

The Association Between Allergic Rhinitis and Chronic Suppurative Otitis Media

Yohana Simanjuntak¹, Devira Zahara^{1*}, Ferryran Sofyan¹, Taufik Ashar²

¹Department of Otorhinolaryngology - Head and Neck Surgery, Faculty of Medicine, Universitas Sumatera Utara, Jl. Dr. Mansyur No. 5, Medan 20155, Sumatera Utara, Indonesia;

²Department of Community Medicine, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia;

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*Corresponding Author:

Devira Zahara, Department of Otorhinolaryngology - Head and Neck Surgery, Faculty of Medicine, Universitas Sumatera Utara, Jl. Dr. Mansyur No. 5, Medan 20155, Sumatera Utara, Indonesia; Email: d3_za@yahoo.com

Abstract: Tympanic membrane perforation and continuous discharge are hallmarks of chronic suppurative otitis media, a chronic inflammation of the middle ear. Through the malfunction of the Eustachian tube brought on by allergic inflammation, allergic rhinitis may contribute to the development of CSOM. This study aimed to analyze the relationship between allergic rhinitis and CSOM, identify common allergens, and assess the association between eosinophil levels and CSOM. A case-control study was conducted at RSUP H. Adam Malik and RS Murni Teguh Medan involving 72 participants: 36 CSOM patients and 36 healthy controls. Skin prick tests (SPT) and eosinophil counts were used to assess allergic status. Statistical analysis used Chi-square and Fisher's exact test with significance set at $p < 0.05$. The results showed a significant association between allergic rhinitis and CSOM ($p = 0.001$; OR = 6.192). Common allergens found in CSOM patients were *D. pteronyssinus* (66.7%), *D. farinae* (63.9%), and cockroach (47.2%), with significant associations ($p < 0.05$). No significant relationship was found between allergic rhinitis and CSOM sides or type ($p > 0.05$). Elevated eosinophil levels were more common in the CSOM group but were not statistically significant ($p = 0.624$). In conclusion, allergic rhinitis is significantly associated with CSOM. Allergen screening is recommended for CSOM patients to improve diagnosis, treatment, and recurrence prevention.

Keywords: Allergic rhinitis, CSOM, eosinophils, indoor allergens, skin prick test.

Introduction

Chronic suppurative otitis media (CSOM) is a persistent middle ear inflammation characterized by tympanic membrane perforation and otorrhea for over two months. Globally, it affects 65–330 million people, with approximately 60% experiencing hearing loss (Natarajan & Stankovic, 2023). The incidence of CSOM is higher in developing countries due to socioeconomic factors, inadequate hygiene, and limited access to healthcare (Katre & Harkare, 2017).

In Indonesia, the prevalence of CSOM is approximately 3.1%, affecting over six million individuals (Onifade et al., 2025). This

condition remains a significant cause of hearing loss, especially among adolescents and young adults (Guo et al., 2024). Eustachian tube dysfunction is recognized as one of the main contributors to CSOM pathogenesis (Mansour et al., 2018).

Allergic rhinitis is a common chronic inflammatory disease that affects up to 40% of children and adolescents, characterized by nasal congestion, sneezing, rhinorrhea, and itching (Goniotakis et al., 2023). It has been postulated to influence Eustachian tube function through mucosal inflammation and edema, thereby increasing the risk of middle ear diseases, including CSOM.

Previous studies have reported a

significant association between allergic sensitization, particularly to house dust mites, and the incidence of CSOM. The presence of eosinophilia in allergic rhinitis further supports the role of immune mechanisms in disease progression. Despite these findings, limited research has explored this relationship in Indonesian populations. This study aims to analyze the association between allergic rhinitis and CSOM and identify the most common allergens contributing to allergic sensitization in these patients.

Materials and Methods

Study Design

This study employed an analytical observational design using a case-control approach. It aimed to investigate the relationship between allergic rhinitis and chronic suppurative otitis media (CSOM) incidence. The research was conducted at RSUP H. Adam Malik Medan and RS Murni Teguh Medan between April 2024 and the completion of subject recruitment. The study included 36 CSOM patients and 36 healthy controls who met the inclusion and exclusion criteria. Sampling was performed using a non-probability consecutive sampling technique.

Data collection involved clinical interviews, ear-nose-throat (ENT) physical examination, skin prick test (SPT) using five types of inhalant allergens and two controls, and complete blood count (CBC) tests to assess eosinophil levels. The association between allergic rhinitis and CSOM was analyzed using Chi-square and Fisher's exact tests with significance set at $p < 0.05$. The odds ratio (OR) was calculated to determine the strength of the association.

Skin Prick Test

SPT was performed using five inhalant allergen extracts (*Dermatophagoides farinae*, *Dermatophagoides pteronyssinus*, grasses mix, cat dander, and cockroach), positive control (histamine), and a negative control (saline). The allergens were applied to the volar forearm, pricked, and interpreted after 15 minutes.

Blood Eosinophil Count

The eosinophil count was determined from venous blood samples using standard hematology analyzer procedures.

Data Analysis

SPSS version 22.0 was used to process the data. Fisher's exact test or chi-squared analysis were used to examine categorical data. Statistical significance was defined as a p-value of less than 0.05. To assess the strength of connections, odds ratios (OR) with 95% confidence intervals (CI) were computed.

Results and Discussions

Demographic Characteristics

Seventy-two subjects participated, consisting of 36 CSOM patients and 36 healthy controls. The demographic characteristics are presented in Table 1.

Table 1. Demographic Characteristics of Study Subjects

Characteristic	CSOM (n = 36)	Control (n = 36)	p-value
Gender, n (%)			0.334 ¹
– Male	12 (33.3%)	16 (44.4%)	
– Female	24 (66.7%)	20 (55.6%)	
Age, years			0.101 ²
– Mean \pm SD	28.5 \pm 13.56	31.78 \pm 13.60	
– Median (Min– Max)	23 (13– 62)	28.5 (16– 61)	

¹ Chi-square test

² Mann–Whitney U test

The majority of participants in both groups were female, making up 55.6% of the control group and 66.7% of the CSOM group. The control group's mean age was 31.78 years, whereas the CSOM group's was 28.5 years. Age and gender differences between the two groups were not statistically significant ($p > 0.05$).

Allergen Sensitization Patterns

The skin prick test results, which show that *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus* were the most common allergens in both group, are presented in Table 2.

Table 2.. Allergen Sensitization by Skin Prick Test

Allergen	CSOM Group (n=36)	Control Group (n=36)	p-value	OR	95% CI
D. farinae	23 (63.9%)	8 (22.2%)	<0.001	6.192	2.190–17.505
D. pteronyssinus	24 (66.7%)	11 (30.6%)	0.002	4.545	1.686–12.251
Grasses mix	5 (13.9%)	5 (13.9%)	1.000	1.000	0.263–3.803
Cat dander	3 (8.3%)	2 (5.6%)	0.171 ¹	1.545	0.242–9.850
Cockroach	17 (47.2%)	4 (11.1%)	0.001	7.158	2.046–25.034

¹ Fisher's Exact Test

The most common allergens detected in CSOM patients were *Dermatophagoides pteronyssinus* (66.7%), *Dermatophagoides farinae* (63.9%), and cockroach (47.2%). These allergens showed a statistically significant association with CSOM. Meanwhile, grasses mix and cat dander showed no significant relationship with CSOM. These findings confirm that indoor allergens, particularly house dust mites and cockroach allergens, are the most relevant in the pathogenesis of CSOM in the studied population. This supports the need for allergen-specific diagnosis and management of rhinitis allergy in CSOM cases.

Association Between Allergic Rhinitis and CSOM

The proportion of CSOM subjects with allergic rhinitis was significantly higher than that of controls (Table 3).

Table 3. Association Between Allergic Rhinitis and CSOM

Allergic Rhinitis	CSOM Group (n=36)	Control Group (n=36)	p-value	OR	95% CI
Yes	28 (77.8%)	13 (36.1%)	0.00	6.19	2-190-5
No	8 (22.2%)	23 (63.9%)	1	2	17.50

The analysis showed a significant association between allergic rhinitis and CSOM. Among the CSOM group, 28 subjects (77.8%) had allergic rhinitis based on clinical symptom and skin prick test result, whereas only 13 subjects (36.1%) in the control group had allergic rhinitis. Statistical analysis using the Chi-square test yielded a p-value of 0.001. The odds ratio (OR) was 6.192 (95% CI: 2.190–17.505), indicating that individuals with allergic rhinitis

are 6.2 times more likely to develop CSOM than those without allergic rhinitis.

Association Between Allergic Rhinitis and Bilateral CSOM

Among the 28 CSOM patients with allergic rhinitis, 10 subjects (35.7%) had bilateral CSOM. In contrast, only 1 subject (9.1%) of the 8 CSOM patients without allergic rhinitis had bilateral CSOM. However, Fisher's Exact Test statistical analysis showed no significant association between allergic rhinitis and bilateral CSOM (p = 0.388).

Table 4. Association Between Allergic Rhinitis and Bilateral CSOM

Allergic Rhinitis	Bilateral CSOM	Unilateral CSOM	p-value
Yes	10 (35.7%)	18 (64.3%)	0.388 ¹
No	1 (9.1%)	7 (87.5%)	

¹ Fisher's Exact Test

Association Between Allergic Rhinitis and CSOM Type

Among 28 CSOM patients with allergic rhinitis, 21 (75%) had tubotympanic-type CSOM, while 7 (25%) had atticofacial-type. Among the 8 CSOM patients without allergic rhinitis, 4 (50%) had tubotympanic-type CSOM. Statistical analysis using Fisher's Exact Test showed no significant relationship between allergic rhinitis and the type of CSOM (p = 0.214).

Table 5. Association Between Allergic Rhinitis and CSOM Type

Allergic Rhinitis	Tubotympanic	Atticoantral	p-value
Yes	21 (75.0%)	7 (25.0%)	0.214 ¹
No	4 (50.0%)	4 (50.0%)	

¹ Fisher's Exact Test

Association Between Eosinophil Count and CSOM

Higher blood eosinophil counts were

observed in the CSOM group compared to the control group; however these findings shows that elevated eosinophil counts are not significantly associated with CSOM in this study population. Fourteen (38.9%) of the 36 CSOM patients exhibited high eosinophil levels. In contrast, 12 out of 36 individuals (33.3%) in the control group had elevated eosinophils. Eosinophil levels and the incidence of CSOM did not significantly correlate, according to statistical analysis using the Chi-square test ($p = 0.624$).

Table 5. Eosinophil Count Comparison

Group	Elevated Eosinophils (%)	Normal Eosinophils (%)	P-value
CSOM	14 (38.9%)	22 (61.1%)	0.624
Control	12 (33.3%)	24 (66.7%)	

Discussions

This study found a significant association between allergic rhinitis and CSOM ($p = 0.001$), with an odds ratio of 6.192. Subjects with allergic rhinitis had a 6.2-fold higher risk of developing CSOM compared to those without rhinitis. These findings are consistent with Afriana *et al.* (2023), who reported a significant relationship between history of allergic rhinitis and CSOM, with a prevalence ratio (PR) of 2.438 (95% CI: 1.038–5.724; $p = 0.031$). Similarly, Yani and Djamin (2018) found that 77.78% of CSOM patients had history of allergic rhinitis.

Byeon (2019) showed that children aged 7–12 with allergic rhinitis had a significantly increased risk of otitis media (OR = 2.04; 95% CI: 1.30–3.18). In Hasanah's (2019) study, CSOM patients with allergic rhinitis had a 14-fold higher risk of recurrence than those without allergic rhinitis ($p = 0.000$; OR = 14.000). This evidence reinforces that allergic inflammation may contribute significantly to CSOM development and recurrence. Daud *et al.* (2019) in Malaysia also found a significantly higher prevalence of allergic sensitization among CSOM patients (59.7%) than in the general population (30.6%). However, Bakhshaei *et al.* (2011) in Iran found no significant association ($p = 0.241$; OR = 1.28), likely due to the predominance of outdoor allergens in their subjects, which tend to be seasonal rather than perennial. Although 35.7% of CSOM patients

with allergic rhinitis had bilateral involvement compared to only 9.1% among those without allergic rhinitis, this difference was not statistically significant ($p = 0.388$). The lack of significance may be due to the predominance of unilateral CSOM in this study (69.4%).

Among 28 CSOM patients with allergic rhinitis, 75% had the tubotympanic type and 25% had the atticointral type. However, no significant association was found between rhinitis allergic status and CSOM type ($p = 0.214$). This may be due to the similarity in pathophysiological mechanisms between the two CSOM types. Allergic reactions in the nasal mucosa can influence the Eustachian tube and tympanic membrane via various pathways, such as cytokine release and mucosal edema, leading to middle ear pressure changes, tympanic membrane retraction, and perforation. Although 38.9% of CSOM patients showed elevated eosinophil levels compared to 33.3% in the control group, the difference was insignificant ($p = 0.624$). This aligns with findings from Gorgulu *et al.* (2012), who also observed no significant difference in eosinophil levels among CSOM patients. Elevated eosinophilia also present in parasitic infections, malignancies, and renal disorders—may explain why it lacks strong correlation with CSOM.

Conclusion

The results of this study indicate a significant association between allergic rhinitis and chronic suppurative otitis media (CSOM). Positive skin prick test results were more prevalent in the CSOM group, suggesting that allergic sensitization, particularly to house dust mites, may contribute to the pathogenesis of CSOM. Elevated blood eosinophil levels further support the involvement of systemic allergic mechanisms. This study highlights the importance of evaluating rhinitis allergic status in patients with CSOM. Incorporating allergy screening, especially skin prick test, in the clinical management of CSOM may aid in reducing recurrence rates and improving therapeutic outcomes. The findings contribute valuable evidence to the growing understanding of the role of immunological factors in middle ear disease, particularly in tropical regions.

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References

- Afriana, A., Syabriansyah, S., & Dita, D. A. A. (2023). Profile of allergic rhinitis and its association with chronic suppurative otitis media. *Muhammadiyah Medical Journal*, 4(2), 64–71. <https://doi.org/10.24853/mmj.4.2.64-71>
- Bakhshaei, M., Rajati, M., Fereidouni, M., Khadivi, E., & Varasteh, A. (2011). Allergic rhinitis and chronic suppurative otitis media. *European Archives of Oto-Rhino-Laryngology*, 268(1), 87–91. <https://doi.org/10.1007/s00405-010-1290-3>
- Byeon, H. (2019). Risk of otitis media associated with allergic rhinitis: A nationwide cohort study. *International Journal of Pediatric Otorhinolaryngology*, 117, 107843. <https://doi.org/10.1016/j.ijporl.2018.11.012>
- Daud, M. K. M., Din, L. S., & Ahmad, M. S. A. (2019). Chronic suppurative otitis media and allergy: Is there a link? *Malaysian Journal of Medicine and Health Sciences*, 15(1), 76–81. [https://medic.upm.edu.my/upload/dokumen/201912121151245_MJMHS_15\(S1\)76.pdf](https://medic.upm.edu.my/upload/dokumen/201912121151245_MJMHS_15(S1)76.pdf)
- Goniotakis, I., Perikleous, E., Fouzas, S., Steiropoulos, P., & Paraskakis, E. (2023). A clinical approach of allergic rhinitis in children. *Children*, 10(9), 1571.
- Gorgulu, O., Ozelci, M., Suleyman, O., Mehmet, Y., Olgun, M. K., & Arikan, O. K. (2012). The role of allergy in the pathogenesis of chronic suppurative otitis media. *International Advances in Otolaryngology*, 8(2), 276–281. <https://www.advancedotology.org/Content/files/sayilar/78/276-281.pdf>
- Guo, Z., Ji, W., Song, P., Zhao, J., Yan, M., Zou, X., ... & Song, L. (2024). Global, regional, and national burden of hearing loss in children and adolescents, 1990–2021: a systematic analysis from the Global Burden of Disease Study 2021. *BMC Public Health*, 24(1), 2521.
- Hasanah, K. N. (2019). Peran rinitis alergi terhadap kekambuhan otitis media supuratif kronik. Universitas Diponegoro. <https://eprints.undip.ac.id/69609/>
- Katre, P., & Harkare, V. (2017). Epidemiological study of factors influencing incidence of chronic suppurative otitis media in paediatric age group of rural population. *Panacea Journal of Medical Sciences*, 7(1), 35–39.
- Mansour, S., Magnan, J., Nicolas, K., Haidar, H., Mansour, S., Magnan, J., ... & Haidar, H. (2018). Chronic suppurative otitis media (CSOM): a middle ear mucosal disease. *Middle Ear Diseases: Advances in Diagnosis and Management*, 205–274.
- Natarajan, N., Batts, S., & Stankovic, K. M. (2023). Noise-induced hearing loss. *Journal of clinical medicine*, 12(6), 2347.
- Onifade, A., Katolo, H. W., Mookerjee, S., & Bhutta, M. F. (2025). Epidemiology of Chronic Suppurative Otitis Media: Systematic Review To Estimate Global Prevalence. *Journal of Epidemiology and Global Health*, 15(1), 1–12.
- Yani, W. S. H. P., & Djamin, R. (2018). Karakteristik dan faktor risiko otitis media supuratif kronik pada pasien di RS Wahidin Sudirohusodo periode Januari–Desember 2017. *Jurnal Ilmu Kesehatan Makassar*, 8(1), 45–50.