EJMR
ERA'S JOURNAL OF MEDICAL RESEARCH
p-ISSN: 2348-9839, e-ISSN: 2394-5222 | www.ejmr.org

Volum 12 Issue 1
REVIEW ARTICLE

Reasons for Otitis Media: Recognizing and Treating Middle Ear Infections

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Received on: 07-02-2025 Published on: 30-04-2025

ABSTRACT

Background: As middle ear infections are so common in children, this review article will try to dig into the causes of *otitis media* and the best ways to treat them. The process begins with a comprehensive literature search using targeted data sources and keywords, and then continues with data extraction to produce studies that meet the criteria.

Aim: The aim is to provide a thorough grasp of *otitis media*'s causes, potential dangers, anatomy, and present methods for diagnosis, treatment, and prevention. The findings provide light on a number of elements that play a role, such as inherited tendencies and environmental circumstances, and they also provide useful diagnostic tools and treatment choices, such antibiotic treatment and surgical procedures.

Method: Method of data extraction in a review article on *otitis media* involves systematically gathering and analyzing relevant information from primary research studies to address specific research questions or objectives.

Conclusion: The importance of preventing *otitis media* is highlighted, with a certain effort on the pneumococcal vaccination. So as to enhance patient outcomes by precise diagnosis, individualised treatment plans, and efficient preventative measures, it is crucial to have a comprehensive awareness of *otitis media*, as highlighted in the conclusion.

***Keywords*:** *Middle Ear Infection, Otitis Media, Prevention, Risk Factor, Treatment.*

Era's Journal of Medical Research. 12(1);2025 [doi: 10.24041/ejmr.2025.15]

INTRODUCTION

The outside ear, the center ear, and the inward ear are the three primary parts of the ear. The ear waterway and pinna, the piece of the ear that is apparent to the unaided eye, make up the external ear. A layer called the tympanic film partitions the external ear from the center ear; it is an expansion of the external ear. There is an empty past the eardrum called the center ear, which is loaded up with air. It conveys sound waves from the center ear to the internal ear by means of three little bones: the malleus, the incus, and the stapes.[1] The eustachian tube connects the center ear to the nasal depression and the rear of the throat. This cylinder permits air to circle inside the ear, bringing the inner strain of the center ear nearer to that of the external climate. The cochlea and maze are situated in the inward ear, which is liable for hearing and equilibrium. From the cochlea to the cerebrum, the hear-able nerve ventures.[2]

OTITIS MEDIA

When fluid collects in the middle ear space (Figure 1) it might lead to otitis media (OM), an infection or inflammation of the ear. A cold, sinus or throat infection, allergic response, swollen adenoid tissue, or inflammation of the Eustachian tube may cause this illness. A buildup of fluid in the middle ear, if not addressed, may lead to infection.

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How to cite: Singh P, Shukla P, Gupta P, Faiz SM, Khare V. Reasons for Otitis Media: Recognizing and Treating Middle Ear Infections. Era J Med Res. 2025;12(1):69-74.

In 70% of instances, bacteria are shown to be the main cause of OM.[3] *Haemophilus influenzae and Streptococcus pneumoniae* are the bacteria that are most often identified. *Moraxella catarrhalis and Streptococcus pyogenes* are two of the less frequent bacteria that may be implicated. Although viruses do not often cause OM directly, they do contribute significantly by inflaming the nasal passages and reducing the effectiveness of the ear's defensive mechanisms, such cilia. This illness is common in children aged one to three, however it may also affect adults and older children.[4]

Children are more prone to OM than adults for a variety of reasons. As a first point, the immune systems of young children are still maturing, making them more susceptible to illness.

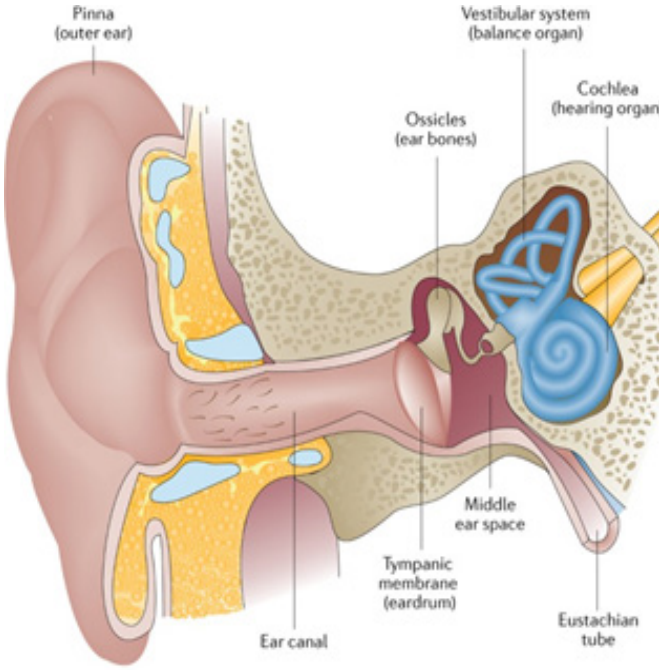

Figure 1: Otitis Media. [5]

The shorter and more horizontal shape of the eustachian tube in children compared to adults is another factor. In the ways that follow, this aggravates OM. On a regular basis, the eustachian tube opens to let air into the middle ear, refill its air supply, and bring its air pressure into equilibrium with the surrounding air. But the middle ear cannot get the air it needs if the eustachian tube is enlarged or mucus plugs its opening.[6] The result is a buildup of fluid in the middle ear because it is unable to drain properly. In addition, germs from the nasal passages and throat may more easily enter the middle ear via the slanted shape of the eustachian tube in youngsters.

Otitis Media Development and Risk Factors

Blockage of eustachian tube as a result of an upper respiratory infection, such as a cold, flu, throat, sinus infection, is the main cause of OM. Age is another risk factor; ear infections are more common in babies and toddlers. Recurrence of ear infections is more likely in children who are younger when they first experience them.[7] Another factor that might lead to ear infections is enlarged adenoids. Because breast milk protects infants from infections, bottle-fed infants are more likely to have ear infections, particularly when laying down. When the Eustachian tube swells, as might happen with the flu or antipathies, it can lead to an ear infection. Infectious diseases, such as ear infections, are more common in children who are exposed to second hand smoking. The prevalence of ear infections is greater among children from lower socioeconomic groups compared to those from more affluent neighborhood, suggesting that socioeconomic status is a factor. Furthermore, infections are more common in males than in girls.[8]

Anatomy of The Ear

Transduction is the means by which the human ear recognizes and processes sound. It is an organ of hearing and equilibrium.[9] The external ear, center ear, and inward ear are its three parts. Sound waves are assembled by the external ear and coordinated towards the tympanic layer. The hear-able ossicles connect the center ear, a little chamber situated in the transient bone.[10] The vestibular framework and hearing tactile organs are situated in the inward ear, frequently alluded to as the maze. The organs being referred to are the particular terminals of the eighth cranial nerve.[11]

Table 1: Research study data.

Topic Covered	Research Study	Title
Otitis media causes and treatment options	examined the causes, treatment options, and risk factors for bacterial or viral infections that cause otitis media.	Causes and treatments for otitis media
Acute otitis media	portrayed the pathogenesis, risk variables, predominance, and treatment strategies of intense otitis media exhaustively.	Acute otitis media
Antimicrobial therapy's impact on middle ear effusion	investigated how antimicrobial therapy affected the middle ear effusion's resolution after acute otitis media.	Effect of anti-infection treatment on center ear emission decrease during intense otitis media
The causes, assessment, outcomes, and treatment of pediatric intense otitis media	gave a thorough overview of the causes, symptoms, consequences, and therapy of childhood acute otitis media.	The causes, examination, consequences, and treatment of pediatric acute otitis media
Children with acute otitis media treated with antibiotics	investigated the shift in the management of acute otitis media with antibiotics from evidence to clinical recommendations.	From data to clinical recommendations for the management of antibiotics in children with acute otitis media

Outer ear

The anatomy of the human ear, particularly the auricle, makes it distinct. Made of yellow elastic cartilage covered in skin, the auricle is a thin, immovable shell located close to the skull. Auricle attachment to the skull and scalp is made possible by a few tiny primitive muscles, most of which are nonfunctional.[12] In order to keep insects out of the external auditory canal, modified sweat glands that create earwax surround the skin, which is slightly curved.

TYMPANIC MEMBRANE AND MIDDLE EAR

Tympanic membrane

The eardrum, also known as the tympanic membrane, serves as the line between the middle and outer ears. It is shaped like a flattened cone and has a diameter of 8–10 mm. When diagnosing middle ear disorders, particularly in young children, the membrane is essential. The skin, mucous membrane, and fibrous tissue are its three layers. Under an otoscope, the membrane appears transparent, pearl-gray, and has a hint of pink or yellow. It is sensitive to pain because it has an abundance of sensory nerve fibers and blood vessels.[13]

Middle-ear Cavity

The atrium and attic are the top and lower chambers that make up the middle ear cavity, which is a small, air-filled region. It is made up of a floor, four walls, and a ceiling. The tympanic membrane serves as the outside wall, while the bone plate serves as the roof. It's a thin plate of bone for a floor. While the front wall connects the ear to the nasopharynx, the rear wall divides the middle ear from the mastoid antrum. The middle ear and inner ear are divided by the inner wall.[14]

Auditory Ossicles

The malleus, incus, and stapes are three little bones that make up a short ossicular chain that connects the middle ear chamber. Whereas the incus resembles a premolar tooth, the malleus resembles a club. Ligaments hold these bones in place, enabling the chain to vibrate and produce sound. The incus has a short process and a loose junction with the stapes, while the malleus has a handle and a head. At 3 mm in length and 3 mg in weight, the stapes is the smallest bone in the body.[15]

Muscles

The tensor tympani and stapedius are two little muscles found in the middle ear. The malleus is pulled inward by the lengthier tensor tympani muscle, which keeps the tympanic membrane taut. By tilting the stapes backward, the stapedius, a shorter muscle, may diminish sound intensity selectively, particularly with lower frequency noises. To keep the ear healthy, both muscles cooperate.[16]

Nerves

The facial nerve, a seventh cranial nerve, connects the brainstem to the face muscles by passing via the facial canal in the temporal bone. Emerging from the canal and passing through the pars tensa membrane is the chorda tympani nerve, a vital branch that supplies sensory fibers to the tongue and parasympathetic secretory fibers to the salivary glands.

Eustachian Tube

The tympanum and nasopharynx are associated by the 31–38 mm long eustachian tube. It is more extensive nearby the pharynx and smaller toward the top. Cilia cover its mucous coating, working with quick mucous seepage. The cylinder, which is shut very still and opens during gulping, supports keeping up with equivalent pneumatic force on the two sides of the tympanic film. The Valsalva method opens the cylinder and increments pharyngeal pneumatic stress. It is named after the Italian doctor anatomist Antonio Maria Valsalva.[17]

Inner Ear

There are two mazes in the internal ear: the bone maze and the film maze. The vestibule, three half circle trenches, and the cochlea make up the bone maze. Perilymph makes up for the shortcoming between each construction, which contains comparable segments of the membranous maze loaded up with endolymph. The vestibule and crescent channels, which house the utricle and saccule (otolith organs) and half circle conduits, are portions of the vestibular framework, which is accountable for balance. These designs' maculae and cristae contain hair cells that sense development and position of the head. The tangible organ of hearing, the organ of Corti, is housed in the twisting molded cochlea, which looks like a snail shell and is upheld by the basilar layer.[18] Between the scala vestibuli and scala tympani, which are both loaded up with perilymph, is the cochlear pipe, which is loaded up with endolymph. Due to primary varieties all through its length, the basilar layer might respond to different sound frequencies. Blood courses give nourishment and oxygen, particularly to the organ of Corti, which is essential for hearing.[19]

METHODS

The final data extracted from studies is compiled into a coherent narrative or thematic presentation, discussing key points related to OM, such as treatment efficacy, patient outcomes, or risk factors. A review article might also discuss gaps in current knowledge, highlight controversies (e.g., overuse of antibiotics for OM), and suggest directions for future research. Clinical recommendations might be provided, based on the strength of the evidence, helping clinicians make informed decisions about managing OM in different patient populations.

Data Sources and Terms of Search

We searched MEDLINE extensively to find the relevant articles for our study. We used these search terms: infections of the middle ear, infections in children, OM, what causes it, how to cure it, and how to avoid it.[20]

Data Extraction

After analyzing the papers and abstracted data separately, two reviewers reached a consensus to settle any discrepancies. The quality of the studies was assessed, and a review methodology was adhered to at all times. Data extraction in a review article on OM involves systematically gathering and analyzing relevant information from primary research studies to address specific research questions or objectives. The goal is to synthesize findings from multiple studies to provide a comprehensive understanding of the condition, its treatments, and outcomes.

Table 1 offers an overview of evaluations of the literature from many OM studies, each concentrating on a distinct facet of the illness. In their investigation into the etiology and therapeutic approaches of OM, Aljohani *et al.* (2018) highlighted the significance of bacterial and viral infections in addition to a number of risk factors. A thorough review of acute otitis media (AOM) was given by Rea and Ronan (2018), who also addressed its pathogenesis, management techniques, and frequency in children. They also emphasized the need of balanced treatment methods. A detailed review of AOM in children was provided by Jamal, Alsabea, Tarakmeh, and Safar (2022). It included the origin, diagnosis, complications, and management of the condition, emphasizing the significance of precise diagnosis and customized treatment approaches. Lastly, Spoială, Stanciu, Bild, Ababei, and Gavrilovici (2021) looked at the shift from clinical recommendations to evidence in the management of antibiotic-associated open wounds (AOM) in children. When taken as a whole, these studies advance our knowledge of the causes, treatments, and cure of OM, emphasizing the value of individualized care based on clinical data.

DISCUSSION

Anatomical contrasts, cell science pathophysiology (counting, transaction between microbiological specialists and the ensuing host immunological reaction), and different factors all add to OM's perplexing etiology. Adenovirus, respiratory syncytial infection, and cytomegalovirus are a couple of instances of the viral upper respiratory parcel infections that frequently happen previously or simultaneously as AOM episodes. It is currently very much acknowledged that viral infections assume a critical part over AOM, and antiviral treatment for AOM has been affirmed by ongoing randomized controlled investigations.[26] Claims propose that microscopic organisms might colonize, stick to cells, and attack the middle ear after a viral infection of the nasopharynx establishes a climate good for their development.

In AOM, the most pervasive bacterial microbes found in middle ear emissions are those that cause infections in the upper respiratory parcel.[27] Microscopic organisms found in OME are, by and large, like those found in recurrent acute otitis media (RAOM).[28]

The middle ear may be aspirated with nasopharyngeal infections if the problem is not treated. Clinical manifestations of AOM occur when these microorganisms cause inflammation, which in turn causes pus to form in the middle ear.[29] During this inflamed time, the ossicles in the middle ear decrease in mobility and may even undergo resorption, leading to long-term conductive hearing loss. Chronic middle ear illness is more common in persons with smaller mastoid cavities, according to studies; however, the extent to which this impact contributes is still up for debate. Sensorineural hearing loss may occur in people with persistent infections as a result of ototoxicity.[30]

TREATMENT

When suitably treated with absense of pain and antipyretic, AOM frequently improves without antibiotics. Roughly 80% of children with AOM report feeling improved on their own between two days to about fourteen days, as indicated by meta-examinations. Results are less reliable and OM goal might be pretty much as low as 30% in a couple of days in youths under 2–years. In children determined to have AOM, assuming that no further issues are identified, essentially perception might be appropriate because of the by and large high paces of abatement.[31]

Antibiotics are suggested for children more seasoned than a half year with extreme, one-sided or respective AOM as per ebb and flow US treatment proposals. When a youngster between the ages of 6 and 23-months has reciprocal AOM, regardless of whether it isn't incredibly extreme, antibiotics ought to in any case be controlled. Antibiotics might be suggested or rigorously observed in instances of gentle to direct one-sided AOM in children matured 6-23 months, or in instances of gentle to direct one-sided/two-sided AOM in children matured 2 years or more. In the event that enduring it is liked, a procedure to direct antibiotics ought to be ready on the off chance that side effects don't die down following a few days ought to be set up. It is critical to think about the kid's clinical state, yet additionally the assessments of guardians or parental figures, and to pursue decisions together. One urgent piece of treating AOM is overseeing and evaluating torment. It ought to be noticed that contrasted with children who move antibiotics immediately, the people who go through an underlying time of perception don't have a higher gamble of confusions.[32]

Pneumococcal Vaccine

In order to mitigate the effects of OM, the negative side effects of antibiotic treatment, and the rise of bacteria resistant to these drugs, it is crucial to take steps to stop the illness from starting and from progressing. Vaccination

antigens include *S. pneumoniae, M. catarrhalis,* and *N. influenza*. A lot of focus has been on the pneumococcal conjugate vaccination recently since, while it was originally created to manage invasive pneumococcal diseases like pneumonia, it has now been beneficial in tackling the most prevalent cause of AOM.

Pneumococcal immunization effectively prevents pneumococcal AOM, according to many systematic studies. Children in North America saw a decrease in AOM cases after receiving the 7-valent pneumococcal conjugate vaccination (PCV7).[33,34] There was a 25.2% overall drop in AOM between 2000–2007 in Canada, with vaccines accounting for 13.2% of that drop and having the greatest effect on the baby age group, according to studies. The introduction of PCV7 also led to significant decreases in nasopharyngeal vaccination serotypes. Although pneumococcal serotype 19A grew, PCV7 reduced the number of vaccine-coverage serotypes.[35-37]

After inoculation, AOM-related entanglements, like mastoiditis and other intracranial complexities, diminished; nonetheless, after a couple of years, they shockingly got back to pre-immunization levels, raising worries about the drawn-out advantage of vaccination notwithstanding encouraging outcomes. Pneumococcal infections contaminating different spots have similarly seen this downfall and resulting increment; be that as it may, these infections are by and large less regular now than they were before inoculation turned out to be generally utilized. Serotype substitution raises opposition concerns, similarly as with non-pneumococcal infections.[38]

CONCLUSION

The aetiology and management of OM, a frequent middle ear infection in children, are examined in this study. It demonstrates that it is mostly brought on by bacterial or viral infections and is exacerbated by physiological and anatomical factors. Its high incidence is caused by environmental factors such as tobacco smoke and daycare centres. The study emphasises how crucial it is to comprehend ear anatomy in order to provide an accurate diagnosis and provide appropriate treatment. Pneumococcal vaccination is one preventive measure that can greatly lessen the severity of the illness. To maximise care, more investigation and evidence-based procedures are required.

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