

**PREVALENCE AND DETERMINANTS OF OTITIS MEDIA IN CHILDREN 1 TO 6 YEARS OF AGE: AN ANALYTICAL CROSS-SECTIONAL STUDY****Dr Ghandi Mariappan,\* Dr John Samuel, Dr Thiyagaraj A Kumarasamy**Specialist Paediatrician, Amana Healthcare Paediatric Long term Care Hospital, Alain,  
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**Abstract**

**Objectives:** The aim of the present study was to determine the prevalence of Otitis Media; and to assess the risk factors for Otitis media in children aged one to six years of age. **Methods:** This was an analytical cross-sectional study conducted in the Rural Field Practice Area (RFPA) of a tertiary healthcare facility in north India between September 2018 and December 2019. Children in the age group of 1 to 6 years presenting with acute suppurative otitis media, or sequelae of acute otitis media including Otitis media with effusion and chronic otitis media were considered as cases of Otitis media. **Results:** The overall prevalence rate of Otitis media was found to be 12.7%. Regarding the distribution of types of Otitis media, it was found that 36.8% had Otitis media with effusion, 34.2% had eustachian tube catarrh, 21.1% had Chronic suppurative otitis media – Tubotympanic disease (CSOM-TTD), and 7.9% had Acute suppurative otitis media (ASOM), in that order. We found that age less than three years (or 36 months) (OR 2.86, 95% CI 1.92 to 3.45); living in a kutch house (OR 1.91, 95% CI 1.04 to 3.74); malnutrition, that is weight for age <-2SD from reference median (OR 3.18, 95% CI 1.76 to 5.58); breastfeeding for less than six months (OR 2.24, 95% CI 1.30 to 4.88); and persistent rhinorrhoea (OR 2.78, 95% CI 1.56 to 4.33) were significant predictors of Otitis media among children one to six years of age ( $p < 0.05$ ). **Conclusion:** Efforts should focus on improving housing conditions, promoting breastfeeding practices, addressing malnutrition, and managing respiratory symptoms effectively.

**Keywords:** Otitis media, Prevalence, Risk factors, India, ASOM, CSOM**Introduction**

Otitis media (OM), also known as middle ear infection, is indeed one of the most common diseases of childhood worldwide.(1) It begins in early childhood and is characterized by inflammation and infection of the middle ear, which is the space behind the eardrum.(2) OM can cause pain, hearing loss, and in some cases, complications such as mastoiditis or meningitis.(3) It is a disease that not only has a substantial impact on patients and their families, but also is a burden on health care systems in both well-developed industrialized nations and developing countries.(4) Globally, the disease burden of otitis media is significant, particularly among children under the age of five. According to the World Health Organization (WHO), it is estimated that around 709 million cases of acute otitis media occur each year worldwide.(5)

This high prevalence can be attributed to various factors such as frequent upper respiratory tract infections, inadequate access to healthcare, crowded living conditions, and lack of appropriate immunization.(6)

In India, otitis media poses a substantial disease burden, especially considering the country's large population and diverse socio-economic conditions.(7) The prevalence of OM in India is significant, and it affects a significant number of children. Several factors contribute to the burden of otitis media in India, including poor hygiene practices, inadequate sanitation, overcrowding, and limited access to healthcare services in rural areas.(8) The host factors include male gender, age less than 3 years, and a family member with acute otitis media. Environmental factors include day care attendance, parental smoking, poor ventilation, low socioeconomic status, and lack of adequate breast feeding. Other risk factors include race, altered host defences, and seasonal variation.(9, 10)

Otitis media in developing countries poses a special problem particularly in the preschool age group. It can lead to pain, discomfort, hearing loss, and speech and language delays, affecting the overall quality of life and educational outcomes.(11) Furthermore, untreated, or recurrent episodes of OM can have long-term consequences, such as permanent hearing loss and potential developmental delays. Acute otitis media (AOM) precedes chronic suppurative otitis media (CSOM).(12) Estimates of direct and indirect costs attributed to the medical and surgical treatment of children with OM among children under five years of age exceeds five billion dollars each year.(13)

Efforts are being made globally and in India to address the burden of otitis media. These include promoting vaccination against common pathogens that cause middle ear infections, improving access to healthcare services, raising awareness about prevention and treatment, and implementing strategies to improve hygiene practices and sanitation.(14) It is important to recognize the significance of otitis media as a public health concern and prioritize efforts to prevent, diagnose, and treat the condition effectively, especially among vulnerable populations, such as children in low-resource settings.(15) By addressing the burden of otitis media, we can improve the health and well-being of children globally, including in India.

Against this background, the aim of the present study was to determine the prevalence of Otitis Media; and to assess the risk factors for Otitis media in children aged one to six years of age.

## Methods

This was an analytical cross-sectional study conducted in the Rural Field Practice Area (RFPA) of a tertiary healthcare facility in north India between September 2018 and December 2019. The study was approved by the Institutional Human Ethics Committee (IHEC). The contents of Participant Information Sheet (PIS) in local language (Hindi) was provided to the parents and/or guardians' and contents were read to them in their own language to their satisfaction. The study subjects were enrolled in the study after obtaining written informed consent. In the present study, children in the age group of 1 to 6 years presenting with acute suppurative otitis media (ASOM, presence of earache and fever with or without ear discharge and a congested or bulging ear drum) or sequelae of acute otitis media including Otitis media with effusion (presence of a dull tympanic membrane with or without a fluid level and a type B curve on tympanometry; with or without hearing loss and earache) and chronic otitis media (including CSOM tubotympanic type and CSOM atticoantral type; with or without cholesteatoma) were

considered as cases of Otitis media. We excluded children presenting with Down's syndrome, cleft palate, systemic diseases like juvenile diabetes, nephrotic syndrome etc., and immunodeficiency.

We estimated the sample size using prevalence estimates reported in a similar study conducted in rural settings. Considering the prevalence of Otitis media to be 22.3% among children 1 to 6 years of age, we estimated the minimum required sample size to be 300, with 5.0% absolute precision, 80.0% power (20.0% beta error), 5.0% alpha error, 10.0% non-response and 95.0% confidence. We developed purpose designed, semi structured, pretested questionnaire – to be administered by the investigator – that had three parts namely, sociodemographic characteristics, risk factors for Otitis media (including persistent rhinorrhoea, attendance in Anganwadi centres (day care nursery), poor ventilation, lower socioeconomic status, malnutrition, exposure to smoke, bathing in ponds, and lack of adequate breast feeding), and details of clinical examination including pure tone audiometric thresholds and middle ear compliance measurements. The children were enrolled in the study and sociodemographic characteristics were obtained by interviewing the accompanying parent and/or guardian; study identification number was given. The child was then examined for presence or absence of Otitis media. All the children underwent nasopharyngeal swabbing. Children who presented with ear wax were given ear drops and was asked to come after the wax was syringed by ENT specialist in the hospital.

Data was collected from 300 participants, entered in Microsoft Excel, and analysed using Software for Statistics and Data Science (Stata) v16. Descriptive analysis was presented using numbers and percentages. Chi square test of significance (two-sided) was applied to test for association between risk factors and Otitis media. Statistical significance was considered at  $p < 0.05$ .

## Results

The present study included a total of 300 children 1 to 6 years of age. The mean (SD) age of the children was 46.87 months (14.39). More than half the children (51.3%) were males; 48.7% were females. The results showed that 3.0% parents and/or guardians of the children were unemployed; majority (71.3%) were involved in either unskilled/semiskilled work and one in four (25.7%) were involved in skilled work and above. One in ten parents and/or guardians of the children were illiterate (10.3%); majority (75.7%) had completed primary and/or middle school and 14.0% had completed high school and above. The present data showed that nearly two thirds of children were from pucca house (63.7%), whereas more than one in three children were from kutcha houses (36.3%).

**Distribution of ear examination findings:** The results showed that 62.0% children normal ear; whereas 31.0% had ear wax and 7.0% had ear discharge. Tympanic membrane was normal in majority of children (87.7%); whereas 10.0% had retracted tympanic membrane and 2.3% had perforated tympanic membrane. The results of tympanometry (or tympanogram) showed that 87.0% children had type A (normal), 5.7% children had type B (flat, clearly abnormal), and 7.3% children had type C (indicating a significantly negative pressure in the middle ear, possibly indicative of pathology). It was found that 3.0% children in the present study had hearing loss (audiometry).

**Prevalence of Otitis media:** There were 38 children diagnosed to have Otitis media in the present study. The overall prevalence rate of Otitis media was found to be 12.7%. Regarding the distribution of types of Otitis media, it was found that 36.8% had Otitis media with effusion, 34.2% had eustachian tube catarrh, 21.1% had Chronic suppurative otitis media – Tubotympanic disease (CSOM-TTD), and 7.9% had Acute suppurative otitis media (ASOM), in that order.

**Risk factors of Otitis media in children:** The present study found that gender, education of parents and/or guardians, and enrolment in Anganwadi centres were not significantly associated with presence of Otitis media in children 1 to 6 years of age. However, we found that age less than three years (or 36 months) (OR 2.86, 95% CI 1.92 to 3.45); living in a kutch house (OR 1.91, 95% CI 1.04 to 3.74); malnutrition, that is weight for age <-2SD from reference median (OR 3.18, 95% CI 1.76 to 5.58); breastfeeding for less than six months (OR 2.24, 95% CI 1.30 to 4.88); and persistent rhinorrhoea (OR 2.78, 95% CI 1.56 to 4.33) were significant predictors of Otitis media among children one to six years of age ( $p < 0.05$ ).

## Discussion

The present study included a sample of 300 children aged 1 to 6 years, with a mean age of 46.87 months (14.39). The gender distribution was fairly equal, with 51.3% males and 48.7% females. The socioeconomic characteristics of the children's families were also examined, including parental employment and education levels, as well as the type of housing. The finding that 3.0% of parents and/or guardians were unemployed suggests that the majority of families had at least one employed caregiver. This could potentially have implications for the children's access to healthcare and other resources.(16) Additionally, the distribution of parental occupations, with 71.3% involved in unskilled/semiskilled work and 25.7% in skilled work and above, provides insights into the socioeconomic status of the participants. The educational levels of the parents and/or guardians are also noteworthy.(17) Educational attainment can influence health literacy, healthcare-seeking behaviours, and awareness of preventive measures, which could impact the occurrence of otitis media in children.(18) The type of housing is another factor examined in the study. Nearly two-thirds of the children (63.7%) were from pucca houses, while more than one-third (36.3%) were from kutch houses. The quality of housing and the associated environmental conditions can contribute to the risk of developing otitis media. Factors such as ventilation, overcrowding, exposure to allergens, and second-hand smoke can play a role in the incidence of ear infections.(19)

Epidemiological studies have identified several risk factors for otitis media in children, including, age (younger children, especially those under two years of age, are more prone to developing otitis media due to their immature immune systems and smaller Eustachian tubes), gender (some studies have suggested a slightly higher prevalence of otitis media in males compared to females, although the difference is generally small), and socioeconomic status (lower socioeconomic status, including factors such as parental education and employment, has been associated with a higher risk of otitis media).(20) Limited access to healthcare resources, crowded living conditions, and exposure to environmental pollutants can contribute to this association. Environmental factors such as exposure to second-hand smoke, attending daycare or preschool, and living in households with multiple siblings or close contacts can increase the risk of otitis media. Literature evidence have shown that breastfeeding can have a

protective effect against otitis media, potentially due to the transfer of immune factors from the mother to the infant.(21)

The distribution of ear examination findings indicate that the majority of children in the study did not have any visible abnormalities or signs of infection in their ears. However, approximately 31.0% of children had ear wax, which is a common condition. Ear wax, or cerumen, is a natural substance that helps protect the ear canal, but excessive build-up can sometimes cause discomfort or temporary hearing impairment.(22) Similarly, 7.0% of children had ear discharge, which suggests the presence of an ongoing ear infection or inflammation. Ear discharge can be a symptom of otitis media, and its presence indicates the need for further evaluation and treatment.(23)

The majority of children (87.7%) had a normal tympanic membrane, indicating a healthy middle ear. A normal tympanic membrane is an important indicator of proper ear functioning and absence of middle ear pathology.(24) However, about 10.0% of children had a retracted tympanic membrane. Tympanic membrane retraction occurs when negative pressure builds up in the middle ear, often due to Eustachian tube dysfunction. It can be associated with increased risk of otitis media.(25) Similarly, a small percentage (2.3%) of children had a perforated tympanic membrane. A perforation can result from severe or recurrent ear infections. It is important to note that a perforated tympanic membrane can significantly impact hearing and may require medical intervention.(26)

Tympanometry measures the compliance of the tympanic membrane and provides information about the condition of the middle ear. In this study, 87.0% of children had a type A tympanogram, which indicates a normal middle ear function. Approximately 5.7% of children had a type B tympanogram, characterized by a flat and abnormal tracing. Type B tympanograms suggest a middle ear dysfunction, which can be indicative of otitis media with effusion (OME) or other middle ear pathologies.(27, 28) About 7.3% of children had a type C tympanogram, indicating negative pressure in the middle ear. This finding suggests Eustachian tube dysfunction and may be associated with an increased risk of developing otitis media.(29) The study found that 3.0% of children had hearing loss as determined by audiometry. Hearing loss can have various causes, including chronic or recurrent otitis media, middle ear effusion, or other factors affecting the auditory system. It is important to identify and address hearing loss in children as it can impact their speech and language development, academic performance, and overall quality of life.(30)

The study identified 38 children (12.7% prevalence) diagnosed with otitis media. This indicates that otitis media is a significant health concern in the studied population. To compare this prevalence rate, it is important to consider the specific population, location, and methodology of the present study. Otitis media prevalence can vary among different populations and geographical regions. The study found that 36.8% of children had OME, characterized by the presence of fluid in the middle ear without acute signs of infection. OME is a common type of otitis media and often resolves spontaneously. It is associated with hearing loss and can impact language development in children. Approximately 34.2% of children had eustachian tube catarrh. This condition refers to inflammation and mucus buildup in the eustachian tubes, impairing their normal function. Eustachian tube dysfunction can contribute to the development of otitis media. The study reported that 21.1% of children had CSOM-TTD.(31) This type of otitis media is characterized by chronic inflammation, discharge, and perforation

of the tympanic membrane. It is often associated with poor socioeconomic conditions, inadequate healthcare access, and hygiene practices. Approximately 7.9% of children had ASOM, which refers to acute infection and inflammation of the middle ear, often with accompanying ear pain and fever. ASOM is a common form of otitis media in children.

The findings of the present study provide valuable insights into the risk factors associated with otitis media in children aged 1 to 6 years. The study found that children under the age of three had a significantly higher risk of developing otitis media. This finding is consistent with previous research, which has consistently shown that younger children are more susceptible to otitis media due to factors such as immature immune systems, smaller Eustachian tubes, and increased exposure to respiratory infections.(32, 33) The study identified living in a kutcha house as a significant risk factor for otitis media. Kutcha houses are typically associated with poorer living conditions, inadequate ventilation, and increased exposure to environmental factors that can contribute to the development of ear infections.(34, 35) Overcrowding and suboptimal housing conditions have been linked to higher rates of respiratory infections and otitis media.(36) The study found that malnutrition, specifically weight for age below -2 standard deviations from the reference median, was significantly associated with otitis media. Malnutrition can weaken the immune system and impair the body's ability to fight infections, making children more vulnerable to otitis media.(37, 38) Malnutrition and otitis media often coexist in resource-limited settings, creating a vicious cycle of poor health outcomes.(39) The study revealed that breastfeeding for less than six months was a significant predictor of otitis media. Breast milk provides antibodies and other immune factors that can help protect infants against infections, including otitis media.(40, 41) Prolonged and exclusive breastfeeding has been associated with a lower risk of otitis media in several studies.(42, 43) The presence of persistent rhinorrhoea (prolonged nasal discharge) was identified as a significant predictor of otitis media. Rhinorrhoea can contribute to the development of otitis media by increasing the risk of Eustachian tube dysfunction and subsequent middle ear infections.(44, 45) Effective management of nasal symptoms and addressing underlying respiratory conditions may help reduce the incidence of otitis media.

It is important to note that the present study did not find significant associations with gender, education of parents and/or guardians, or enrolment in Anganwadi centres. However, these findings may vary across different populations and settings, and further research is needed to explore these factors comprehensively.

The study has a few limitations. A larger sample size with more diverse characteristics would enhance the generalizability of the results. The study may have encountered selection bias if the participants were not randomly selected or if certain groups were overrepresented or underrepresented. The study relied on self-reported information from parents and/or guardians, which could introduce recall bias. The study adopted a cross-sectional design, which limits the ability to establish causal relationships between the identified risk factors and otitis media. Longitudinal studies would provide more robust evidence regarding the temporal relationship between risk factors and the development of otitis media. The study might not have accounted for all potential confounding factors that could influence the development of otitis media. Factors such as exposure to tobacco smoke, daycare attendance, or history of previous otitis media episodes could contribute to the development of the condition but might not have been adequately controlled for in the analysis.

However, the results of this study have implications for preventive strategies and interventions to reduce the burden of otitis media in children. Efforts should focus on improving housing conditions, promoting breastfeeding practices, addressing malnutrition, and managing respiratory symptoms effectively. These findings can inform healthcare providers, policymakers, and community health workers in implementing targeted interventions to reduce the risk of otitis media in vulnerable populations.

### **Conclusion**

Understanding the prevalence and risk factors associated with otitis media in children is essential for developing effective preventive strategies and interventions. By identifying specific risk factors prevalent in the studied population, targeted interventions can be implemented to reduce the burden of otitis media. Education programs targeting parents and caregivers, improving access to healthcare services, and promoting healthy environmental practices may be valuable approaches.

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**Table 1: Distribution of sociodemographic variables**

		Number (n) N = 300	Percentage (%)
Age (in months) <i>Mean (SD)</i>		46.87 (14.39)	
Gender	Male	154	51.3
	Female	146	48.7
Occupation	Unemployed	9	3.0
	Unskilled/Semiskilled	214	71.3
	Skilled and above	77	25.7
Education	Illiterate	31	10.3
	Primary/Middle	227	75.7
	High school and above	42	14.0
Type of house	Kutcha	109	36.3
	Pucca	191	63.7

**Table 2: Distribution of ear examination findings**

		Number (n) N = 300	Percentage (%)
Ear	Normal	186	62.0
	Wax	93	31.0
	Discharge	21	7.0
Tympanic membrane	Normal	263	87.7
	Retraction	30	10.0
	Perforation	7	2.3
Tympanometry	Type A	261	87.0
	Type B	17	5.7
	Type C	22	7.3
Audiometry	Normal	291	97.0
	Hearing loss	9	3.0

**Table 3: Distribution of types of Otitis media**

	Number (n) N = 38	Percentage (%)
Otitis media with effusion	14	36.8
Eustachian tube catarrh	13	34.2
Chronic suppurative otitis media – Tubotympanic disease (CSOM-TTD)	8	21.1
Acute suppurative otitis media (ASOM)	3	7.9

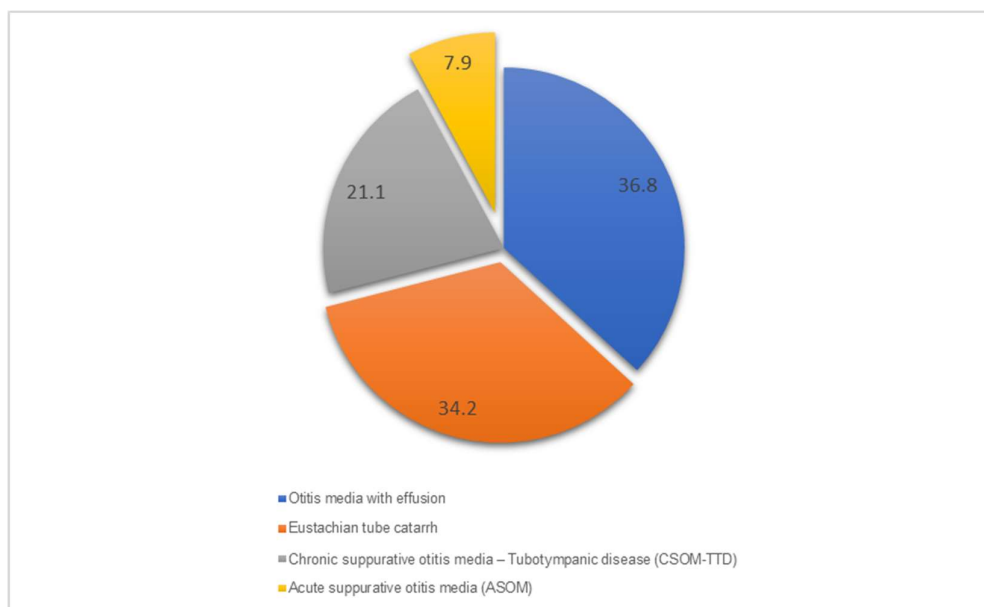


Figure 1: Distribution of types of Otitis media

Table 4: Risk factors of Otitis media in children – regression analysis

	Otitis media Present N = 38	Otitis media Absent N = 262	Odds ratio (95% CI)	P value
	n (%)	n (%)		
<b>Age</b> <i>Less than 36 months</i>	27 (71.1)	121 (46.2)	2.86 (1.92 to 3.45)	0.027*
<b>Gender</b> <i>Male</i>	19 (50.0)	139 (53.1)	1.28 (0.64 to 2.03)	0.445
<b>Education</b> <i>Less than 8<sup>th</sup> grade (Middle school)</i>	20 ( )	136	1.14 (0.55 to 3.52)	0.628
<b>Housing</b> <i>Kutcha</i>	26	119	1.91 (1.04 to 3.74)	0.042*
<b>Malnutrition</b> <i>(Weight for age &lt;-2SD from reference median)</i>	30	120	3.18 (1.76 to 5.58)	0.004*
<b>Anganwadi</b> <i>Not enrolled</i>	17	143	3.28 (0.34 to 7.49)	0.831
<b>Breastfeeding</b> <i>Less than 6 months</i>	26	122	2.24 (1.30 to 4.88)	0.038*
<b>Rhinorrhoea</b> <i>Persistent</i>	28	120	2.78 (1.56 to 4.33)	0.023*