International Journal of TROPICAL DISEASE & Health
21(4): 1-7, 2017; Article no.IJTDH.31363
ISSN: 2278–1005, NLM ID: 101632866

SCIENCEDOMAIN *international*
www.sciencedomain.org

Risk Factors of Otitis Media with Effusion among Preschool Children in Port Harcourt, Nigeria

Chibuike Nwosu[1*], O. B. da Lilly-Tariah[1] and Lucky Obukowho Onotai[1]

[1]Department of ENT Surgery, University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author CN designed the study. Authors OBLT and LOO wrote the protocol and the first draft of the manuscript. All authors did the literature search and analysis of the data in this study. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJTDH/2017/31363
Editor(s):
(1) Jorge Paredes Vieyra, Universidad Autonoma De Baja California, Campus Tijuana, Mexico.
Reviewers:
(1) P. K. Hota, NTR University of Health sciences, India.
(2) Norhafiza Mat Lazim, Universiti Sains Malaysia, Kota Bharu, Kelantan, Malaysia.
(3) Philip Rajan, Hospital Raja Permaisuri Bainun, Malaysia.
Complete Peer review History: http://www.sciencedomain.org/review-history/17953

Original Research Article

Received 2nd January 2017
Accepted 7th February 2017
Published 24th February 2017

ABSTRACT

Background: Otitis media with effusion (OME) is the commonest cause of hearing loss in children worldwide. It has a lot of host related and environmental factors that influence it's development. These factors had remained controversial from previous studies done, thus necessitating this research. The aim of this study was to determine the risk factors associated with OME among children within the age of one to six years.
Methodology: This was a cross sectional study involving 226 preschool pupils selected by multi-staged sampling technique from ten (10) day-care and nursery schools from Port Harcourt metropolis, carried out between November 2014 and June 2015. Tympanometry was done on each participant and questionnaire was used to assess the risk factors associated with OME. Data was collected and analyzed using SPSS version-20.
Results: Among the 226 pupils, OME was diagnosed in 57 (25.2%) of the pupils. The pupils with upper respiratory tract infection (URTI), nasal allergy, upper respiratory obstruction and those who

**Corresponding author: Email: onotailuckinx@yahoo.co.uk;*

were in the prenursery age group showed significant association with OME. However, on further analysis with logistic regression, only URTI and being in the prenursery age group were found to be significant predictors of OME.
Conclusion: This study had shown that URTI, nasal allergy, upper respiratory obstruction and the prenursery age group are important risk factors of OME, with URTI and the prenursery age group being predicting factors of the disease.

Keywords: Risk factors; tympanometry; otitis media with effusion; preschool children; Port Harcourt.

1. INTRODUCTION

Otitis media with effusion (OME) is a middle ear disease characterized by the presence of mucoid effusion in the middle ear without any sign or symptoms of infection [1]. The presence of fluid in the middle ear leads to impaired mobility of tympanic membrane (TM) and conductive hearing loss with resultant poor speech and language development which are very important public health problems [2,3].

Many medical and anatomical abnormalities have been noted to increase the risk of OME [4]. Children with cleft palate have been known to have a higher incidence of OME at all ages especially during the first two years of life due to poor functioning of the Eustachian tube (ET) from impaired insertion of the Tensor veli palatini muscle into the soft palate [4]. However, even if the palate is not cleft, other abnormalities of the palate and skull base like Treacher Collins syndrome, Down syndrome, Apert's syndrome can also affect the ET function [4,5]. Children with congenital or acquired immunodeficiency often have difficulty in fighting and clearing infection which makes them more susceptible to OME [4]. Adenoid hypertrophy causes mechanical peritubal obstruction of the pharyngeal end of the Eustachian tube [6,7]. It also causes decrease number of T-Helper cells which causes compromised immunological response in children, impaired adaptive immunity, leading to spread of infection to the Eustachian tube [6]. Nasal allergy causes mucosal oedema and narrowing of the ET lumen, thus leading to changes in middle ear pressure and resultant effusion [8]. Parents with low educational status and overcrowding homes are known to increase the risk to OME due to the impact of poor hygiene and increase in the susceptibility to acquiring infection [9]. Other conditions that can increase the risk of OME include recurrent upper respiratory tract infection, exposure to cigarette smoke, bottle feeding, males, increased family size, daycare attendance, familial predisposition, and winter season [4,10].

Systematic literature reviews had noted these risk factors to be controversial [11]. However, many authors had identified Eustachian tube (ET) dysfunction as the cornerstone in the pathogenesis of OME [4,12]. The tube is shorter, more horizontal, and straighter making it easier for bacteria to enter. Not only that, the tube is floppier, with a tinier opening that's easy to block. [4]. The ET has been traditionally described to provide 3 main functions: equilibration of pressure between the middle and external ears, clearance of secretions, and protection of the middle ear. Its dysfunction can be caused by any number of circumstances from anatomic blockage to inflammation secondary to allergies, upper respiratory tract infection (URTI), or trauma [3]. Young children get more colds because it takes time for the immune system to be able to recognize and ward off cold viruses. Other risk factors such as upper respiratory tract infection and allergy lead to oedema and narrowing of the ET lumen [4]. If ET dysfunction is persistent, a negative pressure develops within the middle ear from the absorption and/or diffusion of nitrogen and oxygen into the middle ear mucosal cells. This negative pressure elicits a transudate from the mucosa, leading to the eventual accumulation of a serous, essentially sterile effusion. Because the ET is dysfunctional, the effusion becomes a good medium ideal for the proliferation of bacteria and resultant acute otitis media. This classic model is somewhat incorrect, as multiple studies have revealed that the same pathogenic bacteria are present in otitis media with effusion as in acute otitis media [3,4]. Once OME has been established, the normal flat cuboidal middle ear mucosa is patchily replaced by thickened pseudo-stratified epithelium with varying degree of specialization [4].

Several studies on the risk factors of OME had been done in the developed countries, there are just a few done in Nigeria [8,9,13]. These risk factors had remained controversial thus, necessitating this research. The aim of this study was to determine the risk factors associated with

OME among children within the age of one to six years.

2. METHODOLOGY

This work was a prospective cross sectional study; It was carried out between November 2014 and march 2015 carried out among preschool children in Port Harcourt Metropolis. The study included public and private daycare and nursery school children within the ages of 1-6 years. Those excluded are children with history or features of ear diseases, tympanic membrane perforation, previous ear surgery, congenital ear deformities. The minimum sample size estimation was 226 pupils. A multi-staged sampling technique was employed: using simple random sampling, 10 schools were selected; using population proportion to size to assign number of pupils to each school; then using stratified sampling to select the pupils. Ethical clearance was given by our institution (UPTH). A complete ENT which involves otoscopy anterior rhinoscopy, examination of the mouth, throat, head and neck besides physical examination were carried out for all pupils.

We used a head mirror with a Thudichum speculum to expose the nasal cavity, which allows examination of the nasal cavity. We identified the nasal septum medially; turbinates laterally.

We checked for features of inflammation (rhinitis), position of the septum, and presence of polyps (touch to check sensitivity; it should be insensitive to touch). A foreign body, usually accompanied by an offensive unilateral discharge, may be seen inside the nose of a child.

A mirror and headlight or an endoscope instrument can be used to view the nasopharynx (the postnasal space, which contains the Eustachian tube orifices and pharyngeal recess (of Rosenmüller) and may contain adenoids or nasopharyngeal tumour), but this is not always possible during a routine examination and was not done in this study. Finally, we examined the palate. We looked for large nasal polyps and tumours arising from the soft palate.

Tympanometry was done using Auto Tymp 262 Welch Allyn, USA. Types B and C were used as indicator of OME. The risk factors were assessed using a structured questionnaire which covered information on OME: Upper respiratory tract infection, nasal allergy, upper respiratory obstruction; hypertrophied turbinates; septal deviation; family size; tobacco smoke exposure; level of education of parents/guardian. The diagnostic criteria were as follows URTI- pupils with at least 2 of the following symptoms: frequent cold/ catarrh, nasal obstruction, frequent throat pains/ refusal of food or cough [14].

Allergic rhinitis- pupils with at least 2 of the following symptoms: Paroxysmal sneezing, watery catarrh, nasal itching, nasal blockage; and at least one of the following: history of allergy, family history of allergy or positive history of asthma [15,16]. Hypertrophied turninates: This can be visualized and seen abutting on the nasal septum; septal deviation can be visualized during anterior rhinoscopy, the nasal septum will be deviated to either the right side or left. Upper respiratory obstruction- pupils with at least 2 of the following symptoms: frequent snoring, difficulty with breathing during sleep, sleep apnoea/ cessation of breath for at least 7 seconds during sleep and mouth breathing [17].

Overcrowding- when greater than or equal to 4 children sleeping in a room [9].

Exposure to Parental smoking- when either of the parents smokes at home [18].

The data was collected and analyzed using SPSS version 20. $P < 0.05$ was considered significant and confidence interval was set at 95%.

3. RESULTS

Two hundred and twenty two (226) pupils were recruited and participated in the study. There were 130 (57.5%) males and 96 (42.5%) females. OME was diagnosed in 57 (25.2%) of the pupils using both tympanometric and clinical findings. The pupils that met the diagnostic criteria of the risk factors are as shown in the Table 1, with URTI with the highest frequency (25.2%), while the least was Exposure to parental smoking (4.4 %).

As shown in Table 2, the pupils with OME among the Pre-Nursery age group (1-2 years) were 31 (33.7%). This was shown to be statistical significant. (χ^2= 5.908, df=1, p-value= 0.015, 95% C.I. = 1.149-3.879). The pupils with OME among females were 27 (28.1%) while among males were 30 (23.1%). This was not significant. (χ^2 = 0.746, p-value=0.388, df=1, 95% C.I. =0.419-1,402). The pupils with OME among

those with Upper respiratory tract infection (URTI) were 39 (68.4%). This was shown to be significant, (χ^2 =75.425, df=1, p-value=0.000, 95% C.I. =8.653-38.177). The pupils with OME among those with allergic rhinitis were 11 (64.7%). This was significant (χ^2 = 15.196, df=1, p-value= 0.000, 95% C.I.= 2.280-18.512). The pupils with OME among those with Upper respiratory obstruction were 9 (75.0%). This was shown to be significant (χ^2 =16.650, df=1, p-value=0.000, 95% C.I. =2.702-39.843). The pupils with OME among those with exposure to parental smoking were 3 (30.0%). This was not significant. (df=1, p-value=1.286, 95% C.I.=0.292-5.357). The pupils with OME among those with overcrowding (≥ 4 children sleeping in a room) were 6 (27.3%). This was not significant. (χ^2 = 0.054, df=1, p-value=0.816, 95% C.I.= 0.330-2.393). The pupils with OME among those with Low parental level of education were 5 (21.7%). This was not significant (χ^2 = 0.165, df=1, p-value=0.685, 95% C.I.= 0.285-2.281).

Following logistic regression, age category 1-2 years (pre-nursery), upper respiratory tract infections were found to be statistically significant. This is as shown in Table 3. Otoscopic findings did not reveal much in our study. Tympanic membranes of patients suspected to have OME were mostly dull and retracted.

Table 1. Frequency of selected risk factors for OME n=226

Variables	Frequency N	Percentage (%)
URTI	57	25.2
Allergic rhinitis	17	7.5
Upper respiratory obstruction	12	5.3
Exposure to parental smoking	10	4.4
Overcrowding (≥ 4 in a room)	22	9.7
Low parental educational level	23	10.2

4. DISCUSSION

This study shows that the age group 1-2 years is implicated as a risk factor for OME. In addition to other risk factors children with the age group 1-2 years are more prone to OME. This shows that the pre-nursery age group is more prone to OME, probably because of their being more susceptible to infections and perhaps, the orientation of the Eustachian tube: being wider and shorter; with reduced cartilage density when compared with older children, making it too

Table 2. Predisposing factors of OME n=226

Variable	OME N %	No OME N %	Total N	X^2	df	p-value
Age category						
Pre-Nursery (1-2 years)	31 (33.7)	61 (61.3)	92	5.908	1	0.015*****
Nursery (3-6 years)	26 (19.4)	108 (80.6)	134			
Gender						
Male	30 (23.1)	100 (76.9)	130	0.746	1	0.388
Female	27 (28.1)	69 (71.9)	96			
URTI						
Yes	39 (68.4)	18 (31.6)	57	75.425	1	0.000*****
No	18 (10.7)	151 (89.3)	169			
Allergic rhinitis						
Yes	11 (64.7)	6 (35.3)	17	15.196	1	0.000*****
No	46 (22.0)	163 (78.0)	209			
Upper respiratory obstruction						
Yes	9 (75.0)	3 (25.0)	12	16.650	1	0.000*
No	48 (22.4)	166 (77.6)	214			
Exposure to parental smoking						
Yes	3 (30.0)	7 (70.0)	10	-	1	
No	54 (25.0)	162 (75.0)	216			1.286$^+$
Overcrowding						
Yes	6 (27.3)	16 (72.7)	204	0.054	1	0.816
No	51 (25.0)	153 (75.0)	22			
Low parental level of education						
Yes	5 (21.7)	18 (78.3)	23	0.165	1	0.685
No	52 (25.6)	151(74.4)	203			

**significant, + fischers exact*

Table 3. Logistic regression of the predisposing factor of OME

Variables	Odd ratio (OR)	95% C.I. for OR		p-value
		Lower	Higher	
Age category 1-2yrs	2.894	1.280	6.540	0.011*
Gender	0.525	0.239	1.155	0.109
URTI	19.457	8.172	46.322	0.000*
Allergic rhinitis	2.273	0.594	8.700	0.231
Upper respiratory obstruction	1.192	0.224	6.350	0.837
Exposure to parental smoking	0.736	0.107	5.054	0.755
Overcrowding	0.657	0.184	2.356	0.520
Low parental level of education	0.497	0.123	2.014	0.328

**significant*

floppy and less stiffer which makes the Eustachian tube not to open properly during the contraction of the tensor veli palatini muscle [19]. In a cohort study among day-care facilities attendants in Lagos [20], there was a similar significant association between this age group and OME.

It is generally accepted that Upper respiratory tract infection (URTI) plays an important role in the pathogenesis of OME and therefore is a potential cofounder in the risk analysis [21]. The pupils with OME among those with URTI was 68.4%. This was shown to be significant ($p<0.01$). A similar observation was found among children less than 15 years of age in a rural screening in Nigeria [22]. Furthermore, a similar association was reported among American children within the ages of 2-6 years with strong significant association between OME and the presence of URTI [23].

Allergy conditions cause raised levels of eosinophils, basophils and histamine in the nasal and middle ear mucosa of young children with OME [8]. This is associated with allergic rhinitis in about 24 to 89% of cases [8]. The mediators released by the mucosa during allergic inflammation influences the mucociliary transport time; modifies the cilia function and structure; and increases the secretory activity of the mucosa cells; thus resulting into effusion of the middle ear [8]. Clinically, some patients with allergic rhinitis may have hypertrophied or engorged inferior turbinates which can cause upper airway obstruction. The result of this study have demonstrated a statistical significant association between allergic rhinitis and OME ($p<0.01$). A similar association was reported in Siena, Italy [8] among children within the ages of 5-9 years.

Also, in this study, Upper respiratory obstruction was found to be significantly associated with OME ($p<0.000$). This was comparable with the study among children with symptoms of adenoidal obstruction in Rizgari teaching hospital, Erbil which showed significant association with OME [24]. Additionally, a similar association was reported in Enugu [25] in a cohort study among adenoidal children, with a 7 fold increase in the incidence of OME which is also proportionate with the degree of nasopharyngeal obstruction.

Overcrowding homes are known to increase the risk factors to OME due to the impact of poor hygiene and increased susceptibility to acquiring infection [9]. Overcrowding (≥ 4 children sleeping in a room) in this study was found not to be significantly associated with OME. This was contrary to the study done in Ile Ife [9] that reported significant association between OME and overcrowding, using the same criteria of 4 or more children sleeping in a room and also not considering the ventilation of the rooms. It is also noted that the size and the ventilation of the room were not measured in this study.

Cigarette smoke contains over 4000 chemical agents including nicotine, carbon monoxide, ammonia, as well as hydrogen cyanide which causes local reaction, impaired mucociliary function and compromised local respiratory defense [26]. However, in this study there was no significant association between OME and Exposure to parental smoking. A similar finding was reported among Preschool children in Malaysia [27] between OME and exposure to smoke. This was also contrary to the study in Ile Ife [9] that reported significant association between OME and exposure to parental smoking.

Moreover, low parental level of education, i.e those parents that only attained primary or non-formal education did not show any significant association with OME. Report from a study done

in Lagos [13] among school entrant pupils noted a similar finding, and also showed a positive relationship between OME and high parental education. This study also noted no statistical significance between OME and gender. A similar finding was reported by Saim et al. [27] among Malaysian preschool children.

In this study, the age category 1-2 years (OR=2.894, CI= 1.280-6.540) and URTI (OR=19.457, CI=8.172-46.322) were found to be significantly associated with OME following analysis with Logistic regression. This shows that the orientation of the Eustachian tube in the younger age group (≤ 2 years) and the presence of URTI play an important role in the pathogenesis of OME. Hence, being in the Pre-nursery age group and having URTI are of higher index in predicting the occurrence of OME.

5. CONCLUSION

This study had shown that URTI, nasal allergy, upper respiratory obstruction and the pre-nursery age group are significant risk factors of OME, with URTI and the prenursery age group being significant predictors of the disease. Other factors such as gender, overcrowding at home, exposure to parental smoking and low parental level of education were not statistically significant.

6. RECOMMENDATION

There should be continuous education, advocacy and enlightenment of the population, in collaboration with the government so as to modify these risk factors to the barest minimum.

CONSENT

As per international standard, patient's written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Alho OP, Oja H, Koivu M, Sorri M. Risk factors for chronic otitis media with effusion in infancy: Each acute otitis media episode induces a high but transient risk. Arch Otolaryngol Head Neck Surg. 1995; 121:839-43.
2. Aydoğan B, Kiroğlu 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(6):747-50.
3. Bernstein JM. The role of IgE-mediated hypersensitivity in the development of otitis media with effusion. Otolaryngol Clin North Am. 1992;25:197-211.
4. Margaret AK, Adriane DL. Epidemiology of otitis media with effusion. In: Byron JB, Jonas TJ, Shawn DN, et al, eds. Head and Neck Surgery-Otolaryngology. 4th edn. New York: Williams and wilkins; 2006;1: 1297-306.
5. Austeng ME, Akre H, Overland B, Abdelnoor M, Falkenberg ES, Kvaerner KJ. Otitis media with effusion in children with Down syndrome. Int J Pediatr Otorhinolaryngol. 2013;77(8):1329-32.
6. Pleshko RI, Starokha AB, Shcherbik NV, Kologrivova EN, Lunusov Rsh, Klimov AV, et al. The morphofunctional pre-requisite for the development of exudative otitis media in children presenting with chronic adenoididtis. Vestn Otorinolaringol. 2014; 4:39-41.
7. Wright ED, Pearl AJ, Manoukian JJ. Laterally hypertrophic adenoids as a contributing factor in Otitis media. Int J Pediatr Otorhinolaryngol. 1998;45:207-14.
8. Desiderio P, Giulio CP, Maria L, Antonio R, Luisa B, Francesco MP. Nasal allergy and Otitis Media. Areal correlation? Sultan Qaboos Univ Med J. 2014;14(1):59-64.
9. Amusa YB, Ijaduola GTA, Onayade OO. Epidemiology of Otitis media in a local tropical African population. West Afr J Med. 2005;24(3):227-30.
10. Pelton SI. New concepts in the pathophysiology and management of middle ear disease in children. Drugs. 1996;52:62-7.
11. Lubianca Neto JF, Hemb L, Silva DB. Systematic literature review of modifiable risk factors for recurrent acute otitis media in childhood. J Pediatr (Rio J). 2006;82:87-96.
12. Xia Z, Wang Z, Cui L, Wei C, Liu Y, Huang F. The observational and analysis of the function and morphology of the ET in OME and chronic rhinosinusitis in children. Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi. 2014;28(13):929-31.

13. Olusanya BO, Okolo AA, Adeosun AA. Predictors of hearing loss in school entrants in a developing country. J Postgrad Med. 2004;50:173-79.
14. Johnson BR. Acute respiratory infection. In: Azubuike JC, Nkanginieme KEO, editors. Pediatrics and child health in a tropical region. 2nd edn. Owerri: African Educational Services. 2007;400-2.
15. Annesi-Maesano I, Didier A, Klossek M, Chanal I, Moreau D, Bousquet J. The score for allergic rhinitis (SFAR): A simple and valid assessment method in population studies. Allergy. 2002;57:107-114.
16. Van Hoecke H, Vastesaeger N, Dewulf L, Sys L, Van Cauwenberge P. Classification and management of allergic rhinitis patients in general practice during pollen season. Allergy. 2006;61(6):705-11.
17. Brouilette R, Hanson D, David R, Klemka L, Anna S, Fernbach S, et al. A diagnostic approach to suspected obstructive sleep apnea in children. J Pediatr. 1984;105(1): 10–14.
18. United States Department of Health and Human Services. The Health consequences of involuntary exposure to Tobacco Smoke: A report of the Surgeon General. Atlanta: United States. Department of Health and Human Services; 2006.
19. Dhingra PL. Anatomy of the ear. In: Elsevier, ed. Disease of the ear nose and throat. 4th edn. New Delhi: Gopsons. 2009; 4-8.
20. Rudolf P, Gerhard G, Heinrich I (eds.). Special anatomy and examination of the external ear. In: Basic Otorhinolaryngology. 2nd edn. Stuttgart: Georg Thieme Verlag. 2004;208-9.
21. Zielhuis GA, Heuvelmans-Heinen EW, Rach GH, Van Den Broek P. Environmental risk factors for OME in preschool children. Scandinacian Journal of Primary Health Care. 1989;7(1):33-38.
22. Miller SA, Omena JA, Bluestone CD, Torkelson DW. A point prevalence of Otitis media in a Nigerian village. Int J Pediatr Otorhinolaryngol. 1983;5(1):19-29.
23. Casselbrant ML, Brostoff LM, Flaherty MR, Bluestone CD, Cantekin EI, Doyle WJ, et al. Otitis media with effusion in preschool children. The Laryngoscope. 1985;95(4): 428-36.
24. Khayat FJ, Dabbagh LS. Incidence of otitis media with effusion in children with adenoidal hypertrophy. Zanco J Med Sci. 2011;15(2):57-63.
25. Orji FT, Okolugbo NE, Ezeanolue BC. The role of adenoidal obstruction in the pathogenesis of OME in Nigerian children. Niger J Med. 2010;19(1):62-8.
26. Sofluwe GO. Smoke pollution in dwelling of infants with bronchopneumonia. Arch Environ Health. 1968;16:670-72.
27. Saim A, Saim L, Saim S, Ruszymah BH, Sani A. Prevalence of OME among preschool children in Malaysia. Int J Pediatr Otorhinolaryngol. 1997;41(1): 21- 8.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/17953