

# A Prospective Observational Study on Tympanometric Screening for Otitis Media with Effusion in Children with Upper Respiratory Tract Infections in a Tertiary Care Centre

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## ABSTRACT

**Background:** Secretory otitis media (SOM), characterized by fluid accumulation in the middle ear without signs of infection, is a prevalent cause of hearing impairment in children. Otitis media with effusion (OME), frequently associated with upper respiratory tract infections (URTI), can lead to fluctuating hearing loss, impacting neurodevelopment if not promptly identified and treated. Hence, assessment of the incidence of OME in children with URTI and evaluation of the efficacy of tympanometry in diagnosing middle ear effusion becomes essential.

**Methods:** A prospective observational study was conducted over three months in the Department of Otorhinolaryngology at the Mandya Institute of Medical Sciences. A total of 182 children aged 7 months to 6 years presenting with URTI symptoms were included. Clinical examinations, including otoscopy and tympanometry, were performed. Tympanometry results were categorized using Sade's retraction staging system, with impedance audiometry to aid the findings.

**Results:** Among 182 children, 46.15% exhibited B-type tympanograms, indicating the presence of middle ear effusion, while 39.01% had A-type, and 14.84% had C-type tympanograms. Otoscopic examination revealed that 42.3% had fluid behind the tympanic membrane. A significant proportion (16.48%) showed tympanic membrane retraction, and 34.89% displayed congestion. Hearing loss or decreased hearing was reported in 43.41% of the children.

**Conclusion:** The study demonstrates a significant association between OME and URTI in children aged 7 months to 6 years, with a B-type tympanogram being a reliable indicator of middle ear effusion.

**Key-words:** Otitis Media, Otitis media with effusion, Upper Respiratory Tract Infection, Association

## INTRODUCTION

Secretory otitis media is defined as fluid in the middle ear without signs or symptoms of infection. Otitis media with effusion (OME) is the most common cause of hearing impairment in childhood <sup>[1]</sup>. Many children who develop episodic middle ear effusion will suffer from a variety of fluctuating deafness for weeks and months. <sup>[2]</sup>

Young age is the most important predictor of AOM that complicates URTI. Otitis media is considered to complicate URTI if it occurs within 28 days after the onset of URTI unless there is no new onset of URTI in between. Otitis media occurred in approximately one-half of children with URTI due to adenovirus, respiratory syncytial virus, and coronavirus, and in approximately one-third of those with URTI due to influenza and parainfluenza virus, rhinovirus, etc. <sup>[3]</sup> Overall incidence of otitis media that complicated URTI is 61%, with a 37 % incidence of acute otitis media and a 24% incidence of otitis media with effusion. <sup>[4,5]</sup> Although the disease can heal spontaneously, treatment should be performed immediately to prevent sequelae of the condition. Early identification of middle ear disease in children is

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important because hearing impairment, even at mild to moderate levels, can have irreversible consequences for the development of the nervous system. Tympanometric screening is a strategy to detect children who have a middle ear effusion in a pain-free, safe, scalable, quick, and cost-effective manner. A special task force constituted by the American Speech-Language-Hearing Association (ASHA) studies the use of impedance in screening for middle ear disease and concludes the significance of the same. The ASHA guidelines include the case history, examination of the ear namely the ear canal and tympanic membrane, and an impedance audiogram using 220Hz or 226 Hz probe tone <sup>[6]</sup>. The sensitivity of tympanometry in the detection of exudate in the middle ear was 96%. A reduction in middle ear pressure and increasing volumes of middle ear fluid also appear to be associated with deteriorating hearing thresholds. Therefore, in addition to being a sensitive method of detecting a middle ear effusion, a flat tympanogram might also be sensitive in those ears with a hearing impairment. The results of many studies have concluded that tympanometry may be used to screen younger children with otitis media with effusion for hearing impairment <sup>[7,8]</sup> without the need for a pure tone audiogram because of the high sensitivity of the B-tympanogram in detecting mean hearing thresholds greater than 25dBHL by pure tone audiometry. and it led to the conclusion that only if a child has two successive flat tympanogram 3 months apart will audiometry be required to assess hearing thresholds accurately. If the tympanogram has a peaked trace, further audiological assessment is not required. <sup>[2]</sup> Tympanometry provides an objective measurement of the middle ear condition by measuring middle ear pressure, compliance, and the stapedial reflex. <sup>[9,10]</sup>

## MATERIALS AND METHODS

**Study design-** A prospective observational study was conducted in the Department of Otorhinolaryngology at Mandya Institute of Medical Sciences, Mandya, over 3 months after the approval from the institutional ethics committee of the institution on 182 children between the age group of 7 months and 6 years presenting with symptoms of URTI such as complaints of sore throat, headache, change in voice, nasal congestion, cough with or without sputum expectoration, common cold, low-grade fever, and fatigue with their parent or any

responsible guardian of the patient who agreed to the informed consent.

**Inclusion Criteria-** Patients with upper respiratory tract infection and willing to provide informed consent in the age group of 7 months to 6 years are included in the study.

### Exclusion Criteria

- ✚ Patient with hearing loss beyond 55db.
- ✚ Children with evidence of ear discharge were excluded from the study
- ✚ External ear pathologies, including ear canal atresia, other congenital abnormalities, or the presence of cerumen.
- ✚ Patients with a previous history of ear surgery.
- ✚ Patients with a history of acoustic trauma, exposure to ototoxic substances, occupational noise exposure, or radiation. <sup>[2]</sup>

**Study intervention-** A specially designed proforma was used to collect data on every child, consisting of the clinical examination including otoscopy and tympanometry. An otoscopic examination was done to assess the status of the tympanic membrane. Careful examination of the tympanic membrane was done to assess for any signs of middle ear effusion, including a bluish hue of the tympanic membrane, fluid behind the tympanic membrane with or without air bubbles, hairline sign, meniscus sign, etc. A reddish tinge membrane with a cartwheel sign and Pars tensa retraction could point out the same. <sup>(2)</sup> The following staging system of Pars tensa retraction suggested by Sade was used.

Stage I: Retraction of the tympanic membrane due to negative pressure in the middle ear. Anterior and posterior malleal folds are prominent and there is distortion of light reflex.

Stage II: retraction of the tympanic membrane, which is reaching a long process of Incus.

Stage III- Middle ear atelectasis or collapse: Tympanic membrane touching the promontory and the ossicles but not adherent to these structures. The middle ear remains relatively intact.

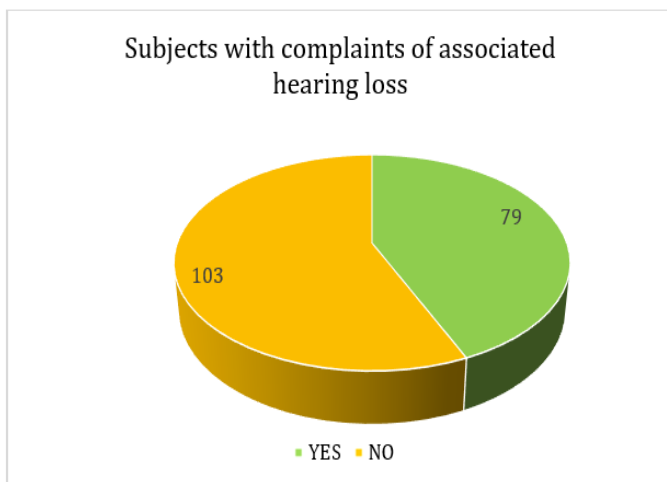
Stage IV: Adhesive otitis media: middle ear space is obliterated. The tympanic membrane is adherent to the ossicles and promontory. No movements can be elicited.

The patient was then subjected to tympanometry using an impedance audiometer done using an AT235 impedance audiometer with a probe having a frequency of 226 Hz. 85 dB SPL+/-1.5dB measured in an IEC 126 acoustic coupler was recorded. The level was maintained constant for all volumes in the measurement range. In a soundproof audiometry room, the mother was educated to hold the child on her lap while the impedance audiogram was recorded with hand-held probe. A type “B” trace was deemed to be highly positive compared to “C” or reduced “A” or “As”.

**Statistical Analysis-** All data was entered in a Microsoft Excel spreadsheet. Descriptive analysis like proportion, mean, standard deviation, etc. was used for analysis.

## RESULTS

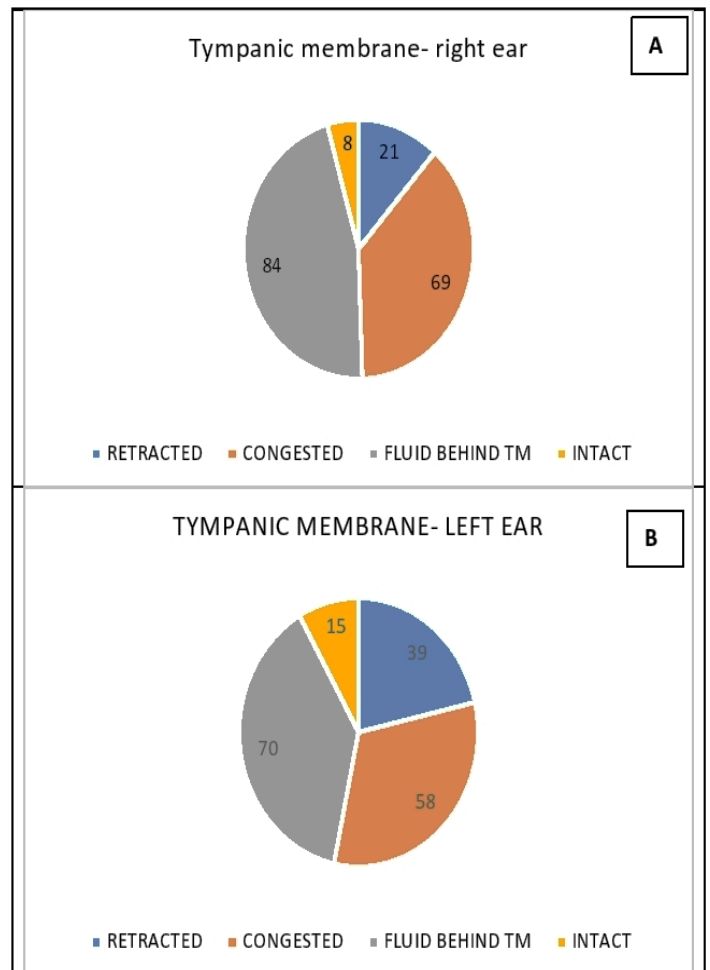
A total of 182 subjects were selected for the study based on the criteria mentioned. Out of 182 subjects, 3 children were 2 years of age, 12 subjects were 3 years old, 36 subjects were 4 years old, 61 subjects were 5 years old, and 70 subjects were 6 years of age, with a gender ratio of M:F = 2:1.



**Fig. 1:** Patients with complaints of associated hearing loss

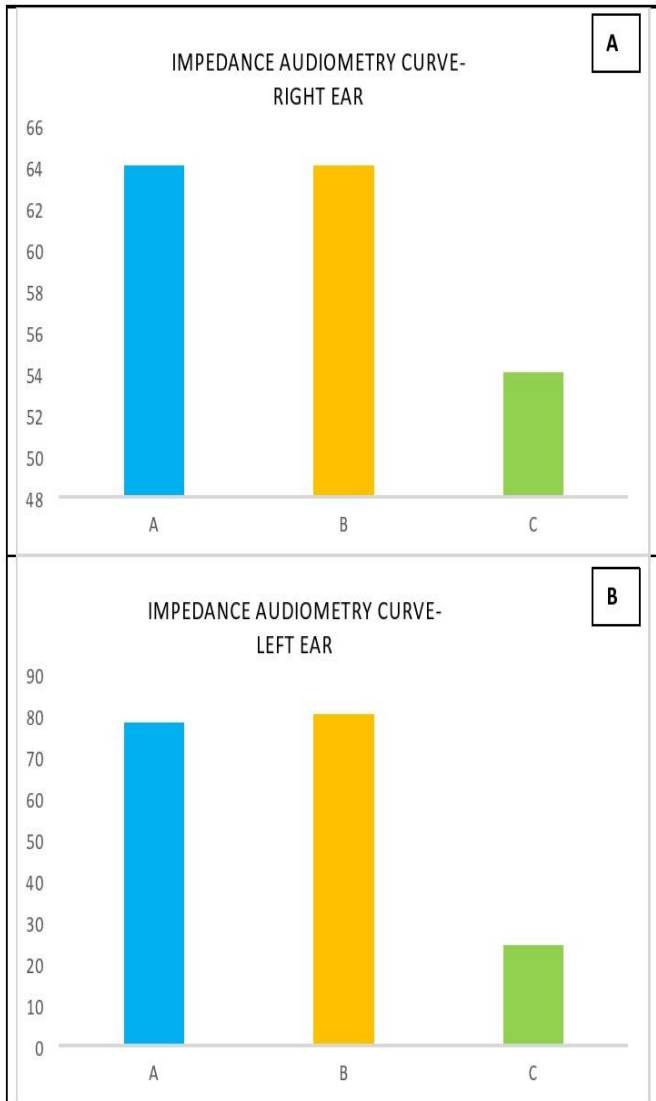
When the patients were questioned, 79 out of the 182 study subjects were found to have an associated hearing loss or decreased hearing comparatively. Out of the 182 subjects, 16.48% of the tympanic membrane was found to be retracted, 34.89% of the tympanic membrane was congested, 42.30% of the tympanic membrane had fluid behind the tympanic membrane with a dull appearance, 6.31% of the

tympanic membrane was found to be intact on otoscopic examination (Fig. 2).



**Fig. 2:** Findings of the tympanic membrane in right ear (A); Findings of the tympanic membrane in left ear (B)

Tympanometry done for the above 182 subjects demonstrated the following results a B-type tympanogram dominating, pointing positively towards otitis media with effusion, closely followed by an A-type. C-type curves were in lesser proportions in children with upper respiratory tract infections in the younger age group (7 months–6 years) in our study. Among the 84 patients who had fluid behind the tympanic membrane with or without air bubbles, 100% of them significantly had B-type curve at least in one ear (Fig. 3).



**Fig. 3:** Findings of the Impedance audiometry curve in right ear (A); Findings of the Impedance audiometry curve in left ear (B)

## DISCUSSION

This observational study provides findings regarding the possible association of otitis media with effusion in younger children prone to repeated upper respiratory tract infections. The key finding in our research is the predominance of the finding of fluid behind the tympanic membrane with or without air bubble(s) and a dull tympanic membrane with an associated B-type curve in tympanometry, as noted in 46.15% of patients, followed by 39.01% of patients with type A curve and 14.84% of study subjects with a type C curve.

Our findings were similar to a prospective observational study done by Rajamani *et al.* using the 'Dervan child middle ear effusion protocol' consisting of impedance audiometry and hearing evaluation, concluding that 47% of their study subjects had middle ear effusion. They

also demonstrated that tympanometry in a selected high-risk population was an accurate and reliable test for the evaluation of middle ear effusion.<sup>[11]</sup> A study by Dempster *et al.* on similar 3–12-year-old children showed that 20% had a hearing impairment and that the type-B tympanogram was 93% sensitive in detecting those children with that degree of hearing impairment of greater than or equal to 25dB HL.<sup>[12]</sup> Results of another prospective study by Kazanas *et al.* suggested that tympanometry is maybe acceptable for age 3–5 years, questionable for 6–7 years, but unacceptable for older children aged 8–10 years. It also stated that the estimation of stapedial reflex does not increase the accuracy of pure tone air conduction thresholds and need not be routinely included in the routine examination for otitis media with effusion.<sup>[10,13]</sup> Results of the study by Spremo *et al.* showed a mucous exudate in 76% of ears associated with retraction and 24% serous exudate. The study suggested a three-month evaluation of tympanometric and audiologic patterns, repeated every three weeks in children suspected of having exudate in the middle ear. A huge trend of spontaneous disappearance of exudate in the middle ear and changing of tympanogram type was noted. If exudate in the middle ear persists for three months and the type of audiogram is unchanged, myringotomy is considered.<sup>[11,14,15]</sup>

Thus, our study emphasizes early detection to minimize the consequences of hearing impairment or chronic middle ear disease due to the upper respiratory tract infection as early as possible so that the disorder will not interfere with the neuro-development of the child.

## CONCLUSIONS

Recurrent respiratory infections (RRI) are a common clinical condition in children, with 25% of children under 1 year and 6% of children under 5 years having RRIs. This study showed a statistically significant association between otoscopic findings of otitis media with effusion and tympanogram (B type curve in 46.15% samples) among the paediatric population from 7 months to 6 years presenting with upper respiratory tract infection, emphasizing early diagnosis with adequate follow up and appropriate treatment of the same to minimize the fluctuating hearing loss and mainly to prevent future neuro-developmental complications as an irreversible complication of persistent middle ear effusion.

## LIMITATIONS

As it was an observational study without information about the test results and assessment during follow-up, the progression and prognosis of the condition are not available. The number of study subjects is limited to generalize the results on a larger scale.

## CONTRIBUTION OF AUTHORS

**Research concept-**D. Ravi, Balaji NK, Janani SR

**Research design-** D. Ravi, Balaji NK, Janani SR

**Supervision-**D. Ravi

**Materials-**D. Ravi, Balaji NK, Janani SR

**Data collection-**D. Ravi, Balaji NK, Janani SR

**Data analysis and Interpretation-** D. Ravi

**Literature search-** D. Ravi, Balaji NK, Janani SR

**Writing article-**D. Ravi, Balaji NK, Janani SR

**Critical review-**D. Ravi

**Article editing-**D. Ravi, Balaji NK, Janani SR

**Final approval-**D. Ravi

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