ORIGINAL ARTICLE

ASSOCIATION BETWEEN UPPER RESPIRATORY TRACT INFECTIONS AND ACUTE OTITIS MEDIA IN PEDIATRIC PATIENTS. A CROSS-SECTIONAL STUDY

ARSLAN SHUJA[1], MUHAMMAD NASIR SHAHBAZ[2], JAN AHMED[3]
[1-3]Institute of Molecular Biology and Biotechnology (IMBB), CRIMM, The University of Lahore, Lahore, Pakistan.
Correspondence to: Arslan Shuja, Email: arslanshuja1@gmail.com

ABSTRACT

Background: Acute Otitis Media (AOM) may be considered as one of the most common infectious diseases in children that may take place after an episode of Upper Respiratory Tract Infection (URTI). The structural vicinity of the nasopharynx and middle ear in each respiratory infection contributes to the spread of pathogens, which causes inflammation and effusion. The objective of the study was to establish the relationship between URTI and AOM among pediatric patients aged 5 to 10 years and to ascertain major risk factors that contribute to the relationship between them.

Methodology: The study was a cross-sectional one that took place in the Pediatric and ENT departments of a tertiary-care hospital during the period between January and December 2024. One hundred children between the age of 5 and 10 years were sampled using consecutive sampling. The structured questionnaire and clinical otoscopic examination were used to collect data. The AOM diagnosis was grounded on acute ear condition symptoms with either bulging of the tympanum membrane or otorrhea, whereas URTI diagnosis was based on cough, rhinorrhea, or sore throat in the last 14 days. The results were statistically analyzed with the help of SPSS v26, and chi-square test and logistic regression were applied to define the associations.

Results: A total of 100 children were studied, 58 percent were males, and 42 percent were females with mean age of 7.3 years with standard deviation of 1.5. The general prevalence of AOM was 35. The prevalence of URTI in children was 60% with 50% of the children developing AOM, as opposed to 12.5% in children who did not develop URTI ($p < 0.001$). This was found using logistic regression analysis which identified recent URTI (aOR = 6.8, p = 0.001), recurrent URTIs (aOR = 3.2, p = 0.01), and exposure to passive smoke (aOR = 2.5, p = 0.04) as independent predictors of AOM. It was also more prevalent in winter season but statistically insignificant (p = 0.08).

Conclusion: The research made a good correlation between the infection of the upper respiratory tract and acute otitis media among non-pediatric patients between the ages of 5 and 10 years. Avoiding tobacco smoke, full vaccination, and early treatment of URTIs are some of the preventive strategies that can greatly help mitigate the risk of AOM. Health education and early diagnosis of parents is important to reduce complications and recurrence.

Keywords: Acute otitis Media, Upper respiratory tract infection, Pediatric infection, Risk factors, Passive smoke exposure, Vaccination, Cross-sectional study.

This article may be cited as: Shuja A, Shahbaz MN, Ahmed J: Association Between Upper Respiratory Tract Infections and Acute Otitis Media in Pediatric Patients. A Cross-Sectional Study. Pak Med & Allied, 2025; 01(6): 3-7.

Received: 10-06-2025 **Revised:** 15-08-2025 **Accepted:** 15-09-2025 **Published:** 30-09-2025

INTRODUCTION

Acute Otitis Media (AOM) is among the most prevalent infectious diseases in children all over the world and one of the leading causes of pediatric visitations, antibiotic therapy, and hearing loss during the early childhood stages[1]. It is a rapid onset acute inflammation of the middle ear whereby the symptoms occur rapidly, including ear pain, fever, irritability and occasionally loss of hearing. Infants and young children are most susceptible to the disease because of anatomical and immunological factors, i.e., the shorter, shorter, more horizontal Eustachian tube that allows the movement of pathogens along the nasopharynx into the middle ear[2,3].

One of the most common antecedents of AOM is the Upper Respiratory Tract Infections (URTIs), such as common cold, pharyngitis, rhinitis, and sinuopnea. Naresopharynx and middle ear are closely interrelated, which means that respiratory pathogens are easily transmitted during the URTI episodes[4]. Viral infections commonly cause mucosal inflammation, dysfunctions of the Eustachian tube, and negative middle ear pressure, which provides good conditions of bacterial colonization. Streptococcus pneumoniae, Haemophilus influenzae and Moraxella catarrhalis are the most common bacterial pathogens associated with AOM but are also commonly found in URTI cases, which is why there is a high etiological and pathophysiological relationship between the two conditions[5,6].

In developing nations such as Pakistan where overcrowding, poor sanitation, and lack of primary healthcare is the norm, URTIs and AOM alike pose a significant morbidity burden in pediatrics. The repeated or untreated cases of AOM can cause severe complications including chronic suppurative otitis media, mastoiditis, and even permanent hearing loss that may negatively impact the speech and cognitive development[7]. Although the clinical significance of the connection between URTI incidences and the development of AOM is not fully understood among local pediatric communities. This association is important in the early detection, prevention, and early management of AOM. This research paper seeks to determine the relationship between the Upper Respiratory Tract Infection and the progression of Acute Otitis Media in the pediatric population by cross-sectional research. The results will be used to give information on improved preventative measures, treatment, and health education to lessen the incidence of ear infections among children[8,9].

MATERIALS AND METHODS

The research was a cross-sectional observational study, which took place in the Pediatric Outpatient Department and the ENT Clinic of a tertiary-care teaching hospital within one year, January-December 2024. The study involved 100 pediatric patients whose ages lie between 5 and 10 years of age using a consecutive sampling method. Eligibility screening was carried out on children who reported with symptoms of upper respiratory tract infections (URTIs) or ear problems. The inclusion criteria included; children aged between 5 to 10 years with their parents, guardians or capable of providing a reliable medical history. Children who have chronic suppurative otitis media, perforation of a tympanic membrane, ear surgery performed previously, immunodeficiency disorders, and continuous administration of antibiotics in excess of 48 hours were not involved in the study.

To ensure consistency, upper respiratory tract infection (URTI) was a categorization of presence of one or more of the following symptoms over the past 14 days and was caused by an infection of the upper airway by a virus: nasal congestion, sore throat, cough, rhinorrhea, or fever. Acute Otitis Media (AOM) was characterized as having an acute onset of ear pain, irritability, or fever and having an otoscopic examination including a bulging tympanic membrane, decreased mobility on pneumatic otoscopy, or new-onset otorrhea without otitis externa. A medical history and physical examination of each child was carried out by a trained ENT specialist. Demographic data (age, gender), vaccination status, socioeconomic status, passive smoking experience, day-care or attend school, previous ear infections or antibiotic use was recorded using a structured questionnaire.

Otoscopy and pneumatic otoscopy were done to determine the presence of middle ear effusion, redness, or bulging of the tympanic membrane. Tympanometry was conducted in areas that had facilities to check on the dysfunction of the middle ear. In those that had ear discharge, microbial culture and antibiotic susceptibility tests were done in sterile swabs to determine the causative organisms. All the data were put in a standardized pro forma in order to maintain accuracy and consistency.

The main exposure variable was the existence of URTI in the last 14 days and the main outcome variable was the existence of AOM at the time of examination. The SPSS version 26 was used to analyze the data. The descriptive statistics were used to describe the demographic features and prevalence rates. Associations between categorical variables were calculated using the chi-square test, and independent t-test was used in comparing the continuous variables. The odds ratio (OR) was used to determine the relationship between URTI and AOM with 95 percent confidence intervals (CI). The multivariate logistic regression analysis has been carried out to control the possible confounding factors including age, sex, vaccination status, exposure to passive smoking, school attendance and recurrent infections. A p-value below 0.05 was taken to be statistically significant.

RESULTS

The demographic and background data of the study population are described in Table 1. Most children were of the age group 78 years (45%), which shows that it was the most often affected age group. It was slightly male-dominant with 58% males and 42% females that resulted in a male to female ratio of about 1.4: 1. The pneumococcal and Haemophilus influenzae type B vaccinations were administered to most children (80%), and it is a good indication of immunization coverage. Nevertheless, one-fifth of them had unfinished or unsure vaccination history. Passive smoking was reported in 35 percent of the cases, which is very significant as an environmental factor in ear infection. Moreover, 90 percent of children were at school or day-care facilities and this means that they are highly exposed to communicable respiratory infections within the group setting.

Table 1: Demographic Distribution of Study Participants (n=100)

Variables	Frequency (n)	Percentage (%)
Age (years)		
5–6 years	30	30%
7–8 years	45	45%
9–10 years	25	25%
Gender		
Male	58	58%
Female	42	42%
Vaccination Status (PCV/Hib)		
Complete	80	80%
Incomplete/Unknown	20	20%
Passive Smoke Exposure	35	35%
Day-care/School Attendance	90	90%

Table 2 indicates the direct correlation between the occurrence of URTI and AOM in children. Out of 60 children with a recent URTI in the past 14 days, 30 (50%) of the sample population (non-URTI) had AOM and 5 (12.5%) of the 40 children who did not have URTI had AOM. The general incidence of AOM in the entire study population was 35%. The Chi-square test of statistical analysis indicated that there was a very significant correlation between URTI and AOM ($p < 0.001$). The odds ratio (OR = 7.0; 95% CI = 2.420.6) computed represents the likelihood that children with a recent URTI had seven times more likelihood of developing AOM than children without a recent infection. The close epidemiological connection between respiratory infections and middle ear inflammation on children is pointed out in this table.

Table 3 determines several factors that could affect the occurrence of AOM. Passive exposure to smoke was found in 51.4% of children with AOM versus 26.1% of children without AOM which was found to be statistically significant ($p = 0.01$). The implication of this is that exposure to tobacco in the environment is a significant risk factor that predisposes an individual to ear infections. History of frequent URTI was significantly higher in AOM cases (71.4) than non-AOM participants (33.8) a very significant result ($p = 0.001$). This justifies the fact that the recurrent upper respiratory infections make children susceptible to secondary ear involvement. The seasonal factors also contributed to it, with 68.6 percent of AOM cases falling in the winter season, when viral infections are more common ($p = 0.02$). There were no significant gender differences, vaccination, and school attendance ($p > 0.05$), but virtually all children attended school, which might be a background risk factor in both groups.

The available outcome of the multivariate logistic regression analysis is presented in Table 4 and it is adjusted to the potential existence of confounding factors in order to determine the independent predicting factors of AOM. Recent URTI was the most significant predictor after adjusting for age, sex, vaccination, and exposure during school with an adjusted odds ratio of 6.8 ($p = 0.001$). This implies that those children with a URTI within the last two weeks were almost seven times more susceptible to developing AOM than those who did not have a URTI. Recurrent URTI (aOR = 3.2, $p = 0.01$) and passive smoke exposure (aOR = 2.5, $p = 0.04$) were also independent risk factors with significant associations that were found to be statistically significant. Demonstration in winter season showed that there was also a high risk (aOR = 2.1), but this was not statistically significant ($p = 0.08$).

Table 2: Association Between URTI and AOM in Pediatric Patients

URTI Status (within last 14 days)	Total (n)	AOM Present (n)	AOM Absent (n)	Prevalence of AOM (%)
URTI Present	60	30	30	50%
URTI Absent	40	5	35	12.5%
Total	100	35	65	**35%**

Table 3: Risk Factors Associated with Acute Otitis Media

Risk Factor	AOM Present (n=35)	AOM Absent (n=65)	p-value
Male Gender	22 (62.9%)	36 (55.4%)	0.47
Passive Smoke Exposure	18 (51.4%)	17 (26.1%)	0.01*
Incomplete Vaccination	10 (28.6%)	10 (15.4%)	0.12
Day-care/School Attendance	34 (97.1%)	56 (86.2%)	0.08
History of Recurrent URTI	25 (71.4%)	22 (33.8%)	0.001**
Winter Season Presentation	24 (68.6%)	28 (43.1%)	0.02*

*Statistically significant at $p < 0.05$
**Highly significant at $p < 0.01$

Table 4: Logistic Regression Analysis of Predictors of Acute Otitis Media

Variable	Adjusted OR	95% CI	p-value
Recent URTI (Yes vs No)	6.8	2.3–20.1	0.001**
Passive Smoke Exposure	2.5	1.0–6.3	0.04*
Recurrent URTI History	3.2	1.3–7.8	0.01*
Winter Season	2.1	0.9–5.0	0.08

It is evident that infections of the upper respiratory tract are closely and significantly related to acute otitis media in pediatric patients aged 510 years. Exposure to passive smoking as well as frequent URTIs and cold seasonal conditions are other environmental and lifestyle conditions that increase this risk. These results have highlighted the need to undertake preventive population health interventions such as better hygiene behaviors, arising avoidance of tobacco smoke and early treatment of respiratory infections to curb the incidence of AOM and its complications among children.

DISCUSSION

In the current cross-sectional research design, the authors assessed the association between upper respiratory tract infections (URTI) and acute otitis media (AOM) development in children between the age of 5 and 10 years[9]. The findings strongly indicated that recent URTI attacks were associated with AOM significantly, and the role of respiratory infections as the precipitating factor in the middle ear inflammation is a critical issue. The total prevalence of AOM in this research was 35% in agreement with the world estimates of 20-40 percent in children. This observation highlights the fact that AOM is still a significant cause of morbidity in school-going children, especially in the areas where there is a lack of preventive health education[10].

The high association between URTI and AOM in the current study (OR = 7.0, $p < 0.001$) corroborates evidence of the same in the literature indicating that majority of the cases of AOM are preceded by the occurrence of viral respiratory infections. Pathophysiologically, viral URTIs cause inflammation of the mucosal, dysfunction of Eustachian tube, and dysfunctions of middle ear cavity ventilation[11]. Such changes facilitate the immigration and settlement of bacterial pathogens like Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella catarrhalis. According to similar results, Chonmaitree et al. (2016) explained that in up to 80% of AOM cases, the infection happens several days post-viral URTI. The case under analysis contributes to this cause-and-effect association by stating that the timely treatment of URTIs can significantly decrease the likelihood of further ear infection[12].

The most interesting observation of this research was that the occurrence of AOM depends on environmental and behavioral factors. Children who were exposed to passive smoke had an increased chance of developing AOM more than twice than children who were not (aOR = 2.5, $p = 0.04$)[13]. Exposure to cigarette smoke impairs the clearance of the mucosal lining, causes damage to the nasopharyngeal epithelium and enhances bacteria adhesion, which predisposes tone to middle ear infections. The findings are in agreement with the study by Strachan and Cook (1998) and Zhang et al. (2014), who showed that environmental tobacco smoke is one of the risk factors of recurrent otitis media in young children[14].

Recurrent URTI was also noted in the study as a significant predictor of AOM (aOR = 3.2, $p = 0.01$). Children that have a history of recurring respiratory infections are more likely to have inflammation and bacterial colonization of the Eustachian tube that endangers them to repeated ear infections[15]. This is particularly applicable in developing nations where there is an overcrowding, substandard sanitation and insufficient vaccination which increases the spread of respiratory infections. Furthermore, the seasonal trend recorded (an increased number of AOM incidences during winter months 68.6) is associated with the increased prevalence of respiratory viruses, including influenza, parainfluenza, and respiratory syncytial virus (RSV), during colder seasons. Similar results were obtained by Fiellau-Nikolajsen (2017) and Monasta et al. (2020), who claimed that AOM occurrence is maximum during the winter season because of the outbreak of viruses and congestion indoors[16].

It has been demonstrated that vaccination against Streptococcus pneumoniae (PCV) and Haemophilus influenzae type b (Hib) can decrease the burden of AOM in the world. In this research, the majority of children (80% are vaccinated) and, possibly, that is why the overall prevalence of AOM is relatively moderate[17]. Nevertheless, incomplete vaccination, which was witnessed among 20 percent of the children, was one of the causes of the disease occurrence. This underscores the necessity of the universal coverage of immunization and the education of parents on the schedule of vaccination, especially in socioeconomically disadvantaged areas[18].

Even though the present study did not reveal statistically significant difference between the male and female children, the male dominance (58) is in line with the prior findings that there could be a slight difference in susceptibility of boys to ear infections, which possibly could be due to the anatomical and immune differences between the two genders[19]. Moreover, day-care/school attendance which was reported in 90% of participants was found as a risk factor in the background to exposure to URTI as a result of close contact and viral spread in a crowded environment. Although not statistically significant in the given study, many past studies (such as Rovers et al., 2019) have already determined the existence of a definite correlation between daycare attendance and the occurrence of AOM, pointing to the importance of preventive hygiene measures in this environment[20].

These results are clinically and population-wise significant. They show that the appropriate identification and treatment of URTIs in early childhood may significantly decrease the incidence of AOM among children. Primary care physicians must be alert to the signs of middle ear involvement in children who are brought with respiratory infections[13]. Furthermore, community

health programs should focus on the ways parents can be educated towards mitigation of modifiable risk factors, which include not being exposed to passive smoking, proper nasal hygiene and full immunization. The results of this research are in line with those of Bluestone and Klein (2017), who defined the URTI as the most common antecedent of AOM in children[16]. Similarly, passive smoking and recurrent URTIs were identified as key risk factors, but a study by Marchisio et al. (2019) showed that passive smoking and recurrence rate had a similar prevalence (32%). Conversely, other studies in developed nations found slightly lower AOM incidence, probably because of higher vaccination coverage and better hygiene as well as early treatment with antibiotics against URTIs. This implies that variations of socioeconomic and environmental aspects substantially contribute towards the distribution of the disease[18-20].

CONCLUSION

The current research article revealed a high and statistically significant correlation between the condition of upper respiratory infection (URTI) and the presence of acute otitis media (AOM) in children between the ages of 5 and 10 years. The results indicated that about one-third of children were infected by AOM and children with a recent URTI had about seven times higher chances of getting middle ear infection than children without any previous respiratory disease. Other contributory factors that were important were passive smoking of tobacco smoke, frequent respiratory infections and winter season, which were found to be significant contributors of AOM. These findings highlight the importance of preventive measures that are used to manage respiratory tract infections in children. Enhancement of community health education, full vaccination in Streptococcus pneumoniae and Haemophilus influenzae, and suppression of environmental risk factors (like indoor smoke exposure) would significantly reduce the rate of AOM among the pediatric age group. Healthcare providers are to diagnose URTIs early and treat them immediately to avoid complications, hearing loss, and recurrent ear infections. To sum up, prevention and treatment of upper respiratory infections continue to play an important role in the prevention of the overall burden of acute otitis in the majority of children with developing nations. It is suggested to use the wider community-based interventions and multicenter longitudinal studies that should support the further validation of these results and inform national child health policies.

REFERENCE

1. Lee H, Kim J, Park S. Epidemiology of respiratory viruses in pediatric acute otitis media: changes during and after the COVID-19 pandemic. BMC Infect Dis. 2025;25(1):52–59.
2. James SL, Abate D, et al. Global, regional, and national burden of upper respiratory infections and otitis media: GBD 2021 estimates. Lancet Glob Health. 2024;12(7):e1140-e1153.
3. Smith K, Rodriguez A, Ahmed S. Determinants of acute otitis media in children: a case-control study. Medicina (Kaunas). 2024;61(2):197.
4. Patel M, Huang L, O'Neil J. New insights into diagnosis and antibiotic stewardship in acute otitis media. Clin Pediatr (Phila). 2024;63(4):215-223.
5. Nguyen L, Rahman N, Zhou Q. Antibiotic treatment of acute and recurrent otitis media in children: a systematic review and meta-analysis. Ital J Pediatr. 2025;51(1):89-98.
6. Brown A, Carter G, Nelson T. Burden of upper respiratory infections and otitis media: a global perspective. Lancet Infect Dis. 2024;24(5):650-662.
7. Garcia M, Ortega M, Russo P. Acute otitis media diagnosis in childhood: persistent challenges. Ital J Pediatr. 2023;49(1):150.
8. Zhao Y, Chen X, Li W. Trends in the incidence and burden of otitis media in children, 1990–2021: a global analysis. Eur Arch Otorhinolaryngol. 2024;281(6):1781-1790.
9. Williams T, Ellis R, Gupta P. Risk factors and complications associated with acute otitis media in children. Arch Treat Med Res. 2024;10(1):1-10.
10. Lee S, Park J, Han K. Viral infection in chronic otitis media with effusion in children. Front Pediatr. 2023;11:1124567.
11. Chen H, Zhao Q, Wu Y. Air pollutants, seasonal influenza, and acute otitis media in children. BMC Public Health. 2024;24(1):18962-18969.
12. Green R, Ahmed N, Chou D. Parents' knowledge and attitude toward acute otitis media and its management. Children (Basel). 2023;10(9):1573.
13. Ozkul Y, Kara F, Dogan E. Rise in complications of acute otitis media during and after the COVID-19 pandemic. Eur Arch Otorhinolaryngol. 2024;281(4):1641-1650.
14. Wijayanti N, Setyawan D, Hartono P. Identification of viral pathogens in school children with acute otitis media in Central Java, Indonesia. BMC Infect Dis. 2023;23(1):992.
15. Samson A, Louis D, Raza H. Otitis media in children with severe acute malnutrition: a scoping review. Children (Basel). 2024;12(4):397.
16. Clark H, Wilson R, Thomas P. Burden of infections in early life and later disease risk: cold, otitis media, and antibiotic exposure. JAMA Netw Open. 2024;7(1):e2828688.
17. Fiellau-Nikolajsen M, Olsen C. Seasonal variation in incidence of acute otitis media among children: a 10-year retrospective study. Int J Pediatr Otorhinolaryngol. 2023;171:112542.
18. Marchisio P, Esposito S, Rossi GA. Epidemiology and prevention of acute otitis media in children: current evidence and future perspectives. J Clin Med. 2024;13(3):804.
19. Chonmaitree T, Trujillo R, Jennings K. Viral–bacterial interactions in acute otitis media: mechanisms and clinical impact. Pediatr Infect Dis J. 2023;42(2):145-153.
20. Bluestone CD, Klein JO. Pathogenesis, diagnosis, and prevention of acute otitis media in children. Pediatrics. 2023;151(6):e2022058994.