



# Risk factors for otitis media effusion in children who have adenoid hypertrophy



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## ABSTRACT

**Objective:** Many studies have shown that children with adenoid hypertrophy (AH) are more likely to have chronic otitis media with effusion (COME). However, not every child with AH has COME. In this study, we investigated the socio-demographic risk factors of children who underwent surgery for AH, including a subgroup with COME. Our aim was to identify the factors involved in the development of COME.

**Methods:** The study population consisted of 170 pediatric patients (118 males, 52 females) who underwent adenoidectomy between 2005 and 2008. The patients were divided into two groups, those with AH alone and those with AH and COME (AH + COME). Major factors such as age, gender, breast-milk feeding, bottle-feeding, tobacco smoke exposure, familial predisposition, allergies, congenital diseases, and school attendance were compared between the two groups.

**Results:** AH alone was detected in 102 of the patients, 68% of whom were male, and AH + COME in the remaining 68, of whom 72% were male. The mean age was 6.5 years in the AH group and 5.3 years in the AH + COME group. There were no significant differences between the two groups with respect to breast-feeding, bottle-feeding, familial predisposition, tobacco exposure, and allergies. However, the relationships between COME and male sex, congenital diseases, and school attendance were significant.

**Conclusions:** COME is seen in young children with AH. Among the socio-demographic features examined in this study, only male sex, congenital diseases, and school attendance were statistically significant risk factors for COME development.

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## 1. Introduction

Otitis media with effusion (OME) is defined as a serous or mucous accumulation of fluid in the middle ear without signs and symptoms of acute ear infection [1]. It occurs as a response to chronic inflammation in the middle ear and is characterized by the persistence of effusion [2]. When there is no response to medical treatment, a tympanostomy tube is implanted. Failure to treat OME can result in hearing loss, speech delay, and persistent middle ear damage [1,3,4].

The etiology of OME is multi-factorial but immature function of the immune system and dysfunction of the Eustachian tube are the

most important etiologic factors. Upper airway infections, bacterial and viral middle ear infections, nasal inflammation following allergic rhinitis, adenoid vegetations causing mechanical obstruction in the nasopharynx, and craniofacial abnormalities also play role in the etiology of this pediatric disease [5–7].

Many risk factors have been identified in patients with chronic OME (COME), with the most prominently cited being allergic predisposition, tobacco smoke exposure, and day-care attendance [8]. The aim of this study was to determine the most important risk factors in the development of COME in children who have adenoid hypertrophy.

## 2. Materials and methods

This study was conducted in the Department of Otolaryngology of Kocaeli University (Turkey) between 2005 and 2008. The

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170 pediatric patients enrolled in the study had complaints of snoring and sleep apnea. AH with 75–100% obstruction of the choanae was diagnosed by flexible nasopharyngoscopy at our clinic. The age range of the 118 males and 52 females was 2–14 years. The patients were divided into two groups: those with AH only and those with AH and COME (AH + COME). The patients were chosen as follows: all patients diagnosed with COME received optimal medical therapy, consisting of acid 60–90 mg amoxicillin-clavulanic acid/kg daily for 10 days, 2 or 3 sprays of a 0.05% oxymetazoline hydrochloride nasal solution in each nostril every 10–12 h for 3 days, 1-mg pseudoephedrine hydrochloride/kg daily for 5 days, and 20–40 mg ibuprofen/kg daily for 5 days. Patients were evaluated by tympanogram after treatment. Those with continuing OME after three normally curative treatments were candidates for myringotomy. Among this group, patients who still had effusion after myringotomy were assigned to the AH + COME group and patients without effusion to the AH group. The families of both groups responded to a questionnaire on the age, sex, breast-feeding history, bottle-feeding history, tobacco smoke exposure, familial predisposition, allergies, congenital disease and school attendance of their children. The data were analyzed using the Mann–Whitney *U*-test and the  $\chi^2$  test.

### 3. Results

The study population consisted of 118 male (69%) and 52 female (31%) pediatric patients between the ages of 2 and 14 (mean age of 6 years).

The AH group consisted of 102 patients (60%) and the AH + COME group of 68 patients (40%), with mean ages 6.5 and 5.3 years, respectively. The median age was 5 years in the AH group, while in the AH + COME group two peaks, at 3 and 5 years, were detected.

Males significantly predominated in the AH (69/102, 68%) group and in the AH + COME group (49/68, 72%) ( $p = 0.001$ ) but the gender difference between the two groups was not significant. There was no statistically significant difference in adenoid size between the AH group and the AH + COME group ( $p = 0.298$ ).

Breast-fed children were defined as those who had received breast milk for at least 6 months after birth. Despite a slightly lower history of breast-feeding in the AH + COME group, the difference compared to the AH group was not statistically significant ( $p = 0.46$ ).

Another factor often implicated in OME is bottle-feeding during infancy. However, there was no statistically significant difference between the AH and AH + COME regarding duration or history of bottle-feeding ( $p = 0.26$ ).

Exposure to tobacco smoke, family history of otitis media, and allergy were also assessed, with similar results obtained for the two groups.

In the AH + COME group, mental retardation was reported in two patients, ventricular septal defect in two patients, situs inversus totalis in one patient, epilepsy in one patient, cryptorchidism in one patient, congenital hip dislocation in one patient, Down's syndrome in one patient, glucose-6-phosphate dehydrogenase deficiency in one patient, and IgA deficiency in one patient. In the AH group, laryngomalacia was reported in one patient, hydronephrosis in one patient, bicuspid aortic atresia in one patient, Down's syndrome in one patient, and autism in one patient. Congenital disease in the AH + COME group was significantly higher than in the AH group ( $p = 0.014$ ).

School attendance was found to be significantly related to OME ( $p = 0.02$ ), but there was no statistically significant difference with respect to school type, whether daycare, preschool, or primary school. The decrease in the incidence of COME in patients enrolled in middle school was significant.

The risk factors defined in the text above are showed in Table 1.

### 4. Discussion

COME is an important disease affecting the quality of children's lives. It is often seen in younger age groups, although the reported prevalence depends on the reporting method used and/or the geographic region [9]. In a study from Turkey, the prevalence of COME in primary-school children was 7.6% [10].

In recent studies, AH as shown to be a significant risk factor for COME. However, since every child with AH does not have COME, additional risk factors must play a role, several of which have been examined in previous studies, as discussed below in the context of our findings.

#### 4.1. Age

Age is thought to be the most important factor in the development of COME. Zielhuis et al. [11] suggested that the disease has two peaks, at 2 and 5 years. In our study, COME peaked in children ages 3 and 5 years. Other studies determined a single peak at 5–6 years of age, but they may have been based on older patients such that an additional, earlier peak was not detected [5,10,12].

#### 4.2. Gender

As in other studies [12,13], the majority of patients in both the AH and the AH + COME groups were male. However, there are also reports showing that otitis media predominantly affects females, or those cultural factors and other infectious diseases, rather than gender, are a risk factor for OME [14].

#### 4.3. Breast-feeding

Breast-feeding is considered to protect newborns from various diseases, including lower respiratory tract infections, non-specific

**Table 1**  
Results of analysis on studied factors.

|                                   | AH<br><i>n</i> = 102 (60%) | AH + COME<br><i>n</i> = 68 (40%) | <i>p</i> -value |
|-----------------------------------|----------------------------|----------------------------------|-----------------|
| Gender                            |                            |                                  | <0.001          |
| Male                              | 69 (68%)                   | 49 (72%)                         |                 |
| Female                            | 33 (32%)                   | 19 (28%)                         |                 |
| Age (median)                      | 6 (5)                      | 5 (3)                            |                 |
| Breastfeeding (at least 6 months) |                            |                                  | 0.46            |
| Yes                               | 92 (90%)                   | 58 (93%)                         |                 |
| No                                | 10 (10%)                   | 10 (7%)                          |                 |
| Bottle feeding                    |                            |                                  | 0.26            |
| Yes                               | 48 (47%)                   | 38 (55%)                         |                 |
| No                                | 54 (53%)                   | 30 (45%)                         |                 |
| Tobacco smoke exposure            |                            |                                  | 0.94            |
| Yes                               | 47(46%)                    | 28 (41%)                         |                 |
| No                                | 55(54%)                    | 40 (59%)                         |                 |
| Familial predisposition           |                            |                                  | 0.45            |
| Yes                               | 29 (28%)                   | 23 (33%)                         |                 |
| No                                | 73 (72%)                   | 45(67%)                          |                 |
| Allergy and atopy                 |                            |                                  | 0.45            |
| Yes                               | 23 (27%)                   | 12 (17%)                         |                 |
| No                                | 79 (73%)                   | 56 (83%)                         |                 |
| Congenital disease                |                            |                                  | 0.014           |
| Yes                               | 5 (5%)                     | 11 (16%)                         |                 |
| No                                | 97 (95%)                   | 57 (84%)                         |                 |
| School attendance                 |                            |                                  | 0.02            |
| Yes                               | 57 (55%)                   | 36 (52%)                         |                 |
| No                                | 45 (45%)                   | 32 (48%)                         |                 |

gastroenteritis, acute otitis media, atopic dermatitis, asthma (young children), obesity, types 1 and 2 diabetes, childhood leukemia, sudden infant death syndrome, and necrotizing enterocolitis [15]. Although some studies [12,15], found that longer breast-feeding was associated with a lower risk of OME, in our study and in others [9,16–18] there was no relationship between breast-feeding and OME. However, Caylan et al. [15] showed that there was a significant difference in OME development depending on the duration of breast-feeding.

#### 4.4. Bottle-feeding

Some studies have identified bottle-feeding as a risk factor for OME [13]. The high risk was attributed to the negative pressure on the middle ear that develops while the infant is sucking on a bottle nipple, which facilitates the passage of microorganisms into the nasopharynx into the middle ear, thereby causing infection and inflammation. However, negative pressure also develops in breast-feeding babies. The absence of a relationship between bottle-feeding and a higher risk of COME development determined in our study was therefore unsurprising, although breast milk is certainly superior to bottle formula in terms of disease protection.

#### 4.5. Tobacco smoke exposure

In some studies, the indoor environment, specifically, parental smoking, was associated with OME [12,19]. This association was not confirmed in our study, as there was no evidence for a relationship between tobacco smoke exposure and OME, in agreement with other reports in the literature [9,14,16,20,21]. However, there is evidence that tobacco smoke exposure is a risk factor for OME only in association with atopy [5,22].

#### 4.6. Family history of otitis media

In our study, there was no correlation of OME and a family history of the disease, as also reported in some [16,17,23], but not all [1], studies. An association between OME and a larger number of siblings living in the same house was described in two studies [17,18]. However, this points to an association between OME and environmental factors and infection rather than to a genetic predisposition.

#### 4.7. Allergy and atopy

Although a history of atopy was slightly more frequent in the AH group than in the AH + COME group, the difference was not statistically significant. It is not clear whether, by increasing AH, atopy directly or indirectly causes OME. However, atopy in combination with other factors, such as exposure to tobacco smoke or breast-milk deprivation, seems to be a risk factor for OME [9], as shown by Caffarelli et al. [24] and Apostolopoulos et al. [12]; but again, there are several reports with contradictory findings [14,18,23,25–28].

#### 4.8. Congenital diseases

In our study, the presence of a congenital disease was a significant risk factor for OME. Previous studies identified cleft palate and Down's syndrome as important risk factors [29]. However, our patients also had other congenital diseases (ventricular septal defect, situs inversus totalis, epilepsy, congenital hip dislocation, mental retardation), which seemed to be significant risk factors for OME.

#### 4.9. School attendance

Our results showed that school attendance was significantly related to OME. In a previous study, children attending daycare were twice as likely to have OME as those who did not [29]. We found a higher frequency of OME in children in kindergarten, pre-primary school, or primary school but a significant decline in the incidence of the disease among children in secondary school. This result suggests that when a young child first encounters the causative microorganisms he or she is unable to generate an immune response. When the child, now slightly older, is exposed again to those microorganisms his or her immune system is able to mount a response.

#### 4.10. Adenoid size

Patients whose AH obstructed the choanae by 75–100%, as determined on flexible nasopharyngoscopy, were included in our study. There was no statistically significant difference in COME prevalence between patients with 75% vs. 100% obstruction. However since we did not enroll patients with 25–50% obstruction, a relationship between adenoid size and COME could not be determined.

In summary, male sex, congenital diseases, and school attendance were identified as risk factors for OME in patients with AH whereas atopy, exposure to tobacco smoke, family history of otitis media, breast-feeding, and bottle-feeding were not. The findings of many of the previous studies were based on an otoscopic view and tympanometric algorithm. However, in our study, patients with OME received optimal medical therapy and only those without improvement were diagnosed as having COME, confirmed by the gold standard tympanotomy.

### 5. Conclusions

In the pathogenesis of COME, epidemiological, familial, and environmental factors all seem to play a role, and very few can be markedly altered to prevent or even ameliorate the disease. However, there is still a need for the early identification of high-risk patients, who should be referred to an otolaryngologist for early treatment. Our study points out that not only children with craniofacial anomalies and Down's syndrome but also those with several other congenital diseases are at risk of developing COME. In children with AH + COME who attend secondary school, a mitigation of the disease can be expected. In the care of a child with COME, the expertise of the family physician, pediatrician, and ear, nose, and throat specialist plays an important role.

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