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Incidence and Predisposing factors of Otitis Media with effusion in Muzaffarnagar school going children

KEYWORDS: otitis media effusion, incidence, predisposing factors

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ABSTRACT

Objective: To determine the incidence of otitis media with effusion (OME) among school going children in Muzaffarnagar, region of Uttar Pradesh, India and to determine predisposing factors in affected children.

Methods: Through a cross-sectional study, 1488 children in the age range 6–12 years were randomly selected from 25 primary schools in Muzaffarnagar region. A questionnaire was used to determine predisposing factors for OME. Otoscopy and tympanometry were used to diagnose and confirm OME. Pure tone for children with confirmed OME was measured. Teachers of children were asked to complete a questionnaire assessing child's level of school performance.

Results: Incidence of OME in the study population was 7.5% (112/1488). In univariate analysis, it was strongly associated with age less than 8 years (p< 0.0001; OR= 4.23, 95% CI: 2.85–6.29), family size more than 4 members in the household((p<0.0001; OR= 4.45, 95% CI: 2.23–8.88), mother education less than secondary school education (p<0.0001; OR=2.2, 95% CI: 1.47–3.29), recurrent acute otitis media (AOM) (p<0.0001; OR=5.73, 95% CI: 3.47–9.45), and hearing loss symptom (p< 0.0001; OR= 3.39, 95% CI: 1.92–5.99). It is less strongly associated with history of preschool AOM (p= 0.002; OR= 3.15, 95% CI: 1.67–5.97), nasal discharge (p= 0.003; OR= 1.91, 95% CI: 1.24–2.93) and snoring (p=0.03; OR= 1.76, 95% CI: 1.06–2.94). OME was significantly higher in schools located in rural districts (p<0.001, OR= 2.82, 95% CI: 1.86–4.28). In multivariate regression model, five of these factors were found to be predictors of OME: age less than 8 years (OR= 5.052, 95% CI:3.289–7.762), family size more than4 members in the household) (OR= 4.192, 95% CI: 2.033–8.643), rural school district (OR=3.037, 95% CI: 1.933–4.772), mother education lower than secondary school education) (OR=2.041, 95% CI:1.602–3.877) and recurrent AOM (OR=4.914, 95% CI: 2.677–9.02). Children with OME have poorer school performance compared to normal children (p=0.067). No significant correlation was found between OME and type of feeding during the first two years of life (p=0.62; OR= 0.87, 95% CI: 0.51–1.49), preschool daycare attendance (p=0.17; OR= 0.71, 95% CI: 0.44–1.16), home exposure to cigarette smoke (p=0.4; OR= 1.34, 95% CI:0.68–2.65), visits to ENT clinic (p=0.13; OR= 0.58, 95% CI:0.29–1.18), and ENT operations (p=0.12; OR= 0.46, 95% CI: 0.17–1.27).

Conclusion: Incidence of OME in Muzaffarnagar region reaches 7.5% in school children. Age less than 8 years, family size more than 4 members in the household, mother education less than secondary school education, living in rural area and recurrent AOM are found to be predictors of OME in Muzaffarnagar region. In this population of children, otoscopy and tympanometry should be used as screening tools for OME.

INTRODUCTION

Nation-wide epidemiological studies for middle ear inflammatory conditions are scarce in India [1,2].

Regional studies conducted through hospitals help to investigate incidence of such diseases in states of India.

Otitis media with effusion (OME) is a multi-factorial disease with infection, possibly biofilm in nature [3, 4] and Eustachian tube dysfunction[5] are the most widely accepted etiologies. Many predisposing factors have been associated with this disease: young age [6, 7] lack of breast feeding [6, 8, 9] low mother education,[9-11] low socioeconomic status [6,10] day care attendance [8,11] parental smoking, [6, 11, 12] upper respiratory tract infections [6, 9, 11] allergy [6, 9, 11, 13, 14] and snoring.[6,9]

Although it is a self-limiting condition in the majority of cases, OME may become chronic to the extent that it affects child education and quality of life. Long term effects of this disease on language and academic achievement have been reported, even after the disease had resolved. [15–17]. As age increases the incidence of OME falls, moreover the effect of secretory otitis media on development and scholastic achievements is maximum in children [18]. Therefore, identification of children at risk of OME is important from medical as well as community perspectives.

Incidence varies according to geographical location and race variation, environmental and socio-economic factors [19]. The purpose of this research is to determine incidence of OME in school going children in Muzaffarnagar region and to determine demographic, maternal, and child predisposing factors associated with this disease.

PATIENTS AND METHODS

Twenty five schools (12 urban and 13 rural) were randomly selected from the 241 primary public schools in Muzaffarnagar region. From each school, 65 students in the age range 6–12 years were randomly selected (1625 out of 401 92 students).

The study was conducted through June 2016 to the end of June 2017. A specific questionnaire was designed in Otorhinolaryngology department in Muzaffarnagar Medical College. Questionnaire items included child age, gender and grade, number of family members, mother education (illiterate, primary, preparatory, secondary and university), type of feeding in first 2 years of life (bottle, breast or both), exposure to cigarette smoke at home, preschool daycare attendance, preschool AOM, hearing loss as reported by parents, recurrent AOM necessitating antibiotic and analgesic treatment, nasal discharge, snoring, visit to ENT clinic and ENT operations (adenoidectomy, tonsillectomy, myringotomy and ventilation tube insertion). Questionnaires were delivered with consent forms to parents through school administration; the day before examination of children.

Teachers in charge of children were asked to complete a questionnaire evaluating child's performance. Teachers were asked to classify child's performance as excellent, very good, good, accepted or poor.

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Children with perforated tympanic membrane, ventilation tubes at the time of study, cholesteatoma, craniofacial anomalies or immunodeficiency syndromes were excluded from the study.

A team of an otolaryngologist, a nurse and a social worker visited each school. While collecting the questionnaire, middle ear was assessed with an otoscope and a portable tympanometer. The instrument used was Titan middle ear analyzer (Interacoustics ®, Assens, Denmark) with a probe frequency of 226 Hz and air pressure range of –400 to +100 mm H_2O. Tympanograms were evaluated according to Fielau-Nikolajsen's [20] modification of Jerger's system: type A: peak between +100 to – 100 mm H_2O; type C1: peak between –101 to –200 mm H_2O; type C2: peak between –201 to –300 mm H_2O and type B: no peak detected or pressure could not be measured. Children with obstructive wax that prevents detailed otoscopy had their ear cleaned in the hospital before otoscopy and tympanometry. All children with an abnormal otoscopic appearance of OME (retracted tympanic membrane, fluid level or air bubbles) and type B or type C2 tympanograms were reexamined in the hospital using otomicroscopy, repeat tympanometry and pure tone audiometry.

Criteria for diagnosis of OME in this study were set as follows: documented middle ear effusion on microscopy for a minimum of three months, abnormal tympanogram and average air-bone gap of 10 dB. Type C1 tympanogram was not accepted as indicator of OME. Statistical analysis was performed using SPSS for Windows (Release 17.0 Chicago, SPSS Inc. Chicago, Illinois, USA). Univariate analysis was used to determine association OME with each studied variable. Partial logistic coefficient b, odds ratio and 95% confidence interval were determined for each variable. Predisposing factors with p-values less than 0.05 were put into multivariate logistic regression model for further investigations. A forward stepwise modeling strategy was applied.

RESULTS

Out of 1625 candidate children, 1488 were analyzed. Children whose parents refused to fill the questionnaire or to allow clinical examination were excluded from statistical analysis. Wax was obstructive in 245 children (16.4%) and was removed in the hospital. Results of univariate analysis of predisposing factors with OME are summarized in Table 1.

We found 7.5% of children (112/1488) suffering from persistent OME (> 3 months) in at least one ear. OME was bilateral in 32 cases (2.2%) and unilateral in 80 cases (5.3%). Of all children, 7.3 % of girls (53/721) and 7.6 % of boys (59/767) had OME (Fig. 1) without a statistically significant difference between the two genders (p=0.8 OR =1.05).

Mean age of children with OME was 8.1± 3.8 years and mean age of normal children was 9.4± 2.7 years. OME is significantly higher in 6–7 year old children compared to older (8–12 years) children (Table 1) (p<.0 0001; OR= 4.23, 95% CI= 2.85–6.29). Fifty-two percent of children with OME (59/112) were 6–7 years old; 19 % (21/112) were 8–9 years old; 20 % (22/112) were 10–11 years old and 9%(10/112) were 12 years old (Fig 1).

TABLE 1

Univariate analysis of predisposing factors for OME: odds ratio (OR), logistic coefficient b, P-value and 95% confidence limits (CI)

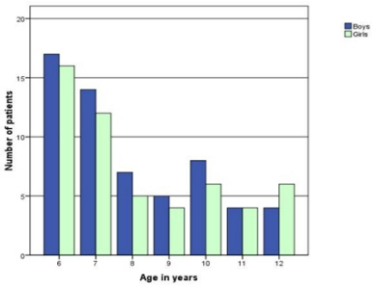
Predisposing factor	Normal		OME		OR & (coefficient b)	*P value	OR 95% CI
Total no of children	**1376**	**92.5%**	**112**	**7.5%**			
Boys	708	47.5%	59	7.6%	**1.05 (0.05)**	**0.8**	**(0.71–1.54)**
Girls	668	45%%	53	7.3 %			
Age (y)							
6–7	248	18%	59	52%	**4.23(1.44)**	**<0.0001***	**(2.85–6.29)**
8–12	1128	82%	53	48%			
Family size							
≤ 4 members	385	28%	9	8%	**4.45 (1.49)**	**<0.0001***	**(2.23–8.88)**
≥5 members	991	72%	103	92%			
Mother education							
low[a]	619	45 %	72	64 %	**2.2 (0.79)**	**<0.0001***	**(1.47–3.29)**
high[b]	757	55 %	40	36%			
Bottle feeding	**234**	**17%**	**17**	**15%**	**0.87 (−0.14)**	**0.62**	**(0.51–1.49)**
Day care attendance	**351**	**25.5%**	**22**	**20%**	**0.71 (−0.34)**	**0.17**	**(0.44–1.16)**
Exposure to cigarette smoke	**94**	**7%**	**10**	**9%**	**1.34 (0.29)**	**0.4**	**(0.68–2.65)**
Preschool AOM	**55**	**4%**	**13**	**11.5%**	**3.15 (1.15)**	**0.002***	**(1.67–5.97)**
Hearing loss	**69**	**5%**	**17**	**15%**	**3.39 (1.22)**	**<0.0001***	**(1.92–5.99)**
Recurrent AOM	**69**	**5%**	**26**	**23%**	**5.73 (1.75)**	**<0.0001***	**(3.47–9.45)**
Nasal discharge	**247**	**18%**	**33**	**30%**	**1.91 (0.65)**	**0.003***	**(1.24–2.93)**
Snoring	**151**	**11%**	**20**	**18%**	**1.76 (0.57)**	**0.03***	**(1.06–2.94)**
Visit to ENT specialist	**179**	**13%**	**9**	**8%**	**0.58 (−0.54)**	**0.13**	**(0.29–1.18)**
ENT operations	**103**	**7.5%**	**4**	**3.5%**	**0.46 (−0.78)**	**0.12**	**(0.17–1.27)**

*statistically significant

[a]illiterate, primary or intermediate school education

[b]secondary school or university education

FIGURE 1



There was a statistically significant influence of family size on incidence of OME. It was less common in small families (≤4 members) than in bigger families. Ninety-two of children with OME had more than 4 family members in the household compared to 72% of normal children (p<0001; OR= 4.45, 95% CI=2.23–8.88). OME was significantly more in families with mother education less than secondary school education (p<0.0001, OR=2.2; 95% CI =1.47–3.29).

In our study, the type of infant feeding during the first two years of life did not have a significant effect on incidence of OME in school years. Fifteen percent of those with OME had exclusive bottle feeding compared to 17% of normal children and this was not statistically significant (p=0.62; OR=0.87 95%CI=0.51–1.49). Regarding daycare attendance in preschool years, 20% of children with OME were sent to daycare centers compared to 25 % of normal children and this was not statistically significant (p=0.17; 95% CI =0.44–1.16). Rate of home exposure to cigarette smoke was7 % in normal children and 9 % in those with OME. This was again not statistically significant (p=0.4, OR=1.34, 95% CI =0.68–2.65).

Preschool AOM, hearing loss symptom as reported by parents and recurrent AOM were statistically higher in children with OME compared to normal children. Preschool AOM was present in 11.5% of children with OME compared to 4 % of normal children (p= 0.002; OR=3.15; 95% CI=1.67–5.97). Hearing loss symptom was present in 15% of children with OME compared to 5% of normal children (p< 0.0001; OR=3.39 %; 95 CI=1.92–5.99). Recurrent AOM was present in 23% of children with OME compared to 5 % of normal children (p< 0.001 OR= 5.73; %95 CI= 3.47–9.45).

Nasal discharge and snoring were statistically higher in children with OME compared to normal children. Nasal discharge was reported in 30 % of children with OME compared to 18% in normal children (p= 0.003; OR=1.91 95% CI =1.24–2.93). Snoring was present in 18 % of those with OME compared to 11 % of normal children (p=0.03, OR=1.76; 95% CI=1.06–2.94).

Eight percent of children with OME and 13 % of normal children have

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visited ENT specialist. Rate of ENT operations (adenoidectomy, tonsillectomy and ventilation tubes) was 3.5 % in children with OME and 7.5 % in children without OME. Difference in these two factors was not statistically significant (p=0.13 and p=0.12).

OME was higher in schools located in rural districts than in urban ones (p<0.001; OR=2.82; 95% CI= 1.86–4.28) (TABLE 2). Seventy percent (78/112) of children with OME were living in rural districts compared to 45 % (617/1376) of normal children living in these districts.

TABLE 2

Incidence of OME by School district

Predisposing factor	Coefficient	Standard error	Odds ratio (95%CI)	p-value
Recurrent AOM	1.592	0.31	4.914 (2.677–9.02)	<0.001
Young age	1.653	0.22	5.052 (3.289–7.762)	<0.001
Rural school district	1.111	0.23	3.037(1.933–4.772)	<0.001
Low mother education	0.919	0.226	2.041(1.602–3.877)	<0.001
Large family size	1.433	0.369	4.192(2.0	

Results of univariate analysis of factors with statistical significance < 0.05 (Fig. 2) were reviewed using multivariate regression model (Table 3). Only five factors were found significant in this analysis: age less than 8 years(OR= 5.052, 95% CI:3.289–7.762), family size more than 4 members in the household(OR= 4.192, 95% CI: 2.033–8.643), rural school district (OR=3.037, 95% CI: 1.933–4.772), mother education less than secondary school education (OR=2.041, 95% CI:1.602–3.877) and recurrent AOM (OR=4.914, 95% CI: 2.677–9.02).

FIGURE 2

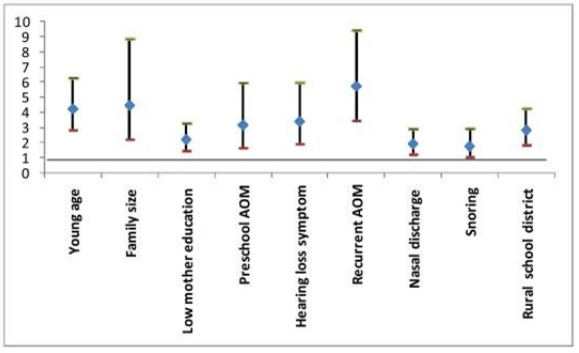

TABLE 3

Multivariate logistic regression for predicting OME

School performance	Number of children	Normal		OME	
		No	%	No	%
Excellent	371	343	24.9	28	25
Very good	683	636	46.	47	42
Good	206	196	14.2	10	8.9
Accepted	116	103	7.5	13	11.6
Poor	112	98	7.1	14	12.5
Total	1488	1376	100	112	100

p=0.067

Assessment of school performance by responsible teachers revealed that there was statistical trend for children with OME to have poor performance (14/112; 12.5%) compared to normal children (98/1376; 7.1%) although this trend did not reach level of statistical significance (p=0.067) (Table 4).

TABLE 4

School performance of normal children and those with OME

School performance	Number of children	Normal		OME	
		No	%	No	%
Excellent	371	343	24.9	28	25
Very good	683	636	46.	47	42
Good	206	196	14.2	10	8.9
Accepted	116	103	7.5	13	11.6
Poor	112	98	7.1	14	12.5
Total	1488	1376	100	112	100

p=0.067

DISCUSSION

In our study, overall incidence of OME was 7.5 %. There is also a considerable variation in the incidence of OME in worldwide studies. It was 16 % in Turkey, [16] 6.8% in Italy[17], 9.5% in Netherlands [21] and 6.5% in Greece. [22] It seems that OME is affected by the type of population studied, the geographical area and its prevailing climate.

In our study, maximum incidence was in the first two school grades (Fig. 1) and it tends to decrease in later grades. In multivariate regression model, there was a statistically significant correlation between OME and ageless than 8 years (p<0.0001; OR= 5.052, 95% CI: 3.289–7.762). Our results go with the opinion that age is one of the most important predisposing factors for OME.[6, 7, 23, 24]Zielhuis et al., used the age specific incidence of OME and concluded that there are two peaks for the disease: one around 2 years and the other around 5 years While OME generally decreases after the age of five, it continues to be seen in a significant proportion of school-age children.[25]

In our study, we found no significant association between genders in incidence of OME (OR=1.05 95% CI=0.71–1.54). Our results are similar to study done Kiris et al., and by Engel et al. In these studies, neither male nor female gender was identified as strong predictor of OME in school children.[6, 24] Other studies showed higher incidence among girls [9] than among boys.[21, 26] According to Tos et al., gender difference in otitis media represents mainly the influence of cultural factors.[27]

In our study, children with OME had larger number of family members in household than normal children (p= <0.0001). From multivariate regression model, we found that family size of more than 4 members is one of the strongest predictors of OME (OR= 4.192, 95% CI: 2.033–8.643). Our results are similar to those reported by Sassen et al.,(28) They found that presence of older siblings is an important factor in occurrence of OME. Probability of disease increases with each additional brother or sister. In Australia, Jacoby P. et al., found higher risk of carriage of bacteria causing otitis media in aboriginal children compared to non-aboriginal children. They highlighted the need to reduce the crowding in Aboriginal households. [29]Gultekin et al.,[11] and Martines et al.,[9] however, found no difference in the number of household between children with and without OME.

In our study, low mother education was found to be a predisposing factor for OME. In multivariate regression model, mother education less than secondary school education was found to be a predictor of OME (p< 0.001;OR=2.041, 95% CI:1.602–3.877). Similarly Gultekin et al., reported higher incidence of OME in families with less parental education. [11] Daly et al., also found that lower levels of maternal education were associated with poorer knowledge regarding otitis media.[30]

In our study, children who were never breast fed during the first two years of life did not have higher incidence of OME than those who had exclusive breast or mixed type of feeding (p=0.62; OR=0.87 95%=0.51–1.49). Our results are similar to those done by Glutekin et al. and Tong et al. [11,31] A protective effect of breast feeding against AOM in preschool children was reported by Abrahams et al. [32] However, Sassen et al., found that 12 months after breast-feeding was discontinued, the risk was virtually the same as if the child had never been breast-fed.[33]

In our study, one quarter of children without OME went to day care centers in preschool years compared to 20% of those with OME. Although we did not find a significant relationship between OME and daycare attendance (p=0.17, OR=0.71 %95CI =0.44–1.16), maintaining good hygiene in daycare facilities and their supervision by health and education officials are essential in order to reduce rates of upper respiratory tract infection in young children attending these facilities.[11,34,35]

One of the most studied predisposing factors of OME is exposure to

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smoking at home. [36] Some studies, using serum, salivary and urinary cotinine as indicator of passive smoke exposure, were able to demonstrate significant relationship to OME. [37–39] In our study, rate of exposure to passive smoking was unexpectedly low (7%). We could not establish a statistically significant relation between exposure to passive smoking and development of OME. (p=0.4, OR=1.34 95% CI=0.68–2.65). Higher rates of smoking were previously reported in Saudi families but it seems that parents are becoming increasingly aware of hazards of passive smoking on their children. [40]

In our study, 11.5% of children with OME had preschool AOM compared to 4% of normal children and this was statistically significant (p=0.002). In univariate analysis, children with OME were three times more likely to have pre-school AOM (OR= 3.15 %95 CI=1.67–5.97). Kiris et al report some of children continue to have middle ear problem secondary to Eustachian tube dysfunction and large adenoid, particularly in first or second grade. [6]

From univariate analysis, hearing loss symptom was significantly higher in children with OME (p=0.0001 OR=3.39, 95%CI= 1.92–5.99). However, in multivariate analysis, it was not significant. In general, sensitivity of parent-suspected hearing impairment seems to be quiet low (15% in our study). Only 8% of children with OME visited ENT clinic and 3.5 % of them had ENT operations (adenoidectomy, tonsillectomy and ventilation tubes). Health education of parents helps to increase their awareness of this silent disease and this has been recommended by Lo et al. [41]

In our study, 23% of children with OME had recurrent AOM compared to 7% in normal children, (p<0.0001). In the multivariate regression model, we found recurrent AOM to be a strong predictor of OME in this age(OR=4.914, 95% CI: 2.677–9.02). Martines et al., and Alho et al., similarly found that children with history of recurrent AOM are more likely to have OME. [9,42]

Nasal discharge, when it is persistent or recurrent, affects the Eustachian tube and middle ear in children. [23,43] Snoring whether due to rhinitis or large adenoids is more common in children with chronic ear problems. [9,16] In our study, thirty percent of children with OME had nasal discharge compared to 18 % of normal children (p=0.003, OR=1.91 95% CI=1.24–2.93). Snoring was reported in 18% of children with OME compared to 11% of normal children (p= 0.03, OR=1.76; 95% CI= 1.06–2.94). Relation of these two symptoms as predisposing factors associated with OME has been reported by Kiris et al. [6]

In our study, OME was more prevalent in rural district schools (Table 2) than in urban district schools. This can be explained by low socioeconomic status and less access to healthcare facilities in multivariate regression model, rural school district is one of the predictors of OME (p<0.001, OR=3.037, 95% CI: 1.933–4.772). Although, Martines et al., found no effect of socioeconomic class on disease incidence, [9] others ascertain that it has a significant effect. [44, 45]

Regarding school performance, we found only a statistical trend for students with OME to have poorer school performance than normal students (p=0.067) (Table 3). Similarly, Kiris et al., [6] found that children with OME had low success levels compared to normal children but the difference in their study was slight (10.7 vs. 6.8%). Conductive hearing loss especially when bilateral (32/112 children in our study) impairs child attention during classes. Using actual student scores in statistical analysis, instead of ranks or grades would have increased statistical power.

Limitations in our study is that we relied on self-reports from the parents. This may be a source of recall bias. 'Yes or no' choices in most of questionnaire items, used for its brevity, might not have allowed parents to give their exact response.

CONCLUSIONS

Incidence of OME in Muzaffarnagar region reaches 7.5% in school children. Age less than 8 years, family size more than 4 members in the household, mother education less than secondary school education, living in rural area and recurrent AOM are found to be predictors of OME in Muzaffarnagar region. In this population of children, otoscopy and tympanometry should be used as screening tools for OME.

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