

Prevalence of Otitis Media with Effusion among Primary School Children in Eastern Black Sea, in Turkey and the Effect of Smoking in the Development of Otitis Media with Effusion

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Abstract The aim of this study was to determine the prevalence of otitis media with effusion (OME) in primary school children in Rize (Eastern Black Sea Region) and the impact of tobacco smoke exposure in the development of OME in primary school children. This study involved a total of 2960 children who appeal for ENT examination to our department at Rize Training and Research Hospital between November 2007 and April 2009. All children were evaluated with regard to OME and exposure to cigarette smoke. Pure tone audiometry and tympanometry tests and pneumatic otoscopy were performed on the children who were diagnosed with OME by otoscopic examination. The association between the children diagnosed as OME and exposure to cigarette smoke was evaluated. The prevalence of OME in this study was 9.86% (292/2960). Exposure to cigarette smoke was a statistically significant factor in development of OME ($P < 0.0001$). Environmental factors such as smoking are important in the development of OME. To prevent delayed diagnosis or development of this disease, parents must be informed about the preventable risk factors and symptoms for the development of OME.

Keywords Otitis media with effusion · Prevalence · Smoking · Primary school children

Introduction

Otitis media with effusion (OME), which refers to the accumulation of fluid in the middle ear cavity without any signs of acute infection [1, 2] is a common health problem both in pre-school and school children. Its symptoms are insidious, the diagnosis is difficult and generally delayed [3]. OME is characterized by a high recurrence rate. The potential risks of sequel formation and complications like tympanosclerosis, retraction pockets, adhesive otitis media and hearing or speech impairment make the disease an important public health problem [4, 5]. The etiopathogenesis of OME has been discussed for many years. The most important etiologic causes are infection, inflammation and insufficient pneumatization of the middle ear. Conditions like eustachian tube dysfunction, insufficient pneumatization of the mastoid, craniofacial abnormalities, infections, immunodeficiency and allergic agents are among controversial causes of OME [2].

There are many environmental risk factors in the development of OME like smoking, poor socio-economic conditions, seasonal conditions and risk factors specific to the child like attendance to daycare centers and sex, race, properties of the eustachian tube, adenoid tissue hypertrophy, allergy, immunologic status, presence of cleft palate and mucocilliary dysfunction.

The aim of this study was to determine the prevalence of OME in primary school children in Rize and to investigate the association between OME and smoking.

Materials and Methods

The study was conducted between November 2007 and April 2009 in Rize Training and Research Hospital. This

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study involved a total of 2,960 primary school children who appeal for ENT examination. The ages of the children in the study (female: 1,272 (43%), male: 1,688 (57%)) ranged from 4 to 15 years (mean, 9.5). In addition to a routine ear, nose, and throat examination, a pure tone audiogram and a tympanogram were obtained from all children, who were prediagnosed with OME during the initial examination with otoscopy.

An air-bone gap of more than 10 dB in audiogram and type B tympanogram were used as diagnostic criteria. The exposure to cigarette smoke was questioned during examinations. Smoking exposure was classified as “mother only smoking”, “father only smoking”, “both parents smoking” or “no smoking”. Medical treatment consisting of systemic and local decongestants, antibiotics and nasal steroids for the patients with allergic findings was started. Subjects were followed for approximately 12 weeks and re-evaluated to determine the persistency of any physical finding. The children with persistent physical findings were treated with myringotomy and insertion of a ventilation tube ($n = 132$). We investigated the association between requirement for insertion of a ventilation tube and cigarette smoking. To do this, children who were diagnosed with OME were divided into two groups. The study group consisted of the children in whom myringotomy and ventilation tube were required and the control group consisted of the children who responded to the medical treatment.

Statistical analysis was carried out using SPSS (Statistical Package for Social Sciences) for Windows 10.0 and the data evaluated by the chi-square test. Statistical significance criterion was defined as $P < 0.05$.

Results

The ages of the children included in the study was ranging between 4 and 15 years and the number of the children aged from 4 to 6 years were 745 (25.1%), the number of the children aged from 7 to 9 years were 680 (22.9%), the number of the children aged from 10 to 12 years were 716 (24.1%) and the number of the children aged from 13 to 15 years were 819 (27.6%). OME was diagnosed in 292 (9.9%) out of 2,960 children. Among the 292 children with OME, 130 (44.5%) were female and 162 (55.5%) were male. Among the 292 children with OME, 132 children with persistent OME (no resolution in three months after medical treatment) required myringotomy and insertion of a ventilation tube. Among the 132 children with persistent OME, 62 were female and 70 were male. Distribution of children according to sex and age is shown in Table 1. All of the children in the study group had more than 15 db air-bone gap in audiogram and type B tympanogram.

Table 1 Distribution of 2,960 children according to sex and age

Age (year)	Boys <i>N</i> (%)	Girls <i>N</i> (%)	Total <i>N</i>
4–6	450 (60.4)	295 (39.6)	745
7–9	370 (54.4)	310 (45.6)	680
10–12	476 (16.08)	240 (8.10)	716
13–15	392 (66.5)	427 (33.5)	819
Total	1688 (57)	1272 (43)	2960

Table 2 Distribution of 2960 children according to age and diagnoses of OME

Age (year)	Diagnosis of OME		Total <i>N</i>
	Yes <i>N</i> (%)	No <i>N</i> (%)	
4–6	110 (14.7)	635 (85.3)	745
7–9	95 (13.9)	585 (86.1)	680
10–12	51 (7.1)	665 (92.9)	716
13–15	36 (4.4)	783 (95.6)	819
Total	292 (9.9)	2668 (90.1)	2960

Table 3 Distribution of 292 children with OME according to age and sex

Age (year)	Boys <i>N</i> (%)	Girls <i>N</i> (%)	Total <i>N</i>
4–6	64 (58.2)	46 (41.8)	110
7–9	51 (53.7)	44 (46.3)	95
10–12	27 (52.9)	24 (47.1)	51
13–15	20 (55.5)	16 (44.5)	36
Total	162 (55.5)	130 (44.5)	292

In our study the prevalence of OME was 9.9% (292/2960). The prevalence of the disease in children between ages 4 and 6 was 14.7% (110/745) and the prevalence in children aged between 7 and 9 years was 13.9% (95/680) (Table 2).

The fact that the most prevalent risk factors of OME such as frequent acute otitis media, history of upper respiratory tract infection and allergies, are mostly seen in children between ages 4 to 9 is able to clarify the higher prevalence of OME in this age group. But the difference between aged group was not significant ($\chi^2 = 0.58$, $P > 0.05$) (Table 3). Likewise, there was no significant differences according to sex distribution between the study and control groups ($\chi^2 = 0.31$, $P > 0.05$) (Table 4). However, there was a significant difference according to exposure to cigarette smoke between the children diagnosed with OME and children who were not ($\chi^2 = 2.64$, $P < 0.05$) (Table 5). At the same time, there was a significant difference according to smoking history of mothers/fathers between the study and control groups ($\chi^2 = 23.06$, $P < 0.0001$) (Table 6).

Table 4 Distribution of 2,960 children according to sex and OME

Gender	OME		Total
	Yes <i>N</i> (%)	No <i>N</i> (%)	
Boys	162 (9.6)	1526 (90.4)	1688
Girls	130 (10.2)	1142 (89.8)	1272
Total	292 (9.9)	2668 (90.1)	2960

Table 5 Distribution of 2,960 children according to exposure to cigarette smoke and OME

Exposure to cigarette smoke	OME		Total <i>N</i>
	Yes <i>N</i> (%)	No <i>N</i> (%)	
Mother	84 (19.3)	351 (80.7)	435
Father	64 (9.1)	635 (90.9)	699
Both	115 (25.7)	332 (74.3)	447
No smoking	29 (2.1)	1350 (97.9)	1379
Total	292 (9.9)	2668 (90.1)	2960

Table 6 Distribution of 292 children with OME according to exposure to cigarette smoke and requirement for insertion of a ventilation tube

Exposure to cigarette smoke	Requirement for insertion of a ventilation tube		
	Yes <i>N</i> (%)	No <i>N</i> (%)	Total <i>N</i>
Mother	34 (40.5)	50 (59.5)	84
Father	24 (37.5)	40 (62.5)	64
Both	70 (60.9)	45 (39.1)	115
No smoking	4 (13.8)	25 (86.2)	29
Total	132 (45.2)	160 (54.8)	292

Discussion

Otitis media with effusion is a common health problem in children less than 15 years old. If left untreated or inadequately treated, it may lead to a series of sequelae and complications, such as permanent hearing loss and hearing or speech impairment [6–8]. The etiology of OME is multifactorial. Infection and Eustachian tube (ET) dysfunction are the most widely accepted contributory factors [9, 10]. Frequent infections like common cold, mechanical obstruction or craniofacial malformations that interfere with the proper ET functioning increase susceptibility to accumulation of fluid within the middle ear cavity [4, 11].

The prevalence of OME is rather variable, ranging from 1.3 to 31.3%, depending on the methods used, population characteristics like race, countries and environmental factors [12–14]. The prevalence was reported as 9.5% for Caucasians and 5.3% for Chinese primary school children [12, 15]. In a study from Greece including 5,121 children who varied in age from 6 to 12, the prevalence of OME

was reported as 6.5% [16], while in a study from Kuwait including 893 children of similar age, it was reported as 31.3% [17]. Our prevalence rate was 9.9% in a similar age group, which was consistent with that of the Greek study but rather younger than the study from Kuwait. This may be related to climatic and environmental factors. The prevalence rates reported in other studies were as follows: 9.5% in the Netherlands (1,004 children aged from 5 to 8) [18]; 10% in Easter Island (220 children aged from 5 to 9) [19]; 13.8% in Saudi Arabia (4,124 children aged from 1 to 8) [20]; and 2.2% in Hong Kong (more than 6,000 children aged from 6 to 7) [21].

In our study, the prevalence of OME was found as 9.9%. The prevalence of the disease from age group 4 to 6 was 14.7% and 13.9% from age group 7 to 9. The reported prevalence rates of OME among primary school children in Turkish literature were as follows: 11.2% by Cuhruk et al. [22] (in 1,391 children aged from 6 to 12), 13.3% by Ozbilen et al. [23] (in 698 children aged from 6 to 12), 11.5% by Goksu [24] (in 410 children aged from 6 to 12) and 2.6% by Palandoken et al. [25] (in 2,165 children aged from 6 to 12). All the studies but the one by Palandoken et al. [25] conducted in Izmir were conducted in Ankara, the capital of Turkey. Our prevalence rates were lower than those reported by the studies conducted in Ankara.

There are also other studies reporting the prevalence of OME in younger age groups. For example, the prevalence rate was reported as 2.6% by Karasalihoglu and Sarikahya [26] (in 500 children aged from 7 to 8), 2% by Almac et al. [27] (in 1,000 children aged from 7 to 8), 12.5% by Kaya et al. [28] (in 1,628 children aged from 4 to 8) and 18.3% by Demireller [29] (in 284 children aged from 3 to 6). Besides the methods used, various climatic and environmental factors may explain the differences between these prevalence rates. In a study conducted in İstanbul/Turkey, the prevalence was reported as 8.7% and the prevalence was found to be higher (9.8%) in the age group 5 to 8 [2]. In a study conducted in Kahramanmaraş/Turkey, the overall prevalence was reported as 6.5% with a maximum prevalence of 10.4% at age group 6 to 8 [14]. Yet in another study from Turkey the prevalence was reported as 11.14% among 1,077 children aged from 5 to 12 [4]. The higher incidence in small children may be related to predisposition to infections in the first years of primary school education.

The etiopathogenesis of OME is multifactorial. There are certain individual and environmental risk factors in the development of OME including sex, socio-economic status, family history, birth and neonatal history including breastfeeding, passive smoking, recent history of hearing loss, allergies, nasal symptoms, acute tonsillitis, recurrent and recent upper respiratory tract infections, previous history of acute otitis media, effect of the season and

attendance to daycare centers. In our study, we found no association between sex and OME. There are some studies that discussed the higher prevalence in males [30, 31], but most of the publications have not shown an effect of sex on OME [32, 33].

Generally the first and the only symptom of OME is hearing loss. As most of the children suffering from OME are under the age of six, the significance of this symptom is suspicious. The insertion of a ventilation tube is the standard treatment of noncomplicated, persistent OME. By this means, middle ear aeration and resolution of the effusion is achieved and hearing loss is prevented.

Passive smoking is one of the most studied risk factors of OME. In a review study done by Blackley and Blackley, they reported that there is insufficient data to indicate a relationship between passive smoking and middle ear disease [34]. In literature there are studies that deny any association between parental smoking and OME [35, 36], however, many other studies demonstrate a clear relationship between them [37, 38]. Maw et al. noted that clearance of glue was statistically less frequent where the child's mother or where both parents smoked [39]. In their study Gultekin et al. demonstrated that smoking history of mother during pregnancy or father was not significant risk factors for the development of OME but smoking history of the mother was one of the contributing factors. They clarified their theory, by suggesting that this may be due to the close relationship between mother and child, and that children spend a longer time with their mothers [2].

In our study we evaluated exposure to cigarette smoke in terms of mother only smoking, father only smoking and both parents smoking and demonstrated that parental smoking in any way results in a higher prevalence of OME. Similarly, there was statistically significant association between requirement for insertion of a ventilation tube and exposure to cigarette smoke. The rate of requirement for insertion of a ventilation tube was found to be significantly higher in children who were exposed to cigarette smoke.

Conclusion

Our study summarizes the prevalence of OME among primary school children in Rize and exposure to cigarette smoke which is one of the environmental factors for the development of OME. We demonstrated that exposure to cigarette smoke increases risk of OME and resistance to medical treatment. The potential of OME to cause a series of sequels and complications such as tympanosclerosis, retraction pockets, adhesive otitis media and hearing or speech impairment or even permanent hearing loss makes the disease an important public health problem. To prevent delayed diagnosis or development of this disease, parents

must be informed about the preventable risk factors and symptoms for the development of OME.

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