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REVIEW ARTICLE

Exploring the Relationship Between Allergic Rhinitis and Otitis Media with Effusion: A Scoping Review

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Abstract: Allergic rhinitis is one of the most common forms of non-infectious rhinitis in the world and has attracted global attention due to its increasing prevalence of up to 30% of the population in some countries. A study showed a significant association between allergic rhinitis and otitis media with effusion (OME) in children. Of the 37 children with OME examnined, 24.3% had allergic rhinitis. The relationship between allergic rhinitis (AR) and otitis media with effusion (OME) is complex and multifactorial. The purpose of this scoping review is to explore and map the current evidence regarding the relationship between allergic rhinitis and otitis media with effusion. This study used a scoping review design to explore the relationship between allergic rhinitis and otitis media with effusion (OME). Finding indicate that allergic rhinitis is a major risk factor for OME, especially in children. Contributing factors include adenoid hypertrophy, smoke exposure, attendance at nursery school, GERD, and LPR. Inflammatory processes and Eustachian tube dysfunction are often identified as the mechanism involved. Several studies report that treatment of allergic rhinitis and related comorbidities can improve OME outcomes, while surgical interventions such as adenoidectomy and ESS also show clinical benefit

Keywords: Allergic Rhinitis, Eustachian Tube Dysfunction, Allergy, Pediatric Hearing Loss, Otitis Media with Effusion

INTRODUCTION

Allergic Rhinitis (AR) and Otitis Media with Effusion (OME) are two conditions with high prevalence worldwide and often occur together, particularly in the pediatric population (1). Allergic Rhinitis is an inflammatory disorder of the nasal mucosa caused by an immune response to specific allergens, such as dust, pollen, or animal fur (2). On the other hand, OME is characterized by the accumulation of fluid in the middle ear without acute signs of infection, which can lead to temporary or permanent hearing loss (3). The combination of these conditions can affect the quality of life, especially in children, as it can impair

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speech development, language, and learning abilities.

A poorly ventilated middle ear can occur in patients with big adenoids because the adenoids can block the Eustachian tube. OME could be the outcome of this kind of obstruction. As a lymphatic structure, the adenoids may be able to carry germs into the Eustachian tube and promote the formation of biofilms. Inflammation brought on by such bacterial development may also make obstruction and fluid accumulation in the middle ear easier (4).

Allergic rhinitis is one of the most common forms of non-infectious rhinitis globally, affecting up to 30% of the population in several countries (5). The main symptoms of AR include sneezing, nasal congestion, itchy nose, and a runny nose, often accompanied by other symptoms such as allergic conjunctivitis. Allergic Rhinitis is triggered by an immune response to type I allergens mediated by IgE, where exposure to allergens stimulates the release of histamine and other inflammatory mediators from mast cells and basophils, causing nasal mucosa inflammation (6). Allergic rhinitis is a common disorder affecting 400 million people worldwide and has garnered global attention due to its increasing prevalence. Allergic Rhinitis often occurs alongside other diseases such as asthma, causing a decline in quality of life, school or work performance, and significant financial burden. The primary cause of AR is associated with an overproduction of Th2 cytokines and impairment of nasal epithelial barrier function (7).

A study by Sharifian et al. (8) showed a significant relationship between allergic rhinitis and otitis media with effusion (OME) in children. Out of 37 children with OME examined, 24.3% also had allergic rhinitis, while only 5.8% from the control group, which had similar conditions, showed a statistically significant difference. However, despite the increase in the prevalence of allergic rhinitis, no significant differences were found in serum IgE concentration or eosinophil count between the OME group and the control group. These findings indicate that although allergic rhinitis may play a role in the development of OME, other contributing factors should also be considered. Therefore, it is important to take allergic evaluations into account for OME patients, particularly those with recurrent or persistent symptoms (8).

Meanwhile, the study by Byeon (9) aimed to identify whether allergic rhinitis is an independent risk factor for otitis media in children aged 7 to 12 years in South Korea. This study is a secondary analysis based on ENT examination data involving 472 children who completed the 2015 Korea National Health and Nutrition Survey. The presence of otitis media was examined by ENT specialists using tympanometry measurements, audiometry assessments, and otoscopic examinations. Allergic rhinitis was diagnosed through several tests, including total serum immunoglobulin E, nasal cytology for eosinophils, and skin

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tests. Potential contributing factors such as age, gender, household income level, and household composition were also considered.

The relationship between Allergic Rhinitis (AR) and Otitis Media with Effusion (OME) is complex and multifactorial. Although many studies have identified a correlation between these two conditions, there is still much to be learned about the underlying pathophysiological mechanisms and their implications for treatment strategies. Further research is needed to develop more effective approaches for the prevention and management of both conditions, which ultimately can lead to an improvement in patients' quality of life.

The aim of this scoping review is to explore and map the current evidence on the relationship between allergic rhinitis and otitis media with effusion. This study seeks to identify and summarize the existing literature on the prevalence, pathophysiological mechanisms, and clinical associations between these two conditions. Furthermore, it aims to highlight gaps in knowledge and suggest areas for future research to enhance understanding of their interaction. Additionally, the review will provide an overview of diagnostic and therapeutic approaches that address the coexistence of allergic rhinitis and otitis media with effusion.

METHOD

The population of this research consists of scientific articles that discuss Allergic Rhinitis, Otitis Media with Effusion, and the relationship between these two conditions. The sample includes articles that meet specific inclusion criteria, which comprise articles published within the last five years (2020-2024) and written in English, sourced from the Scopus database. The sampling technique used is purposive sampling, where articles were selected based on their relevance to the research questions. The inclusion criteria consist of original research articles, review articles, meta-analyses, and systematic reviews focusing on the relationship between Allergic Rhinitis and OME.

Data collection for this narrative review involves identifying and selecting relevant articles from Scopus database The process is divided into several steps. First, a literature search is conducted using keywords such as "Allergic Rhinitis" and "Otitis Media with Effusion" to locate relevant articles in the databases. Next, article selection is performed by screening the titles and abstracts of the articles to ensure they meet the inclusion criteria. Finally, full-text retrieval is done by downloading and analyzing the complete texts of the selected articles for a more in-depth review.

This research uses the scoping review design, which does not strictly adhere to systematic review procedures but instead provides flexibility in organizing findings while constructing a comprehensive map of the research topic. This approach enables the researcher to identify patterns across various articles and studies, offering insights into the

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current literature regarding Allergic Rhinitis and OME. The findings from this review are synthesized to identify gaps in research and provide an analytical overview of existing studies.

The PRISMA flow diagram outlines the systematic process of identifying, screening, and selecting articles for the scoping review. Initially, 215 records were identified from the Scopus database. Of these, 201 articles were removed before screening due to ineligibility based on automation tools. The main reasons for exclusion were publication year outside the range of 2020–2024 (177 articles), non-English language (1 article), non-medical subject (2 articles), non-original research articles (11 articles), and lack of open access (10 articles).

Further, 14 records were retained for screening. During this stage, 1 duplicate record was identified and removed. Afterward, 13 articles were sought for retrieval, but 1 was excluded due to irrelevance, leaving 12 articles for the eligibility assessment. None of the articles assessed for eligibility were excluded, resulting in a total of 12 studies being included in the final review.

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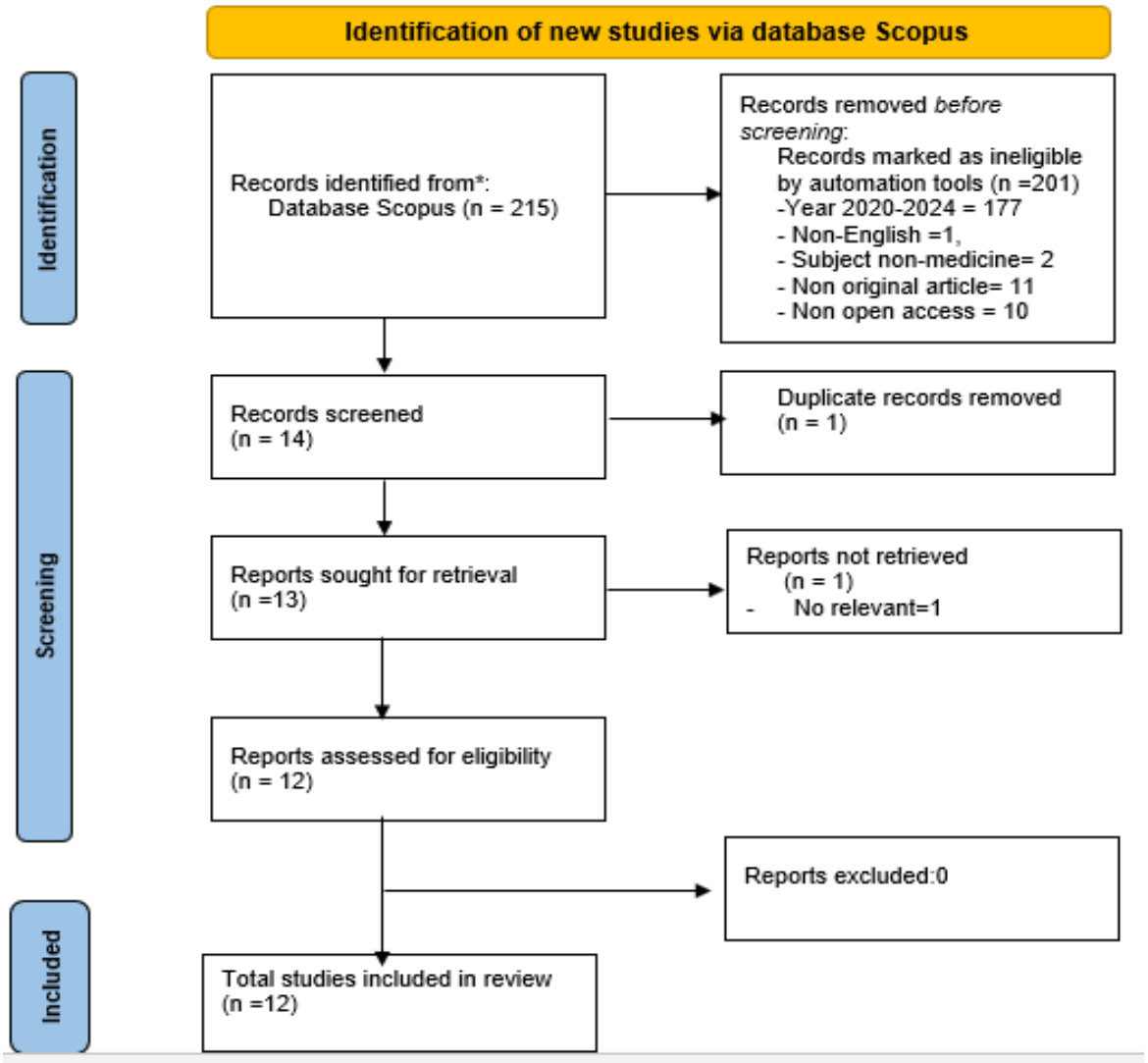

Figure 1. PRISMA Flowchart

E-ISSN :2722-0877

RESULT

Table 1. Extraction of Scoping Review

No.	Title	Authors	Year	Objective	Design Study/ Methods	(N)	Detailed Results/Findings
1	Risk Factors for Otitis Media with Effusion in Preschool and School Children in Calabar Municipality (10)	Adekanye, A.G., Onwughala, B.C., Mgbe, R.B., Anisi, C.O., Somefun, A.O.	2024	To determine the risk factors for otitis media with effusion (OME) among children in Calabar Municipality	A descriptive, cross-sectional, community-based study, questionnaires to assess risk factors for OME.	491	- OME prevalence was higher in younger children than in older ones, with a statistically significant relationship ($P < 0.001$).
2	Co-occurrence of Otitis Media with Effusion and Another Environment-dependent Disease (Selected Allergic Conditions) (11)	Wojas, O., Krzych-Fałta, E., Furmańczyk, K., Samoliński, B., Samel-Kowalik, P.	2024	To assess the co-occurrence of OME, allergic rhinitis, and asthma in children	Cross-sectional study using ECRHS and ISAAC questionnaires.	617	- OME increased the risk of developing allergic rhinitis by nearly two-fold in 6-7 years group (OR = 2.07, 95% CI: 1.738-2.479), OR = 1.61 in 13-14 years group, and OR = 1.55 in 20-44 years group.
3	Analysis of factors that influence the occurrence of otitis media with effusion in pediatric patients with adenoid hypertrophy (12)	Chen W., Yin G., Chen Y., Wang W., Ye J.	2023	To analyze factors that influence the occurrence of OME in pediatric patients with adenoid hypertrophy (AH).	Univariate and multivariate logistic regression analysis to evaluate clinical data and identify risk factors.	511	High adenoid grade, ETS exposure, and comorbid allergic rhinitis (AR) were risk factors for OME in pediatric patients with AH, while breastfeeding was a protective factor.
4	Diagnostic and Therapeutic Value of Sialendoscopy in a Patient with Kussmaul Disease: A Case Report (13)	Gür, H., Özcan, C., Güven, O., İsmi, O., Vayısoğlu, Y., Arpacı, R.B., Görür, K.	2023	To evaluate the diagnostic and therapeutic use of sialendoscopy in a patient with Kussmaul disease.	Case report describing the diagnostic process and therapeutic approach using sialendoscopy.	1	The patient, a 15-year-old girl with bilateral OME, allergic rhinitis, and recurrent swelling. Sialendoscopy revealed mucofibronous plugs and ductal ectasia, helping in the diagnosis and treatment of Kussmaul disease.

E-ISSN :2722-0877

5	Decreased miRNA-320e correlates with allergy in children with otitis media with effusion (14)	Adamczyk P., Narożna B., Szczepankiewicz A., Kałużna-Mlynarczyk A., Szydłowski J.	2021	To study the relationship between miRNA-320e expression and allergic reactions in children with otitis media with effusion (OME).	Comparative study using TaqMan™ MicroRNA Assays to measure miRNA expression in ear exudates of allergic and non-allergic children with OME.	54	MiR-320e expression was significantly decreased in allergic children with OME compared to non-allergic children. Other miRNAs showed reduced expression but the decrease was not significant.
6	Factors affecting the occurrence of otitis media with effusion in preschool and elementary school children: a comparative cross-sectional study (15)	Restuti R.D., Tamin S., Nugroho D.A., Hutauruk S.M., Mansyur M.	2022	To identify the risk factors for OME in preschool and elementary school focusing on laryngopharyngeal reflux (LPR), adenoid hypertrophy, and allergic rhinitis.	Comparative cross-sectional study with history taking, ENT examination, and tympanometry	2016	The probability of OME occurrence was significantly higher in patients with LPR (OR 3.3; 95% CI 1.33 to 8.189; p=0.01). There was no significant relationship between adenoid hypertrophy and OME, but allergic rhinitis was significantly associated with OME (p=0.463; 95% CI 0.61 to 4.28).
7	Clinical profiles of patients referred to an ear, nose and throat specialist clinic via community mobile hearing clinic in Singapore (16)	Lim, Z.H., Soo, Y.P., Loo, J.H.Y.	2021	To analyze the clinical profiles of patients referred from a community mobile hearing clinic to an ENT specialist clinic in Singapore.	Retrospective cross-sectional pilot study	375	Most patients (83.73%) attended their ENT appointments. The most frequently diagnosed conditions were otitis media with effusion, otitis externa, and chronic suppurative otitis media.
8	Prevalence and associated risk factors of recurrent otitis media with effusion in children in Upper Egypt (17)	Saad, K., Abdelmoghny, A., Abdel-Raheem, Y.F., Gad, E.F., Elhoufey, A.	2021	To determine the associations of possible risk factors and prevalence of recurrent OME	Cross-sectional study with multi-factor logistic regression analysis	2003	Recurrent OME was strongly associated with adenoid hypertrophy, tonsil hypertrophy, allergic rhinitis, and gastroesophageal reflux.

E-ISSN :2722-0877

9	Association of gastroesophageal reflux disease with increased risk of chronic otitis media with effusion in adults: A nationwide population-based cohort study (18)	Yeo, C.D., Kim, J.S., Lee, E.J.	2021	To evaluate the risk of developing OME in adults with gastroesophageal reflux disease (GERD).	Retrospective cohort study using propensity score matching	3532	The prevalence of chronic OME was 1.84 times higher in GERD patients. Allergic rhinitis, asthma, and chronic rhinosinusitis were identified as significant comorbidities increasing the risk of OME.
10	Endoscopic sinus surgery improves eustachian tube function in patients with chronic rhinosinusitis: A multicenter prospective study (19)	Chen X., Dang H., Chen Q., Zou H., Xiong H.	2021	To investigate the effect of endoscopic sinus surgery (ESS) on eustachian tube function in patients with chronic rhinosinusitis and eustachian tube dysfunction (ETD).	Prospective study	70	ESS significantly improved tympanogram and reduced inflammation in ETD patients, with improvement observed postoperatively at 8-12 weeks. Concomitant allergic rhinitis and higher preoperative SNOT-22 scores were associated with poorer outcomes.
11	Prevalence of allergic rhinitis in children with otitis media with effusion (1)	Norhafizah S., Salina H., Goh B.S.	2020	To determine the prevalence of allergic rhinitis in children with OME and identify risk factors for OME associated with allergic rhinitis.	Prospective study	100	The prevalence of allergic rhinitis in children with OME was 80.3%. There was significant hearing loss associated with OME, and allergic rhinitis treatment improved hearing thresholds.
12	Risk factors for otitis media with effusion in children with adenoid hypertrophy (20)	Songu M., Islek A., Imre A., Pinar E., Oncel S.	2020	To determine the most important risk factors for the development of OME in children with adenoid hypertrophy.	Retrospective study	539	Adenoid hypertrophy, attending daycare, exposure to smoke, frequent tonsillitis, and family size were significant risk factors for OME in children.

E-ISSN :2722-0877

A series of studies from 2020 to 2024 investigated various factors influencing Otitis Media with Effusion (OME) in children and adults. In 2024, a study by (10) identified risk factors for OME among preschool and school-aged children in Calabar, Nigeria, noting a higher prevalence in younger children with statistically significant findings ($P < 0.001$). Another 2024 study by (11). in Poland examined the co-occurrence of OME with allergic conditions such as rhinitis and asthma, revealing that allergic rhinitis significantly increased the risk of OME, particularly in children aged 6-7 years. In 2023, (12) analyzed factors affecting OME in pediatric patients with adenoid hypertrophy, finding high adenoid grade and secondhand smoke exposure as significant risk factors, while (13) presented a case report on the diagnostic use of sialoendoscopy in managing Kussmaul disease in a 15-year-old girl, which improved the diagnosis and management of salivary gland issues.

In 2021, multiple studies explored the molecular and environmental influences on OME. (14) found that reduced miRNA-320e expression correlated with OME in allergic children, while Restuti et al. identified laryngopharyngeal reflux (LPR) as a significant risk factor in a comparative study of preschool and elementary school children. Another 2021 study by (16) assessed clinical profiles of ENT patients in Singapore, with OME being the most diagnosed condition among attendees. Saad et al. also identified adenoid hypertrophy, smoke exposure, and large family size as prevalent risk factors for recurrent OME in Egyptian children.

The association between gastroesophageal reflux disease (GERD) and chronic OME was highlighted in a 2021 study by (18) (, which found that adults with GERD had a 1.84 times higher risk of developing chronic OME. Chen et.al examined endoscopic sinus surgery (ESS) for eustachian tube dysfunction in 70 patients with chronic rhinosinusitis, showing significant improvements post-surgery (19). Meanwhile, Norhafizah et.al studied allergic rhinitis in children with OME, finding a prevalence rate of 80.3% and noting that rhinitis treatment improved hearing outcomes (1). Lastly, Songu et.al identified adenoid hypertrophy and secondhand smoke as prominent risk factors for OME among children with adenoid hypertrophy (20).

Rick Factors of OME

The risk factors for Otitis Media with Effusion (OME) have been extensively studied, with various environmental and physiological contributors being identified. Key studies highlight several important aspects. Study 1 by (10) emphasizes daycare attendance, lower age, and nursery exposure as significant risk factors for younger children developing OME. Another study by Wojtas et al. (2024) points to the significance of age, allergic rhinitis, and asthma as critical risk factors for the condition. Restuti et.al also identified that laryngopharyngeal reflux (LPR) and adenoid hypertrophy are notable

E-ISSN :2722-0877

contributors to the onset of OME, especially in pediatric patients (15). Moreover, Yeo et.al found that chronic rhinosinusitis and gastroesophageal reflux disease (GERD) are key risk factors in developing OME in adults (18).

The studies collectively suggest that both environmental factors, such as exposure to smoke, daycare attendance, and physiological conditions, including reflux diseases and adenoid hypertrophy, play a significant role in the incidence of OME. Specifically, many of these studies underscore the correlation between age and comorbidities like allergic rhinitis and asthma, which often accompany OME. The findings highlight the complex interplay between external environmental exposures and internal physiological vulnerabilities that contribute to the occurrence and persistence of OME across different age groups.

Many of these studies show that both environmental (e.g., exposure to smoke, daycare attendance) and physiological (e.g., reflux diseases, adenoid hypertrophy) factors significantly contribute to the occurrence of OME. Specifically, studies highlight the correlation between age and respiratory-related comorbidities such as allergic rhinitis and asthma.

In addition to the key findings from the studies listed, previous research has shown that early childhood exposure to respiratory pathogens in daycare settings increases the risk of developing OME. According to a study by Paradise et al. (1997), the frequency of upper respiratory tract infections (URTIs) in daycare environments is directly correlated with a higher incidence of OME. This suggests that crowded environments like daycares create conditions conducive to the spread of infectious agents, which subsequently lead to Eustachian tube dysfunction and fluid accumulation in the middle ear.

Further supporting this, the Eustachian tube dysfunction theory explains that children are more susceptible to OME because of the anatomical and functional immaturity of their Eustachian tubes. The tube is shorter and more horizontal in children, allowing bacteria and viruses from the nasopharynx to reach the middle ear more easily (21). This anatomical vulnerability is often exacerbated by comorbid conditions like allergic rhinitis and asthma, which cause inflammation and further compromise the Eustachian tube's ability to drain fluid from the middle ear.

A study by Cheng et al. (2) (2017) identified that allergic rhinitis was an independent risk factor for recurrent OME. Allergic rhinitis (2) (, which triggers inflammation of the nasal passages and sinuses, further impairs Eustachian tube function. Children with allergic conditions have a higher risk of OME because inflammation and mucus production block the natural ventilation of the middle ear, leading to fluid buildup and infection.

In the realm of gastroesophageal reflux (GERD) as a risk factor for OME, a study by Yeo et al. (2021) concludes that in

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comparison to the non-GERD group, the prevalence of chronic OME in adults was 1.84 times greater in the GERD group. In line with their research, Karyanta et al. found that the GERD group's OME prevalence ratio is 4.5 times higher than that of the non-GERD group (22). GERD-related inflammation weakens the mucosal defense mechanisms of the upper respiratory tract, creating favorable conditions for the development of OME (23).

Role of Allergic Rhinitis in Otitis Media with Effusion

The role of allergic rhinitis in the development of Otitis Media with Effusion (OME) has been well-documented, particularly in children. Several studies indicate a strong association between allergic rhinitis and the occurrence of OME. For instance, Wojas et al. demonstrate a significant relationship between allergic rhinitis and OME. Further, (14) explored the molecular basis of this relationship by highlighting differences in miRNA expression between allergic and non-allergic children with OME, suggesting that genetic and molecular factors might underlie the heightened susceptibility. Additionally, Norhafizah et al. (2020) reported that 80.3% of children with OME also had allergic rhinitis, marking it as a significant risk factor.

The findings collectively underscore the critical role that allergic rhinitis plays in the pathogenesis of OME, particularly by exacerbating complications such as hearing loss. These results align with previous research that has identified allergic rhinitis as a significant comorbidity that increases the likelihood of OME, especially in pediatric populations. Studies on miRNA, like that by Adamczyk et al. (2021), suggest that molecular mechanisms are involved in the progression of OME in individuals with allergic rhinitis. The role of immune response, particularly IgE-mediated hypersensitivity reactions, has also been theorized as a contributing factor, where allergic inflammation may lead to Eustachian tube dysfunction, a key factor in the development of OME (24). Previous studies have also demonstrated the benefit of treating allergic rhinitis to mitigate the severity of OME symptoms (24) (25). Theoretical frameworks propose that allergic rhinitis-induced inflammation in the upper airways may contribute to the obstruction of the Eustachian tube, creating a conducive environment for the development of OME, further validating the strong correlation between these two conditions (2)(24)(26)(27).

Mechanism of allergic rhinitis worsens OME

Allergic rhinitis worsens Otitis Media with Effusion (OME) through several interconnected physiological mechanisms, primarily involving inflammation and dysfunction of the Eustachian tube. Here's a detailed explanation of how allergic rhinitis contributes to the worsening of OME:

1. **Eustachian Tube Dysfunction** (24)

E-ISSN :2722-0877

The Eustachian tube is responsible for equalizing pressure between the middle ear and the atmosphere and for draining fluids from the middle ear into the throat. In allergic rhinitis, the nasal passages, sinuses, and areas around the Eustachian tube become inflamed due to the body's immune response to allergens (such as pollen, dust, or pet dander). This inflammation can extend to the Eustachian tube, causing it to swell and impair its normal functioning.

When the Eustachian tube is blocked or dysfunctional, fluid in the middle ear cannot drain properly. This leads to the accumulation of fluid behind the eardrum, which is characteristic of OME. The persistent presence of fluid creates an environment that can result in ear infections and hearing impairment.

2. **Mucosal Inflammation and Secretion** (28)

Allergic rhinitis causes an increase in mucus production due to the immune system's response to allergens. The overproduction of mucus not only affects the nasal passages but can also block the Eustachian tube. The excess mucus may accumulate in the middle ear, leading to effusion (fluid build-up). This further worsens OME, as the stagnant fluid provides a breeding ground for bacteria and viruses, increasing the likelihood of infections like acute otitis media (AOM).

3. **Immune Response and Inflammation** (29)

In allergic rhinitis, the immune system releases histamines and other inflammatory mediators such as cytokines, leukotrienes, and prostaglandins in response to allergens. These substances cause the blood vessels in the nasal and ear mucosa to dilate, leading to swelling and congestion in the surrounding tissues. The inflammation affects the Eustachian tube's ability to ventilate and regulate pressure in the middle ear, causing fluid retention and pressure imbalance, which are key elements of OME.

4. **Impaired Ciliary Function** (30) (31)

Cilia are tiny hair-like structures that help move mucus and debris out of the respiratory tract, including the Eustachian tube. In allergic rhinitis, inflammation of the mucosal lining in the nose and throat can impair the function of these cilia. As a result, the normal clearance of fluids and mucus from the Eustachian tube is disrupted, allowing fluid to accumulate in the middle ear, exacerbating OME symptoms.

5. **Recurrent Upper Respiratory Infections**

Individuals with allergic rhinitis are often more prone to upper respiratory infections (URIs), such as colds and sinus infections, due to the weakened mucosal barrier and continuous inflammation. These infections can further impair the function of the Eustachian tube, causing it to become more easily blocked and increasing the chances of fluid build-up in the middle ear. Recurrent URIs in combination with allergic rhinitis led to more frequent and prolonged episodes of OME.

6. **Role of Adenoid Hypertrophy**

E-ISSN :2722-0877

Allergic rhinitis often coincides with adenoid hypertrophy (enlargement of the adenoid tissues located near the Eustachian tube opening). Enlarged adenoids can physically obstruct the Eustachian tube, further impairing its ability to ventilate the middle ear and drain fluid. This mechanical blockage worsens the condition in children with both adenoid hypertrophy and allergic rhinitis, leading to persistent OME

Surgical Interventions and Treatment for OME

Surgical interventions have shown significant promise in treating Otitis Media with Effusion (OME), particularly in cases complicated by comorbid conditions such as allergic rhinitis and adenoid hypertrophy. A case report by (13) (highlighted the therapeutic use of sialendoscopy in treating a patient with both Kussmaul disease and OME, showing its effectiveness in managing this complex condition. Additionally, (19) demonstrated that endoscopic sinus surgery (ESS) significantly improves Eustachian tube dysfunction and decreases OME symptoms, providing evidence for its role in managing Eustachian tube-related issues. Furthermore, (20) identified adenoidectomy as a critical intervention for children with OME, particularly those with adenoid hypertrophy, which often obstructs the Eustachian tube and contributes to fluid accumulation in the middle ear. These findings suggest that surgical procedures like adenoidectomy and ESS are essential in improving patient outcomes in complex OME cases. Moreover, additional surgical procedures such as sialendoscopy and tympanostomy tubes (ear tubes) may enhance patient outcomes, especially in cases where conservative treatments have failed to relieve symptoms or prevent a recurrence (32).

The discussion on surgical interventions for Otitis Media with Effusion (OME) has evolved with various studies highlighting the effectiveness of procedures such as adenoidectomy, endoscopic sinus surgery (ESS), and sialendoscopy. These surgical approaches are particularly important in complex cases where comorbidities like allergic rhinitis and adenoid hypertrophy exacerbate the symptoms and chronicity of OME.

Adenoidectomy in Treating OME

Adenoidectomy, the surgical removal of the adenoids, has long been a standard treatment for children with recurrent OME, particularly when adenoid hypertrophy is a contributing factor. The study by (20) supports the critical role of adenoidectomy in reducing OME symptoms, especially in cases where adenoids block the Eustachian tube, leading to fluid accumulation in the middle ear. This is consistent with earlier research that showed adenoidectomy improves Eustachian tube function by removing the mechanical obstruction, thereby restoring middle ear ventilation and reducing effusion.

Endoscopic Sinus Surgery (ESS) and Eustachian Tube Dysfunction

ESS has gained attention as an effective intervention for patients with OME,

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particularly those with comorbid chronic rhinosinusitis. In the study by (12), ESS was shown to improve Eustachian tube dysfunction, which is a common underlying cause of OME. By alleviating sinus inflammation and improving the patency of the Eustachian tube, ESS helps restore proper middle ear ventilation, thereby reducing the incidence of fluid build-up. This finding aligns with previous studies like those by Kim et al. (2016), which demonstrated that ESS not only improves nasal and sinus symptoms but also has a secondary benefit in reducing middle ear effusion in patients with both rhinosinusitis and OME. These results highlight the interconnectedness of nasal, sinus, and middle ear health, where inflammation in one area can lead to dysfunction in others.

Sialendoscopy and Tympanostomy Tubes

The use of sialendoscopy, as illustrated in the case study by (13) offers another innovative approach to treating OME, particularly in cases complicated by other diseases like Kussmaul disease. While sialendoscopy is traditionally used to treat salivary gland issues, its application in managing OME demonstrates its potential in addressing complex head and neck conditions that contribute to Eustachian tube dysfunction. In cases where non-surgical treatments fail, tympanostomy tubes (ear tubes) are also a common intervention, particularly in recurrent or chronic OME. The tubes help drain fluid from the middle ear and restore hearing. According to Rosenfeld et al, tympanostomy tubes are effective in managing chronic OME, reducing effusion, and improving hearing outcomes in pediatric patients (32).

Comorbidities Associated with Otitis Media with Effusion

Comorbidities play a significant role in the onset and progression of Otitis Media with Effusion (OME). The studies reviewed highlight the major comorbidities associated with this condition. (18) found that gastroesophageal reflux disease (GERD) and asthma were critical factors increasing the risk of chronic OME, emphasizing the importance of managing these conditions to prevent the progression of ear infections. Similarly, (20) demonstrated that allergic rhinitis and frequent tonsillitis significantly influence the recurrence and progression of OME. These conditions exacerbate the Eustachian tube dysfunction, contributing to persistent fluid build-up in the middle ear. (Norhafizah et al., 2020) confirmed that allergic rhinitis and recurrent upper respiratory infections were common comorbidities among children with OME, further complicating the disease's management.

Proper management of these comorbidities is crucial to reducing the incidence and complications associated with OME. Conditions such as GERD (18), asthma (33), allergic rhinitis (34), and tonsillitis (35) are known to aggravate Eustachian tube dysfunction, which leads to prolonged or recurrent OME episodes. Effective treatment of these underlying conditions—such as managing allergic responses or treating

E-ISSN :2722-0877

reflux—can significantly reduce the risk and severity of OME in both children and adults. The Unified Airway Theory supports the idea that airway inflammation, whether in the upper or lower respiratory tract, has a systemic effect, which includes complications in the middle ear. Therefore, a comprehensive approach to managing comorbid conditions could result in better outcomes for patients with OME, especially in preventing recurrences and minimizing long-term hearing loss or other complications (36).

Studies that explored comorbidities' role in OME emphasize the importance of managing these associated conditions effectively. For example, children with asthma and allergic rhinitis are more prone to persistent and recurrent episodes of OME due to continuous inflammation in the respiratory and middle ear systems (34)(29). Effective control of these comorbidities through medications like corticosteroids or ant reflux treatments, and addressing allergic symptoms, may reduce the incidence and severity of OME. According to the Unified Airway Theory, which suggests that inflammatory diseases of the airway tend to co-occur and affect the entire respiratory system, managing upper and lower airway diseases can improve outcomes in related conditions, such as OME. Furthermore, recent studies have highlighted that children with both GERD and allergic rhinitis have worse outcomes in terms of OME recurrence and hearing loss, stressing the need for comprehensive treatment strategies targeting multiple comorbidities to prevent long-term complications in OME patients (37).

CONCLUSIONS

The conclusion of this review highlights the complex and multifactorial relationship between Allergic Rhinitis (AR) and Otitis Media with Effusion (OME). The findings indicate that AR significantly contributes to the development and progression of OME, particularly in pediatric populations. The studies reviewed suggest that factors such as environmental triggers, anatomical predispositions, and immune responses play key roles in exacerbating OME in individuals with AR. Effective management strategies, including early detection, targeted treatment of allergies, and comprehensive monitoring of ear health, are essential to mitigate the impact of these conditions. Further research is needed to explore the underlying mechanisms and to develop more effective interventions to improve patient outcomes.

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