Frequency of otitis media with effusion among children aged 1–5 years presenting to immunization center of tertiary care hospitals, Rawalpindi

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Abstract
Objective: We conducted this study to assess the etiopathogenic relation of otitis media with effusion (OME) in a group of children aged 1–5 years among the local population of Rawalpindi.

Methods: This was a cross-sectional retrospective study. Study was conducted among the children presenting to the immunization center of three tertiary care hospitals of Rawalpindi. Otitis media was assessed by clinical examination and tympanometry from August 2019 to January 2020. Multi-factor regression analysis was then applied to recognize the statistical significance and association of various risk factors to OME.

Results: Out of 400 children enrolled in this study, 108 (27.0%) had OME, out of which 65 (60.2%) were males and 30 (27.8%) were of age group 2–3 years. Multivariable regression analysis of risk factors associated with OME showed it was strongly associated with snoring (P < 0.001), last year symptoms (attack of ear aches with hearing loss [P = 0.002]), drugs (URTI antibiotics [P = 0.026], All 3 drugs [P = 0.013]).

Conclusions: We found out that OME is a common disease which if not identified or treated timely can lead to other hard to cure health problems. Control of its etiopathogenic factors can play a major role in its prevention.

KEYWORDS
Etiology, Low resource country, Otitis media with effusion, Prevalence, Tympanometry

INTRODUCTION

Otitis media with effusion (OME) is defined as a chronic inflammatory condition characterised by presence of sterile effusion behind an intact tympanic membrane without the signs and symptoms of acute inflammation. It is a disease which commonly occurs among the younger age groups. Unlike acute otitis media (AOM) in which the child may present with pain and fever, a child with OME might simply present with rubbing of ear, selective hearing, clumsiness and delayed speech.1 Hence the disease has a high tendency to go undetected.2 Given the poor symptomatic presentation in these age groups, OME tends to prolong and leads to life-long effects such as delayed milestones, poor nutrition, adverse effects of persistent medication, barrier in cognitive build up and most importantly, decreased ability to hear. Hence early management and treatment is imperative.3
Otitis media is considered as a highly prevalent disease worldwide, mostly concentrated in the developing world. The burden of disease varies among different ethnic groups, countries and populations.\(^4\) It has been a cause of hearing impairment in approximately 42 million people world-wide, and prevalence of OME varies between 1.3% and 31.3% internationally.\(^5\)

OME has been reported among different studies conducted within Pakistan, showing a prevalence of 6.92%–11.5%.\(^6,7\) However, the studies focused on frequency but not on the risk factors associated with increased prevalence among the young age groups in Pakistan. International literature also lacks analysis covering interdependency of various risk factors leading to OME. Hence this study was conducted to find the prevalence of OME, factors associated with increased rates in children below the age of 5 years and interdependency of those factors. This would allow early identification of the disease among children leading to early treatment and resolution which would eventually prevent complications such as reduced hearing ability in life ahead.

METHODS

This cross-sectional retrospective study was conducted in Rawalpindi district on children presenting to the immunization center of the tertiary care hospitals over a period of six months from August 2019 to January 2020. It was conducted after obtaining an ethical approval from the Institutional Research Forum (IRF), Rawalpindi Medical University, Ref. no. R-30/RMU.

All children were assessed by an ENT specialist, an ENT resident and an audiologist and pre-formed questionnaires were filled at the spot by the ENT resident herself after interviewing the parents. The questionnaires were kept in closed and sealed envelopes.

All children underwent oral cavity examination, otoscopy, anterior rhinoscopy examinations and tympanometry. Children were subjected to end-aural pressure measurement with a portable tympanometer in a separate room reserved in the hospital especially for the study purpose. The instrument used was Amplivox OtoWave 102 Hz hand held portable tympanometer with a probe frequency of 102 Hz and air pressure range of +200 Pa to −400 Pa. Tympanograms were evaluated according to Fielau-Nikolajsen\'s modification of Jerger\'s system: type A: peak between +100 to −100 mmH\(_2\)O; type B: no peak detected and type C: peak between −101 to −300 mmH\(_2\)O.

Inclusion criteria

1. Age between 1 and 5 years.
2. Normal children with no ENT complaints.

Exclusion criteria

1. Children with perforated tympanic membrane, impacted wax, cholesteatoma.
2. Children with congenital craniofacial anomalies or immunodeficiency syndromes.
3. Children already undergone any ENT operative procedure.

Our diagnostic criteria was an opaque/retracted tympanic membrane with absent cone of light on otoscopy plus a type B tympanogram curve. The results were then analysed to assess the frequency of OME and its major influencing factors prevailing in our society.

Data collection and statistical analysis

Data was collected using a verified questionnaire by the Institutional Research Forum Committee members. Questionnaires were filled by the principal investigator. The data was entered in SPSS v22.0 (Statistical Package for Social Sciences). The data included age, gender, family size, socio-economic status, mother\'s education, day care attendance, smoking exposure, nasal allergies, snoring, mouth breathing, any ear symptoms in the past 1 year and history of repeated attacks of AOM or recurrent upper respiratory tract infections in last 1 year plus use of any antibiotics, antihistamines or nasal sprays in last 1 year. Data were expressed as percentages for discrete variables and mean ± SD for continuous variables. Fisher\'s 95% confidence intervals (CI) were calculated for the proportions. Pearson\'s Chi-square test was used as a test of significance at the 5% level. Multi-variable logistic regression analysis was done to recognize the statistically significant risk factors associated with OME.

RESULTS

In this retrospective cross-sectional study, a total of 400 participants were examined. The mean age of the participants was (2.91 ± 1.12) years. Out of the 400 participants, 230 (57.5%) were males while 170 (42.5%) were females. The prevalence of OME, diagnosed on the basis of tympanogram, was found to be 27% (n = 108). Adding further, out of the 73% (n = 292) participants without OME, 59.5% (n = 238) had a completely normal tympanogram while 13.5% (n = 54) had an increased risk of developing OME signified by a type C tympanogram. The mean age of the cases was (2.78 ± 1.41) years.

Prevalence of OME varied with different ages; being highest among the participants with age 4 to 5 years, and least among participants with age 3 to 4 years. However this was statistically insignificant (Table 1). In the univariate analysis (Table 1), OME was strongly associated with: snoring (P < 0.001; OR = 2.94, 95% CI: 1.99–5.74); mouth breathing (P < 0.001, OR = 2.96, 95% CI: 2.03–4.29); previous 6-10 episodes of ASOM/URTI (P < 0.001, OR = 2.58, 95% CI: 1.37–4.85); ENT symptoms in last 1 year (P < 0.001) of hearing loss (OR = 5.50, 95% CI: 2.21–13.67), ear ache attacks (OR = 2.41, 95% CI: 1.59–3.67) and both symptoms (OR = 12.00, 95% CI: 2.42–59.46); and drugs taken in last 1 year (P < 0.001) which included URTI antibiotics (OR = 4.11, 95% CI:3.14–5.36), antihistamines (OR = 4.88, 95%
| Variable                  | OME (case[%]) | Control (case[%]) | OR (95% CI) | P-value |
|---------------------------|---------------|-------------------|-------------|---------|
| **Age (years)**           |               |                   |             |         |
| 1–2                       | 19 (17.6)     | 38 (13.0)         | 1.00 (0.58, 1.73) | 0.525   |
| 2–3                       | 30 (27.8)     | 73 (25.0)         | 0.82 (0.54, 1.26) |         |
| 3–4                       | 15 (13.9)     | 46 (15.8)         | 0.65 (0.36, 1.17) |         |
| 4–5                       | 44 (40.7)     | 58 (19.9)         | 0.79 (0.49, 1.29) |         |
| **Gender**                |               |                   |             | 0.569   |
| female                    | 43 (39.8)     | 127 (43.5)        | 1.00 (0.71, 1.41) |         |
| male                      | 65 (60.2)     | 165 (56.5)        | 1.16 (0.87, 1.55) |         |
| **Number of people living in same house hold** | | | | 0.056 |
| 1–5                       | 34 (31.5)     | 130 (44.5)        | 1.00 (0.68, 1.46) |         |
| 6–10                      | 51 (47.2)     | 108 (37.0)        | 1.80 (1.29, 2.52) |         |
| 11–15                     | 23 (21.3)     | 54 (18.5)         | 1.62 (1.00, 2.65) |         |
| **Total number of people earning** | | | | 0.186 |
| 1                         | 57 (52.8)     | 182 (62.4)        | 1.00 (0.74, 1.35) |         |
| 2                         | 28 (25.9)     | 55 (18.8)         | 1.63 (1.03, 2.56) |         |
| 3                         | 23 (21.3)     | 55 (18.8)         | 1.34 (0.82, 2.17) |         |
| **Mother education**      |               |                   |             | 0.283   |
| Illiterate                | 51 (47.2)     | 121 (41.4)        | 1.00 (0.72, 1.39) |         |
| primary                   | 19 (17.6)     | 38 (13.0)         | 1.19 (0.68, 2.06) |         |
| matric                    | 22 (20.4)     | 80 (27.4)         | 0.65 (0.41, 1.04) |         |
| bachelors                 | 16 (14.8)     | 53 (18.2)         | 0.72 (0.41, 1.25) |         |
| **Day care**              |               |                   |             | 0.421   |
| no                        | 70 (64.8)     | 176 (60.3)        | 1.00 (0.76, 1.32) |         |
| yes                       | 38 (35.2)     | 116 (39.7)        | 0.82 (0.57, 1.19) |         |
| **Smoking in the family** |               |                   |             | 0.038   |
| no                        | 66 (61.1)     | 210 (71.9)        | 1.00 (0.76, 1.32) |         |
| yes                       | 42 (38.9)     | 82 (28.1)         | 1.63 (1.12, 2.37) |         |
| **Allergies**             |               |                   |             | 0.004   |
| none                      | 47 (43.5)     | 168 (57.5)        | 1.00 (0.72, 1.38) |         |
| seasonal                  | 53 (49.1)     | 117 (40.1)        | 1.59 (1.15, 2.20) |         |
| perennial                 | 9 (8.3)       | 7 (2.4)           | 4.59 (1.71, 12.32) |         |
| **Snoring**               |               |                   |             | <0.001  |
| no                        | 63 (58.3)     | 235 (80.5)        | 1.00 (0.76, 1.32) |         |
| yes                       | 45 (41.7)     | 57 (19.5)         | 2.94 (1.99, 5.74) |         |
| **Mouth breather**        |               |                   |             | <0.001  |
| no                        | 59 (54.6)     | 228 (78.1)        | 1.00 (0.72, 1.33) |         |
| yes                       | 49 (45.4)     | 64 (21.9)         | 2.96 (2.03, 4.29) |         |
| **Episodes of ASOM/URTI in last 1 year** | | | | <0.001 |
| 1–5                       | 90 (83.3)     | 271 (92.8)        | 1.00 (0.79, 1.27) |         |
| 6–10                      | 18 (16.7)     | 21 (7.2)          | 2.58 (1.37, 4.85) |         |

(Continues)
TABLE 1 (Continued)

| Variable                                | OME (case[%]) | Control (case[%]) | OR (95% CI) | P-value |
|-----------------------------------------|---------------|-------------------|-------------|---------|
| ENT symptoms in last 1 year             |               |                   |             | <0.001  |
| none                                    | 56 (51.9)     | 224 (76.7)        | 1.00 (0.75, 1.34) |         |
| hearing loss                             | 11 (10.2)     | 8 (2.7)           | 5.50 (2.21, 13.67) |         |
| attack of ear ache                       | 35 (32.4)     | 58 (19.9)         | 2.41 (1.59, 3.67)  |         |
| both                                    | 6 (5.6)       | 2 (0.7)           | 12.00 (2.42, 59.46)|         |
| Drugs taken in last 1 year              |               |                   |             | <0.001  |
| none                                    | 6 (5.6)       | 66 (22.6)         | 1.00 (0.43, 2.31)  |         |
| URTI antibiotics                        | 74 (68.5)     | 198 (67.8)        | 4.11 (3.14, 5.36)   |         |
| decongestants                           | 0             | 1 (0.3)           | -             |         |
| antihistamines                          | 4 (3.7)       | 9 (3.1)           | 4.88 (1.51, 15.86)  |         |
| all 3 type of drugs                     | 24 (22.2)     | 18 (6.2)          | 14.65 (7.96, 27.0)  |         |

*Fischer exact test

TABLE 2 Multivariate analysis of factors related to OME in children

| Factors                        | Coefficient of Regression | Standard Error | Odds Ratio | 95% Confidence Intervals | P-value |
|--------------------------------|----------------------------|----------------|------------|--------------------------|---------|
| Snoring                        | -                          | -              | 1.000      | -                        | -       |
| yes                            | 0.966                      | 0.265          | 2.708      | 1.611-4.661              | <0.001  |
| Last year symptoms             |                            |                |            |                          |         |
| none                           | -                          | -              | 1.000      | -                        | 0.024   |
| hearing loss                   | 1.508                      | 0.879          | 4.518      | 3.600-5.548              | 0.626   |
| attack of ear ache             | 0.561                      | 0.984          | 1.752      | 1.680-1.768              | 0.106   |
| both                           | 1.988                      | 0.885          | 7.299      | 1.300-40.000             | 0.002   |
| Drugs                          |                            |                |            |                          |         |
| none                           | -                          | -              | 1.000      | -                        | 0.001   |
| URTI antibiotics               | 1.122                      | 0.369          | 3.070      | 4.532-2.233              | 0.026   |
| decongestants                  | -                          | -              | -          | -                        |         |
| antihistamines                 | 0.793                      | 0.705          | 2.209      | 1.687-2.928              | 0.102   |
| all 3 type of drugs            | 1.944                      | 0.583          | 6.993      | 2.326-21.270             | 0.014   |
| Constant                       | -1.048                     | 0.268          | 0.351      | -                        | <0.001  |

Cl:1.51-15.86), all 3 drugs (OR = 14.65, 95% CI:7.96-27.0). OME was also associated with the presence of allergies (P = 0.004) both seasonal (OR = 1.59, 95% CI: 1.15-2.20) and perennial (OR = 4.59, 95% CI: 1.71-12.32); and smoking within the family (P = 0.038; OR = 1.63, 95% CI: 1.12-2.37).

All the variables with P-value <0.05 were then added to the multivariable regression analysis. Hence the variables excluded from the multivariable analysis for being insignificant included: age, gender, number of people living in the same house hold, total number of people earning, mother’s education, and child going to day care. Those with P values over 0.05 in the stepwise model that were not entered into the final model were: mouth breather, having allergies and smoking within the family. Multivariable regression analysis of risk factors associated with OME showed it was strongly associated with snoring (P < 0.001), last year symptoms (attack of ear aches with hearing loss [P = 0.002]), drugs [URTI antibiotics [P = 0.026], all 3 drugs [P = 0.013]) (Table 2).
DISCUSSION

OME is one of the commonest chronic conditions affecting children. It often goes undetected and undiagnosed because of the relative asymptomatic picture and hence, becomes one of the most common cause of hearing loss and surgery in childhood.

OME must be considered a potential health hazard due its tendency to cause sequelae and complications which affect a child's long term development. However, the disease is highly underrated due to its asymptomatic course. In Pakistan, the health authorities currently have no screening or assessment protocols targeting the early diagnosis or treatment of OME. Hence, here the propensity of children left undiagnosed is relatively higher than the developed world. This ultimately leads to increased care giver support, increased instability and economic burden.

It is the novelty of our study that the methodology we have used is not biased by diseases leading to health care attendance as we have enrolled children with no active ENT complaints. Hence, our study can be generalised to the local population.

Our study reports a staggering 27% prevalence of OME among school going children in Pakistan, which is relatively much greater than 6.92% and 11.5% reported by studies done earlier in the country.6,7 The difference in results can be attributed to the different age groups targeted. OME is a childhood disease and its incidence decreases with age because the anatomical orientation of the Eustachian tube becomes more vertical with increasing age and also the immune system becomes stronger having met many types of allergens. Age is thus, one of the most important risk factors for OME according to previous studies. Recent international data suggests a peak around six and twelve months of life and decline after age five years.10 Our study focused on children 1-5 years of age while the other two had 3-5 years and 3-7 years in the inclusion criteria.7,8 Secondly, in our study tympanometry was conducted in every participant, while the other two studies only conducted the test in suspicious participants after clinical screening. Tympanometry provides a more objective measurement of the Eustachian tube function, tympanic membrane perforation and estimation of middle ear pressure. Hence, rendering our study more authentic.

A study done in India also presented a relatively high rate of OME prevalence, 16.6%.5 A study done in Cameroon on the age group 2-3 years old presented a prevalence of 7.2%.11 Three studies done in Turkish cities of Anatolia, Istanbul and Trabzon reported prevalence as 10.4%, 8.7% and 11.4% respectively.12-14 Other international settings such as Egypt and Nepal presented with prevalence of 15.4% and 13.2% respectively.15,16

Our study reported strong association with snoring (OR = 2.7, 95% CI = 1.611-4.661), presence of hearing loss and ear ache (OR = 7.299, 95% CI = 1.300-40.000) and usage of URTI drugs, antihistamines and decongestants (OR = 6.993, 95% CI = 2.326-21.270). Snoring and mouth breathing turned out to be important etiological correlates to OME. Our questionnaire helped us stratify the participants into two categories: Snorers and mouth breathers (having nasal blockage throughout day and night, severe symptoms. Indicating definitive nasopharyngeal pathology) and only snorers (having nasal blockage predominantly at night, moderate symptoms.) All mouth breathers were also snorers according to our data. The respective nasopharyngeal pathologies could not be isolated further because of unavailability of nasopharyngoscopy in our outpatient setup. Despite this limitation of our study, it is an easy inference that children with snoring and mouth breathing are more likely to have OME and also to establish the fact that any child presenting with OME symptoms definitely needs his nose to be examined. Our study derives that snoring is an important risk factor of OME. This finding is in agreement with a study done in India that also reported strong association of OME with snoring, adenoids and tinnitus.5 While the study done in Cameroon found a significant association with 'Parents complaining of Upper Respiratory Tract Symptoms’.11 A study done in Turkey reported association with young age, history of snoring and AOM, antibiotic use in the previous 3 months and active upper respiratory tract infection (URTIs).16 The similarity among all these studies is the presence of URTI symptoms being significant among majority of them. This fact was further reaffirmed by the study done in Egypt which found association with Adenoid hypertrophy, tonsil hypertrophy, sinusitis, allergic rhinitis and recurrent URTIs.15

In our study, we did not find any significant association between gender and prevalence of OME which is in line with previous studies.11-13,15 Hence, establishing that gender is not a good predictor of OME. Passive smoking at home is one of the most studied risk factors of OME but we could not establish any such significant association.17

Untreated OME can lead to complications such as tympanosclerosis, retraction pockets, chronic otitis media and hearing or speech impairment. Complications of OME occur if the disease is not recognized in its early stages and/or treated accordingly. The dilemma in our region is that there is not much awareness about OME among the general population and hence, people do not usually get their children properly examined unless they can physically see any ear discharge and by that time, mostly complications have developed. These complications make the disease an important public health problem.18 They pose considerable socio-economic burden on the public health system of Pakistan where already 28% of the population lives below the poverty line.19

Population-based screening is suitable for conditions that are ordinary, can be found by a sensitive and specific test, and provide the advantages stemming from early detection and treatment.20 OME completely fulfills the above criteria as 27% prevalence among children aged 1-5 years is quite significant, it can be easily screened/diagnosed by simple clinical examination and tympanometry and primary prevention and timely management can help prevent further complications. Our study stresses on the fact that a screening/diagnostic system must be put into function for recognising high risk children who should receive priority in early screening, prevention and timely management. The findings of our study can be helpful in laying down a criteria to assess high risk children and better target the prevention criteria. Like this, most of the aforementioned complications of OME can be avoided. Hence, saving the public health sector from a significant burden of ear complications.

Limitations of our study included unavailability of nasopharyngoscopy and telescopic examination of ear in our outpatient department and lack of collection of breastfeeding and pacifier data.
However, it is of utmost importance to mention here that recent knowledge lacks significantly in identifying definitive preventive measures against OME and further research is mandatory on this topic.

CONCLUSION

The prevalence of OME in our study is 27%. Our study signifies that OME is quite common among children of 1–5 years of age in Rawalpindi. In our region, snoring, presence of on and off episodes of hearing loss and ear ache and usage of URTI antibiotics, antihistamines and decongestants were the most important associated factors in etiopathogenesis of OME. As most of the aforementioned factors are modifiable, we suggest their use in forming a basic criteria to assess high risk children who can then be better targeted for the primary prevention measures. In addition, the results of our study can help improve the knowledge of primary health care providers, paediatricians and otolaryngologists about the most important associated risk factors of OME in children who can then in turn educate the parents and school teachers for early detection of such cases. This will ultimately lead to improved care giver support and also lighten the economic burden.

AUTHOR CONTRIBUTIONS

Conceptualization of research, follow up of patients and final edition of the paper: Nida Riaz and Muhammad Ajmal. Methodology and data analysis: Muhammad Shehryar Khan. Writing, review and editing of the paper: Nida Riaz and Muhammad Shehryar Khan.

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DECLARATION OF COMPETING INTEREST

The authors have no conflicts of interest to declare.

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