



ORIGINAL ARTICLE

Prevalence and associated risk factors of otitis media and its subtypes in South Indian population



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Abstract *Background:* Otitis media is a common inflammatory disorder caused by the effusion of fluids or pathological changes in the tympanic membrane of middle ear that leads to hearing loss in all age groups which may be either temporary or permanent. *Objective:* The present study aimed to identify the risk factors responsible for the onset and progression of otitis media and its subtypes as well as its associated co-morbidities in the South Indian population. *Subjects and methods:* The study constituted 2602 subjects including children and adults affected with OM and the diagnosis was confirmed by ENT specialists using all the required otorhinolaryngological tests. The study was carried out by the institutional ethical clearance. The data were coded and evaluations were performed using the Statistical Package for Social Sciences, PASW STATISTICS 18.0 software (SPSS Inc., Chicago, IL, USA). *Results:* squamous-chronic suppurative otitis media was highly prevalent (47.3%) followed by mucosal-chronic suppurative otitis media (18.5%), acute suppurative otitis media (17.6%), and otitis media with effusion (16.6%). The multinomial logistic regression analysis showed significant association of tinnitus with squamous-chronic suppurative otitis media; bilaterality, tinnitus and vertigo with mucosal-chronic suppurative otitis media while bilaterality, adenoids, tinnitus and snoring with otitis media with effusion. Significant differences were observed in different forms of hearing loss at higher frequency within the subtypes of otitis media. *Conclusions:* The study has revealed that otitis media predominantly affects all age groups and has a serious health concern in cases affected with hearing loss and its associated co-morbidities.

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1. Introduction

Otitis media (OM) refers to an inflammation in the middle ear cleft and is accompanied by effusion of fluids into the middle ear due to infection which may be associated with the presence or absence of tympanic membrane perforation.^{1,2} Nearly 90% of OM is mostly seen in younger children less than 2 years of age but its occurrence may also be seen in adults.^{3,4} The vulnerability of OM in relation to aetiopathogenesis is due to the involvement of multiple factors such as demographic, genetic, environmental and other health related factors like infections, allergy, asthma, eustachian tube dysfunction, cleft palate, and adenoid hypertrophy etc.⁵⁻⁷ The presence of fluid in middle ear leads to long term morbidity with varying degrees of hearing loss in children and adults.^{8,9}

The aetiology and duration of OM lead to a sequelae of disorders such as acute suppurative otitis media (ASOM), chronic suppurative otitis media (CSOM) and otitis media with effusion (OME).^{10,11} ASOM an acute form of OM, characterized by inflammation and the presence of fluid in the middle ear includes symptoms such as otalgia, irritability or fever.¹² CSOM is a recurrent or persistent otorrhea over 2–3 weeks through a permanent tympanic membrane perforation leading to long standing inflammation of middle ear or hearing loss.¹² Based on the propensity to cholesteatoma, CSOM can be further classified as squamous (safe) and mucosal type (unsafe).^{12,13} OME is a chronic inflammatory condition that is characterized by a non-purulent effusion which may be either mucoid or serous.^{14,15}

OM is highly prevalent worldwide and is the main cause of hearing impairment in developing countries.¹⁶ World Health Organization (WHO) has reported that hearing impairment in 42 million people (above 3 years) in the world was mainly caused by OM. The prevalence of OM varies in different countries, populations and ethnic groups.¹⁷ Studies around the world have reported that the prevalence of ASOM varies from 2.3% to 20%, CSOM 4% to 33.3% and OME from 1.3% to 31.3%.^{13,17,18} The prevalence rate of ASOM in India is around 17–20%, CSOM is 7.8% and of OME is not yet known.¹⁹ Therefore, the present study aimed to determine the prevalence and identify the role played by various aetiological factors responsible for onset of OM and its subtypes leading to hearing loss in the South Indian population.

2. Methods

2.1. Subjects

All the patients referred with ear problems to MAA ENT Hospitals, Hyderabad, Telangana State, from 2004 to 2014 constituted the study subjects. The subjects with symptoms such as otalgia, otorrhea and no sign of improvement after 24 h were included in the study. According to the age, the patients were grouped into 1–15 years, 16–30 years and > 30 years. The diagnosis of otorhinolaryngological problems was confirmed by ENT specialists using clinical history, clinical examinations including video otoscopy, nasal endoscopy, tympanometry and pure tone audiometry. Audiometric threshold of hearing loss was evaluated using pure tone audiometry and the average for the frequencies 0.5, 1, 2, 4 and 8 kHz was recorded. A special questionnaire has been designed to collect the epidemiological

data and the study has been carried out with institutional ethical clearance. The data have been collected from 3666 subjects, of which 5.8% ($n = 213$) were affected with outer, 76.6% ($n = 2808$) with middle and 17.6% ($n = 645$) with inner ear diseases. Among the subjects affected with middle ear disorders, 65% ($n = 2602$) were affected with OM, of which 17.6% ($n = 457$) were affected with ASOM, 65.8% ($n = 1713$) with CSOM and 16.6% ($n = 432$) with OME. Around 71.9% ($n = 1231$) were affected with tubotympanic and 28.1% ($n = 482$) with atticointral type of CSOM. Patients with otitis externa, congenital hearing loss, Down's syndrome, craniofacial malformation, terminal and systemic illness such as septicaemia were excluded from the study.

2.2. Statistical analysis

The data obtained was coded for statistical evaluations. Appropriate statistical analysis was performed using the Statistical Package for Social Sciences, PASW STATISTICS 18.0 software (SPSS Inc., Chicago, IL, USA). Continuous data are represented as means and standard deviations whereas categorical data as proportions. The chi-square test was used to compare the proportions of categorical variables. Finally, a multinomial logistic regression analysis was used to differentiate and identify statistically significant risk factors associated with subtypes of OM.

3. Results

Out of 2602 OM patients, 58.6% ($n = 1525$) were males and 41.4% ($n = 1077$) were females. High male preponderance with male to female ratio of 1.4:1 was noticed. The mean (SD) age of OM subjects is 32.9 (17.73) years and mean (SD) age of onset is 8.3 (6.73) years in 1–15 years, 30.0 (5.61) years in 15–30 and 53.5 (9.3) years in > 30 years age group. squamous-CSOM (47.3%) was observed to be more common compared to other subtypes of OM. The prevalence of comorbidities such as sinusitis was 30%, tonsillopharyngitis 20.1%, adenoids 9.3%, hypertension 6.5%, diabetes mellitus 4.7%, allergic rhinitis 3.3%, asthma 1.8%, nasal polyps 1.5%, and hypothyroidism 0.6% in the study population.

Significant differences in demographic and clinical findings such as age of onset, sex, season, tympanic membrane perforation, presence of associated co-morbidities, type and degree of hearing loss were observed between the OM subtypes (Table 1). Males were slightly more affected in mucosal-CSOM and OME while females in case of squamous-CSOM. Prevalence of OME was observed to be lower in 16–30 years of age. With regard to seasonal variability, the occurrence of ASOM and OME was more in winter, squamous-CSOM in summer and mucosal-CSOM was commonly noticed in rainy season. The occurrence of nasal/nasopharyngeal disorders such as sinusitis (70.7%) and tonsillopharyngitis (52.2%) was found to be high in CSOM while adenoids (42.1%) increase in case of OME. The occurrence of symptoms such as tinnitus (75.7%), vertigo (80.4%) and post nasal drip (68%) was more in CSOM subjects while jugulodigastric node of > 2 cm size (48.3%) and snoring (39.4%) were found to be increasingly associated with OME (Table 2).

Multinomial logistic regression analysis revealed the significant factors which might be associated with severe forms of

Table 1 Demographic and otological findings in otitis media subtypes.

Parameters	ASOM ^a (n ^b = 457)	squamous CSOM ^a (n ^b = 1231)	mucosal CSOM ^a (n ^b = 482)	OME ^a (n ^b = 432)	Total (n ^b = 2602)	P-value ^{c,d}
<i>Sex</i>						
Male	264(17.3)	691(45.3)	303(19.9)	267(17.5)	1525(58.6)	0.034*
Female	193(17.9)	540(50.1)	179(16.6)	165(15.3)	1077(41.4)	
<i>Age of onset (years)</i>						
1–15 (Mean ± SD ^b)	144(15.5) 9.4 ± 6.10	431(46.3) 8.4 ± 7.28	180(19.3) 8.3 ± 6.71	176(18.9) 6.9 ± 5.58	931(35.8) 8.3 ± 6.73	< 0.001***
16–30 (Mean ± SD ^b)	182(19.5) 29.4 ± 5.39	473(50.4) 30.3 ± 5.65	173(18.4) 29.5 ± 5.69	110(11.7) 30.7 ± 5.80	938(36.0) 30.1 ± 5.61	
> 30 (Mean ± SD ^b)	131(17.9) 54.4 ± 10.15	327(44.6) 52.2 ± 8.54	129(17.6) 53.1 ± 9.02	146(19.9) 55.6 ± 10.00	733(28.2) 53.5 ± 9.30	
<i>Season</i>						
Winter	186(18.1)	423(41.3)	207(20.2)	209(20.4)	1025(39.4)	< 0.001***
Rainy	118(16.8)	356(50.7)	145(20.7)	83(11.8)	702(27.0)	
Summer	153(17.5)	452(51.7)	130(14.9)	140(16.0)	875(33.6)	
<i>Otoscopic findings</i>						
<i>Laterality</i>						
Unilateral	338(19.9)	870(51.3)	292(17.2)	195(45.1)	1695(65.1)	< 0.001***
Bilateral	119(13.2)	361(39.9)	190(20.9)	237(26.1)	907(34.9)	
<i>Degree of hearing loss (decibels-dB)</i>						
> 40 dB	72(9.4)	362(47.2)	195(25.4)	138(18.0)	767(29.5)	< 0.001***
< 40 dB	385(21.0)	869(47.4)	287(15.6)	294(16.0)	1835(70.5)	
<i>Types of hearing loss</i>						
Normal hearing	43(47.3)	21(23.1)	17(18.7)	10(11.0)	91(3.5)	< 0.001***
Conductive hearing loss	353(17.2)	1006(48.9)	355(17.3)	342(16.6)	2056(79.0)	
Sensorineural hearing loss	35(19.8)	64(36.2)	33(18.6)	45(25.4)	177(6.8)	
Mixed hearing loss	26(9.4)	140(50.4)	77(27.7)	35(12.6)	278(10.7)	
<i>Associated co-morbidities</i>						
Otological	205(16.5)	662(53.4)	204(16.5)	168(13.6)	1239(47.6)	< 0.001***
Otological + Nasal/ Nasopharyngeal	212(18.4)	481(41.8)	244(21.2)	214(18.6)	1151(44.2)	
Otological + Metabolic disorders	40(18.9)	88(41.5)	34(16.0)	50(23.6)	212(8.2)	

^a ASOM: Acute suppurative otitis media; CSOM: Chronic suppurative otitis media; OME: Otitis media with effusion.

^b n-frequency; Values in parenthesis are % frequency; SD-Standard deviation.

^c χ^2 -test.

^d Level of significance: *p-value < 0.05, ***p-value < 0.001.

OM. ASOM was considered as the reference category (Table 3). Tympanic membrane perforation (OR = 16.43, 95% CI = 9.93–27.19) and tinnitus (OR = 2.21, 95% CI = 1.62–3.01) were significantly associated with squamous-CSOM; bilaterality (OR = 1.52, 95% CI = 1.13–2.05), tinnitus (OR = 2.37, 95% CI = 1.68–3.32) and vertigo (OR = 1.80, 95% CI = 1.10–2.94) with mucosal-CSOM; bilaterality (OR = 2.89, 95% CI = 2.14–3.89), adenoids (OR = 4.10, 95% CI = 2.44–6.89), tinnitus (OR = 2.10, 95% CI = 1.46–3.02) and snoring (OR = 1.94, 95% CI = 1.02–3.69) with OME (Table 3).

Significant association was observed in squamous-CSOM with greater degree of mixed hearing loss (OR = 4.51, 95% CI = 2.13–9.61) and conductive hearing loss (CHL) (OR = 3.85, 95% CI = 2.17–6.82); mucosal-CSOM with greater degree of mixed hearing loss (OR = 2.55, 95% CI = 1.15–5.66); OME with greater degree of CHL

(OR = 3.49; 95% CI = 1.67–7.38), sensorineural hearing loss (SNHL) (OR = 2.56, 95% CI = 1.04–6.29) and mixed hearing loss (OR = 2.91; 95% CI = 1.13–7.49) as presented in Table 3.

4. Discussion

OM is one of the common inflammatory disorders of middle ear which has an important health concern at early life as well as in adults. The aetio-pathogenesis of OM is complex and factors such as infections or inflammatory conditions such as upper respiratory tract infections, allergic rhinitis or rhinosinusitis, adenoids, tumour or trauma are mostly responsible for its onset.^{19,20} The prevalence of OM varies widely and causes a serious burden of illness globally. However, studies on prevalence of OM are limited in Indian population. Most of the earlier reports indicated the prevalence of OM in

Table 2 Distribution of co-morbidities and symptoms in the prevalence of otitis media subtypes.

Parameters	ASOM ^a n ^b	squamous CSOM ^a n ^b	mucosal CSOM ^a n ^b	OME ^a n ^b	P-value ^{c,d}
<i>Nasal/Nasopharyngeal</i>					
Sinusitis	124(15.9)	364(46.6)	188(24.1)	105(13.4)	< 0.001***
Allergic rhinitis	12(14.0)	40(46.5)	19(22.1)	15(17.4)	0.724
Nasal polyps	6(15.8)	24(63.2)	6(15.8)	2(5.3)	0.154
Asthma	12(25.5)	17(36.2)	7(14.9)	11(23.4)	0.198
Tonsillopharyngitis	125(23.9)	180(34.4)	93(17.8)	125(23.9)	< 0.001***
Adenoids	33(13.6)	74(30.6)	33(13.6)	102(42.1)	< 0.001***
<i>Metabolic disorders</i>					
Diabetes	23(18.7)	56(45.5)	20(16.3)	24(19.5)	0.754
Hypertension	34(20.2)	66(39.3)	27(16.1)	41(24.4)	0.016*
Hypothyroidism	4(25.0)	4(25.0)	5(31.3)	3(18.8)	0.301
<i>Symptoms</i>					
Nasal discharge	52(16.8)	133(42.9)	71(22.9)	54(17.4)	0.148
Facial pain	8(27.6)	10(34.5)	10(34.5)	1(3.4)	0.02*
Post nasal drip	50(16.7)	132(44.0)	72(24.0)	46(15.3)	< 0.001***
Tinnitus	68(9.7)	376(53.7)	154(22.0)	102(14.6)	< 0.001***
Vertigo	29(13.2)	117(53.4)	59(26.9)	14(6.4)	< 0.001***
Snoring	18(16.5)	30(27.5)	18(16.5)	43(39.4)	< 0.001***
Cheek pain	5(27.8)	3(16.7)	4(22.2)	6(33.3)	0.049*
Jugular nodes	6(20.7)	5(17.2)	4(13.8)	14(48.3)	< 0.001***

^a ASOM: Acute suppurative otitis media; CSOM: chronic suppurative otitis media; OME: Otitis media with effusion.

^b n-frequency; Values in parenthesis are % frequency.

^c χ^2 -test.

^d Level of significance: *p-value < 0.05, ***p-value < 0.001.

younger age group but there is scarcity of data available in other age groups.^{4,7} In the present study, 35.8% of the subjects with OM were below 15 years.

The onset of ASOM is not only accompanied by symptoms and signs of otalgia, irritability or fever but also have a short-lived defect in the tympanic membrane.^{12,21} 82.5% of the cases with ASOM were found to have otalgia and 2.5% of these cases were observed to have tympanic membrane perforation. Any chronic defect in tympanic membrane which is accompanied by recurrent otorrhoea can lead to the onset of CSOM.^{12,21} Among the study groups, 65.8% of the cases were found to have CSOM indicating it as the most common otological disorder and 97.8% of which were found to be suffering from hearing loss. The prevalence of squamous-CSOM was more compared to mucosal-CSOM which is comparable to the results of the previous studies.^{22,23} Among the cases of high frequency hearing loss, only 43.1% of the patients having squamous-CSOM had central perforations. It was also observed that CHL and mixed type of hearing loss was found to be more significantly associated with squamous-CSOM while mixed hearing loss was more prevalent in mucosal-CSOM. The findings on the distribution pattern of hearing loss in the study showed variation from the previous studies.^{23,24} The study also revealed that sinusitis, tonsillopharyngitis, tinnitus and vertigo were the common associated co-morbidities of CSOM.

OME was found to affect children between 3 and 7 years age and accounts for 25–35% of all cases of OM.^{14,15} Previous studies have reported that adenoids were one of the most common risk factors associated with OME.²⁵ In the present study, OME was found to be present in 17.6% of the study subjects of which 19.8% were found to have SNHL of more than

40dBHL. It was also observed that 18.9% of cases were below 15 years. Adenoids (13.6%) were found to contribute significantly to OME in children.

The occurrence of OM is influenced by many factors such as ethnicity, age, sex, climate, socioeconomic status etc.²⁶ Earlier studies have reported male preponderance in OM indicating a greater amount of occupational and environmental exposures.^{27,28} However, some studies indicated female preponderance while others indicated no disparity.^{14,29} In the present study, male preponderance was high in all the subtypes except squamous-CSOM where the prevalence of females was slightly more and the observation was in agreement with the previous study.³⁰

Studies have reported that the prevalence of OM is also influenced by seasonal variations occurring at different geographic and climatic zones.^{31,32} It was observed in the present study that there is a significant association of winter season with ASOM and OME, squamous-CSOM with summer and mucosal-CSOM with rainy season. The reason for the prevalence of OM in winter could be due to increased upper respiratory tract infections that enable the prevalence of nasopharyngeal pathologies leading to middle ear infections. In case of squamous-CSOM subjects, the occurrence is seen more in summer which might be due to longer persistence of middle ear infections. Prevalence of unilateral form (65.1%) is more in all the subtypes except in case of OME where bilaterality was observed to be common. The study results are in accordance with the earlier studies carried out on laterality of OM.^{32,33}

In conclusion, the present large study emphasized OM to be affecting both children and adults. Among the subtypes,

Table 3 Risk factors associated in otitis media subtypes.

Parameters	squamous CSOM ^a OR (95% CI) ^{b,c,d}	mucosal CSOM ^a OR (95% CI) ^{b,c,d}	OME ^a OR (95% CI) ^{b,c,d}
<i>Sex</i>			
Female	1.00	1.00	1.00
Male	1.06(0.84–1.35)	1.29(0.98–1.71)	1.21(0.90–1.61)
<i>Age of onset(years)</i>			
1–15	1.13(0.82–1.58)	1.43(0.99–2.07)	0.75(0.51–1.11)
16–30	1.05(0.78–1.42)	1.08(0.76–1.54)	0.62(0.43–0.89)**
> 30	1.00	1.00	1.00
<i>Season</i>			
Winter	0.77(0.58–1.01)	1.24(0.89–1.72)	1.18(0.85–1.61)
Rainy	0.93(0.69–1.27)	1.37(0.96–1.96)	0.75(0.51–1.11)
Summer	1.00	1.00	1.00
<i>Otoscope findings</i>			
<i>Laterality</i>			
Unilateral	1.00	1.00	1.00
Bilateral	0.92(0.70–1.21)	1.52(1.13–2.05)**	2.89(2.14–3.89)***
<i>Degree of hearing loss(decibels-dB)</i>			
> 40	1.69(1.19–2.39)**	2.74(1.88–3.99)***	1.98(1.34–2.93)**
< 40	1.00	1.00	1.00
<i>Types of hearing loss</i>			
Normal hearing	1.00	1.00	1.00
Conductive hearing loss	3.85(2.17–6.82)***	1.78(0.97–3.26)	3.49(1.67–7.38)**
Sensorineural hearing loss	1.91(0.90–4.04)	0.87(0.39–1.96)	2.56(1.04–6.29)*
Mixed hearing loss	4.51(2.13–9.61)***	2.55(1.15–5.66)*	2.91(1.13–7.49)*
<i>Associated risk factors</i>			
Otological	1.00	1.00	1.00
Otological + Nasal/Nasopharyngeal	0.98(0.61–1.55)	1.28(0.76–2.17)	1.08(0.64–1.84)
Otological + Metabolic disorders	0.84(0.45–1.59)	0.80(0.38–1.67)	0.93(0.46–1.88)
<i>Nasal/Nasopharyngeal</i>			
Sinusitis	1.20(0.81–1.78)	1.46(0.93–2.27)	0.73(0.45–1.06)
Tonsillopharyngitis	0.52(0.34–0.78)**	0.56(0.37–0.89)*	0.73(0.45–1.17)
Adenoids	1.17(0.71–1.94)	0.90(0.51–1.89)	4.10(2.44–6.89)***
<i>Metabolic disorders</i>			
Hypertension	0.76(0.39–1.48)	0.78(0.36–1.71)	1.22(0.59–2.57)
<i>Symptoms</i>			
Facial pain	0.81(0.28–2.28)	1.97(0.72–5.36)	0.20(0.02–1.73)
Post nasal drip	0.87(0.59–1.29)	1.14(0.75–1.74)	1.13(0.71–1.79)
Tinnitus	2.21(1.62–3.01)***	2.37(1.68–3.32)***	2.10(1.46–3.02)***
Vertigo	1.32(0.84–2.08)	1.80(1.10–2.94)*	0.43(0.22–0.85)*
Snoring	0.79(0.41–1.52)	1.09(0.54–2.24)	1.94(1.02–3.69)*
Cheek pain	0.26(0.06–1.15)	0.66(0.17–2.61)	1.78(0.49–6.53)
Jugular nodes	0.68(0.19–2.43)	1.22(0.32–4.57)	1.60(0.52–4.88)

^a CSOM: chronic suppurative otitis media; OME- Otitis media with effusion.

^b Multinomial logistic regression analysis.

^c OR-Odds ratio; CI-confidence interval.

^d Level of significance of odds ratio: **p*-value < 0.05, ***p*-value < 0.01, ****p*-value < 0.001.

^e Reference category-ASOM-Acute suppurative otitis media.

squamous-CSOM was found to be highly prevalent in the South Indian population. Upper respiratory tract infections were found to be predominant risk factors for CSOM and adenoids for OME. OM was also found to be significantly associated with hearing loss and tinnitus severely affecting the quality of life of the patients. Since, Otitis Media is a condition of serious concern, further research on the genetic aspects may help to understand the underlying mechanisms for formulating better therapeutic and preventive strategies.

Conflict of interest

There are no conflicts of interest.

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References

1. Bluestone CD, Klein JO. Otitis media, atelectasis and eustachian tube dysfunction. In: Bluestone CD, Stool SE, Scheetz MD, eds. *Pediatric otolaryngology*. Philadelphia: Saunders; 1990:320–486.
2. Pratt-Harrington D. Galbreath technique: a manipulative treatment for otitis media revisited. *J Am Osteopath Assoc*. 2000;100:635–639.
3. Li WC, Chiu NC, Hsu CH, Lee KS, Hwang HK, Huang FY. Pathogens in the middle ear effusion of children with persistent otitis media: implications of drug resistance and complications. *J Microbiol Immunol Infect*. 2001;34:190–194.
4. Dhooge IJ. Risk factors for the development of otitis media. *Curr Allergy Asthma Rep*. 2003;3:321–325.
5. Bernstein JM. The role of IgE-mediated hypersensitivity in the development of otitis media with effusion. *Otolaryngol Clin North Am*. 1992;25:197–211.
6. Aydogan B, Kiroglu M, Altintas D, Yilmaz M, Yorgancilar E, Tuncer U. The role of food allergy in otitis media with effusion. *Otolaryngol Head Neck Surg*. 2004;130:747–750.
7. Adhikari P, Joshi S, Baral D, Kharel B. Chronic suppurative otitis media in urban private school children of Nepal. *Braz J Otorhinolaryngol*. 2009;75:669–772.
8. Klein JO. The burden of otitis media. *Vaccine*. 2000;19:S2–S8.
9. Vergison A, Dagan R, Arguedas A, et al. Otitis media and its consequences: beyond the earache. *Lancet Infect Dis*. 2010;10:195–203.
10. Senturia BH, Bluestone CD, Klein JO, Lim DJ, Paradise JL. Report of the adhoc committee on definition and classification of OM and OME. *Ann Otol Rhinol Laryngol*. 1980;89:3–4.
11. Browning GG. Condition of middle ear-classification. In: Kerr AG, ed. *Scott-Brown's otolaryngology*. London: Arnold; 2008:3396–3401.
12. Qureishi A, Lee Y, Belfield K, Birchall JP, Daniel M. Update on otitis media – prevention and treatment. *Infect Drug Resist*. 2014;7:15–24.
13. Rupa V, Jacob A, Joseph A. Chronic suppurative otitis media: prevalence and practices among rural south Indian children. *Int J Pediatr Otorhinolaryngol*. 1999;48:217–221.
14. Casselbrant ML, Brostoff LM, Cantekin EI, et al. Otitis media with effusion in preschool children. *Laryngoscope*. 1985;95:428–436.
15. Van Zon A, van der Heijden GJ, van Dongen TM, Burton MJ, Schilder AG. Antibiotics for otitis media with effusion in children. *Cochrane Database Syst Rev*. 2012, CD009163.
16. Monasta L, Ronfani L, Marchetti F, et al. Burden of disease caused by otitis media: systematic review and global estimates. *PLoS One*. 2012;7:e36226.
17. Deshmukh CT. Acute otitis media in children-treatment options. *J Postgrad Med*. 1998;44:81–84.
18. Berman S. Otitis media in developing countries. *Pediatrics*. 1995;96:126–131.
19. Lazo-Saenz JG, Galvan-Aguilera AA, Martínez-Ordaz VA, Velasco-Rodríguez VM, Nieves-Rentería A, Rincon-Castaneda C. Eustachian tube dysfunction in allergic rhinitis. *Otolaryngol Head Neck Surg*. 2005;132:626–629.
20. Yeo SG, Park DC, Eun YG, Cha CI. The role of allergic rhinitis in the development of otitis media with effusion: effect on eustachian tube function. *Am J Otolaryngol*. 2007;28:148–152.
21. Giles M, Asher I. Prevalence and natural history of otitis media with perforation in Maori school children. *J Laryngol Otol*. 1991;105:257–260.
22. Panda MK, Sreedharan S, Mann SB, Sharma SC. Prognostic factors in complicated and uncomplicated chronic otitis media. *Am J Otolaryngol*. 1996;17:391–396.
23. Chowdhury MA, Alauddin A. Comparative study between tubotympanic and atticointral type of chronic suppurative otitis media. *Bangladesh Med Res Counc Bull*. 2002;28:36–44.
24. Savic LD, Deleric DR. Facial paralysis in chronic suppurative otitis media. *Clin Otolaryngol*. 1989;14:515–517.
25. Marseglia GL, Poddighe D, Caimmi D, et al. Role of adenoids and adenoiditis in children with allergy and otitis media. *Curr Allergy Asthma Rep*. 2009;9:460–464.
26. MacIntyre EA, Chen CM, Herbarth O, et al. Early-life otitis media and incident atopic disease at school age in a birth cohort. *Pediatr Infect Dis J*. 2010;29:e96–e99.
27. Sade J, Konak S, Hinchcliffe R. *Cholesteatoma and mastoid surgery. Proceedings of 2nd international conference*. Tel-Aviv, Israel: Kugler Publications; 1982.
28. Bluestone CD, Stephenson JS, Martin LM. Ten-year review of otitis media pathogens. *Pediatr Infect Dis J*. 1992;11:S7–S11.
29. Browning GG, Gatehouse S. The prevalence of middle ear disease in the adult British population. *Clin Otolaryngol Allied Sci*. 1992;17:317–321.
30. Kumar N, Chilke D, Puttewar MP. Clinical profile of tubotympanic CSOM and its management with special reference to site and size of tympanic membrane perforation, eustachian tube function and three flap tympanoplasty. *Indian J Otolaryngol Head Neck Surg*. 2012;64:5–12.
31. Kong K, Coates HLC. Natural history, definitions, risk factors and burden of otitis media. *Med J Aust*. 2009;191:S39–S43.
32. Vartiainen E. Otitis media with effusion in children with congenital or early-onset hearing impairment. *J Otolaryngol*. 2000;29:221–223.
33. Ologe FE, Nwawolo CC. Chronic suppurative otitis media in school pupils in Nigeria. *East Afr Med J*. 2003;80:130–134.