusion criteria. The inclusion criteria are having had an MSCT-Scan Paranasal Sinus in January – December 2022. Meanwhile, the exclusion criteria are all MSCT-Scan Paranasal Sinus results due to trauma, secondary type chronic rhinosinusitis, incomplete medical records. Sampling of research subjects used a total sampling technique based on and obtained a total of 47 research subjects.

In this study, the variables to be studied are allergic rhinitis as the independent variable a chronic rhinosinusitis as the dependent variable. We analyzed secondary data obtained from the PKU Muhammadiyah Bantul medical records in 2022 to search for data on patients who underwent MSCT-Scan Paranasal Sinus examinations. The type of data in this research is nominal, so the type of hypothesis used is chi-square. If the chi-square test requirements are not met then the formula is replaced using the fisher exact test. The data was processed and

analyzed using IBM SPSS Statistics 27. This research has received ethical approval issued by PKU Muhammadiyah Bantul with no. 080/EC.KEPK/C/08.23).

3 Results and Discussion

3.1 Characteristics of MSCT-Scan Paranasal Sinuses Patient

Based on research conducted on 47 samples, the results showed that 42 people (89.4%) showed a picture of chronic rhinosinusitis on the MSCT-Scan SPN examination, while 5 people (10.6%) did not show a picture of chronic rhinosinusitis on the MSCT-Scan SPN examination (Table 1). These results are similar to research conducted by hapsari on 54 samples where it was found that 36 people (66.7%) had chronic rhinosinusitis while 18 people (33.3%) did not experience chronic rhinosinusitis [8].

Table 1. Describe the characteristics frequency of msct-scan paranasal sinuses patients

Characteristics	Category	Frequency	Percentage
Chronic Rhinosinusitis	Yes	42	89.4
	No	5	10.6
Allergic Rhinitis	Yes	25	53.2
	No	22	46.8
Gender	Man	18	42.9
	Woman	24	57.31
Age	12-16 years	1	2.4
	17-25 years	5	11.9
	26-35 years	7	16.7
	36-45 years	14	33.3
	46-55 years	6	12.3
	56-65 years	7	16.7
	>65 years	2	4.8
Rhinosinusitis	Maksilaris Unilateral	31	44.3
	Maksilaris Bilateral	10	14.3
	Frontalis Unilateral	3	4.3
	Frontalis Bilateral	3	4.3
	Ethmoidalis Unilateral	13	18.6
	Ethmoidalis Bilateral	6	8.6
	Sfenoidalis Unilateral	1	1.4
	Sfenoidalis Bilateral	3	4.3

Based on research conducted on 47 samples, the results showed that 25 people (53.2%) experienced allergic rhinitis, while 22 people (46.8%) did not experience allergic rhinitis. These results are like research conducted by hapsari on 54 samples where it was found that 40 people (74.1%) experienced allergic rhinitis while 14 people (25.9%) did not experience allergic rhinitis [8].

Based on the results of the research that was conducted, there were 24 people (57.31%) women and 18 people (42.9%) men. In this case, the incidence in women was greater than in men but did not show a significant difference. These results are like research conducted by Siboro where the majority of rhinosinusitis samples were women as many as 48 people (55.2%) and men as many as 39 people (44.8%) [9]. The higher incidence rate in women is thought to be caused by women being more concerned about their health condition, which makes them more likely to have their condition checked by a doctor [10]. In addition, women can suffer from rhinosinusitis, and it develops chronically because the nasal mucosa and blood vessels are influenced by the hormonal effects of estrogen, progesterone and placental

growth hormone [2]. The hormones estrogen and progesterone in women have a pro-inflammatory effect, whereas the hormone testosterone in men has an anti-inflammatory effect [11].

These results are different from research conducted by Nugraha where more men experienced chronic rhinosinusitis as many as 121 people (50.6%) and women as many as 118 people (49.4%) [12]. This is thought to be because men tend to have a smoking habit than women. The toxic substances contained in cigarettes are pro-inflammatory and cause oxidative stress in the mucosa [13]. In addition, men do more outdoor activities, which makes men more often exposed to dust, foreign substances and air pollution [14].

In this study, it was found that the picture of chronic rhinosinusitis relatively increased in the 36-45 year age group, as many as 14 patients (33.3%). These results are in accordance with research conducted by Surono where the results of the distribution of the highest proportion of rhinosinusitis patients based on age were found in the age groups 30-39 years and 40-49 years with 17 patients each with a percentage of 22% [15]. Different from research conducted by Dewi where the research results showed that the largest proportion was aged 46-60 years, amounting to 20 sufferers (37.7%) [16].

According to the literature, exposure to air pollution, dust, cigarette smoke, dry and cold air can damage the cilia and result in changes to the nasal mucosa which results in the productive age group being more at risk of suffering from chronic rhinosinusitis [17]. As people get older, they are more susceptible to rhinosinusitis and it develops chronically because the airways tend to dry out with age. The cartilage that supports the airway also becomes weaker due to decreased tolerance to air changes which can increase the risk of infection [18].

Aging has an effect on the immune system where there is a decrease in the phagocytic process of pathogens such as bacteria and disruption of innate defense mechanisms. Apart from that, the increasing frequency in the 36-45 year age group is associated with working productivity ages where people are more active in working outdoors and are exposed to more pollution and foreign substances. In addition, with increasing age, sinonasal physiological function decreases and anatomical changes occur [12].

This study divides the features of chronic rhinosinusitis based on sinus anatomy and the amount of obstruction. Based on sinus anatomy, rhinosinusitis is divided into maxillary rhinosinusitis, frontal rhinosinusitis, ethmoidal rhinosinusitis and sphenoidal rhinosinusitis. Meanwhile, based on many variations, chronic rhinosinusitis is divided into unilateral and bilateral rhinosinusitis. In this study, the most common presentation of rhinosinusitis was unilateral maxillary rhinosinusitis with a total of 33 cases (44.3%). These results are similar to research conducted by Gultom where the most frequently found image was unilateral maxillary as many as 29 people (59.2%) [19].

The maxillary sinus is the largest paranasal sinus. The ostium of the maxillary sinus is located higher than the floor of the sinus, so drainage only depends on the movement of the cilia, drainage must also go through the narrow infundibulum. Swelling due to inflammation or allergies in the infundibulum area can block drainage of the maxillary sinus and can cause rhinosinusitis [20].

Apart from that, the base of the maxillary sinus is very close to the roots of the maxillary teeth, sometimes also the canines and molars, and the roots of these teeth can even protrude into the sinus, so that dental infections can easily rise upwards and cause rhinosinusitis [21].

Bacterial rhinosinusitis is an infection from sinus to sinus which causes the sinus ostium to become blocked followed by the formation of excessive secretions. This often occurs asymmetrically where one sinus or more than one sinus is unilaterally affected. When the contralateral side is affected, it often appears asymmetrical in anatomical level or location. As a comparison, in allergic rhinosinusitis the affected paranasal sinus area is always symmetrical, usually accompanied by nasal polyps [22].

3.2 The relationship between allergic rhinitis and chronic rhinosinusitis

Chronic rhinosinusitis has several causative factors including infection, inflammation, or structural factors. Other causative factors such as allergic rhinitis, exposure, structural abnormalities, ciliary dysfunction, immunodeficiency, and fungal infections should be considered. Besides that, asthma, otitis media, cystic fibrosis, AIDS and other medical conditions can also be associated with chronic rhinosinusitis [4].

In this study, researchers examined one of the etiologi­cal and predisposing factors that influence the occurrence of chronic rhinosinusitis, namely allergic rhinitis. Based on the bivariate test using the chi-square method, the expected count results were more than 5, so Fisher's exact test was used. The relationship between each variable is said to be significant if the exact sig is <0.05, if the exact sig is >0.05, then there is no relationship between each variable or it is not significant. In this study, the exact sig value (2 sided) was 0.352 (Table 2) so it can be concluded that there is no significant relationship between allergic rhinitis and chronic rhinosinusitis on the MSCT-Scan SPN at PKU Muhammadiyah Hospital Bantul in the period January-December 2022.

Table 2. The relationship between allergic rhinitis and chronic rhinosinusitis

CRS	Allergic Rhinitis		Total	P-Value
	Positive	Negative		
Positive	21	21	42	0.352
Negative	4	1	5	
Total	25	22	47	

This research is not in accordance with research conducted by Hapsari where the results showed that there was a significant relationship between allergic rhinitis and chronic rhinosinusitis [8]. This is based on the existence of an inter-relationship between the nose and the sinus passage. The mechanism of association between rhinitis and chronic rhinosinusitis is thought to involve obstruction of nasal sinus outflow, followed by bacterial colonization, and infection leading to acute, recurrent, or chronic rhinosinusitis.

The mechanism thought to underlie the relationship between allergic rhinitis and chronic rhinosinusitis is that inhaled allergens are processed by immune cells in the nose which then activate T-helper lymphocytes and then migrate to the bone marrow, causing the release of type 2 inflammatory mediators, such as IL-4, IL-5, and IL-13. This in turn results in the production of eosinophils, mast cells, and basophils, which triggers nasal eosinophilia. In addition, nasal and paranasal mucosal cells transfer cell surface molecules that attract inflammatory mediators and also release inflammatory cytokines. In patients with chronic rhinosinusitis, adhesion molecules and chemotactic molecules are distributed in large quantities and are thought to form the mechanism of allergic rhinitis that mediates chronic rhinosinusitis [23]. In addition, Staphylococcus sp which is in the nose and paranasal sinuses can create biofilms and function as a source of superantigens. Superantigens trigger cytokines IL-4, IL-13, and TH2 which then produce IgE in the sinus tissue and further increase the inflammatory response [24].

However, this relationship is still controversial because some studies do not correlate allergies and atopy with chronic rhinosinusitis. Inhaled allergens are unable to penetrate adjacent sinuses and remain stored in the nasal cavity and oropharynx, this shows that there are natural physical limitations to allergies that worsen sinus disease [23]. In a recent consensus statement, evidence linked allergies to chronic rhinosinusitis without nasal polyps (CRSsNP) quite low (level D). More likely is the association between allergies and chronic rhinosinusitis with nasal polyps (CRSwNP), or more specifically, with certain CRSwNP subtypes, such as allergic fungal rhinosinusitis (AFRS) and Central Compartment Allergic Disease (CCAD) [25].

4 Conclusion

We highlighted that there is no significant relationship between chronic rhinosinusitis and allergic rhinitis on multislice computed tomography paranasal sinuses at PKU Muhammadiyah Bantul for the period January - December 2022. More specific research is needed on chronic rhinosinusitis with nasal polyps and chronic rhinosinusitis without nasal polyps.

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Data availability statement

Data will be made available on request

Declaration of competing interest

The authors disclose no conflict

Author contribution statement

Aisyah and Rizky are designed the study

Dewi ari and Elvina are collecting data

Aisyah and Nurcholid umam are analysis data

Rizky, Muriana, Aisyah are write the manuskript

Adnan and Rizky are revise the manuskript

All author were read and approved the manuscript

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