Published in final edited form as:
Sleep Med. 2008 July ; 9(5): 549–554. doi:10.1016/j.sleep.2007.08.002.

Prevalence of Recurrent Otitis Media in Habitually Snoring School-Aged Children

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Abstract

Introduction—The pathophysiology of obstructive sleep apnea (OSA) and recurrent otitis media (ROM) is intimately associated with the presence of adenotonsillar hypertrophy in children. However, it remains unclear whether habitually snoring children have a higher prevalence of ROM and whether they require tympanostomy tube placement more frequently.

Methods—Questionnaires collected from parental surveys of 5–7–year-old children attending the public schools in Louisville, KY were retrospectively reviewed for the presence of habitual snoring (HS), ROM, and the need for tympanostomy tube insertion.

Results—There were 16,321 surveys with complete datasets (51.2% boys; 18.6% African American (AA) with a mean age of 6.2±0.7 years). Of these children, 1,844 (11.3 %) were HS (53% boys; 25.9% AA); and, of these, 827 HS had also a positive history of ROM (44.8%) with a slight predominance in males (55%). In addition, 636 of these children underwent placement of tympanostomy tubes (i.e., 34.4% of all HS and 76.9% of ROM). Among the 14,477 non-snoring children (NS), ROM was reported in 4,247 NS children (29.3%; $p<0.000001$; odds ratio [OR]: 1.95; confidence interval [CI]: 1.77–2.16) of which 57.6% were boys, and 1,969 NS with ROM underwent tympanostomy tube placement (i.e., 46.3% of those with ROM and 13.6% of all non-snoring children). Thus, the risk for tympanostomy tube placement was also greater among HS compared to NS children ($p<0.00001$; OR: 2.19; CI: 1.98–2.43).

Conclusions—Habitual snoring is associated with a significant increase in the prevalence of recurrent otitis media and the need for tympanostomy tube placement. Further studies aiming to assess the prevalence of obstructive sleep apnea among children with ROM are needed.

Introduction

Recurrent otitis media (ROM) is a frequent condition in children, which may affect up to 40% of all young children during the first few years of life (1–5). ROM susceptibility is clearly multifactorial, and includes genetic, environmental (e.g., passive cigarette smoking and allergies), microbial, and other host-related factors (e.g., breast feeding), with delayed language

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development and learning difficulties as possible long-term sequelae of ROM (2,6–8). Enlarged lymphadenoid tissues within the nasopharyngeal passages are clearly involved in the initiation and perpetuation of ROM, such that surgical removal of the enlarged adenoids is consistently employed to prevent disease recurrences (9,10).

Habitual snoring (HS), defined as the presence of loud snoring at least three times per week, is a highly prevalent condition affecting up to 27% of young children (11–14). HS is epidemiologically linked to many of the same risk factors that have been identified for ROM. Furthermore, HS is pathophysiologically determined by the size of upper airway lymphadenoid tissue size (15). The close analogy between HS and ROM from the epidemiological and pathophysiological standpoints prompted us to hypothesize that the two conditions may be related. We, therefore, assessed the frequency of ROM and the need for tympanostomy tube placement among snoring and non-snoring school-aged community children.

Methods

Survey Questionnaire

The study was approved by the University of Louisville Human Research Committee and the Jefferson County Public Schools (JCPS) Board. A previously validated sleep questionnaire was used (16,17). Parents of all children 5–7 years of age enrolling in the JCPS system were invited to complete a detailed questionnaire about the sleeping habits of their children. The information gathered from the questionnaire included gender, age, ethnic background, current or past history of episodes of acute otitis media (OM), insertion of tympanostomy tubes, tonsillectomy and adenoidectomy, atopic diseases (asthma, eczema, hay fever, and food allergy), and passive exposure to cigarette smoke in the household. In addition, questions about whether the child had difficulty breathing during sleep, mouth breathing, witnessed apnea, daytime sleepiness, snoring and, if so, the severity of the snoring were also included. The responses were graded as “never”, “rarely” (once per week), “occasionally” (twice per week), “frequently” (3–4 times per week) and “almost always” (>4 times per week). Returned questionnaires were scanned into a computerized database and were subdivided according to their snoring patterns into non-snoring (NS) children (responses of never or rarely on snore and not applicable on loudness of snore in questionnaire) or habitually snoring (HS) children (responses of almost always [>4 nights/week] or always on snoring frequency and medium loud to loud on loudness of snoring). Subjects were excluded if they had any known genetic or craniofacial syndromes.

Data Analysis

ROM and tympanostomy tube insertion were the main outcome variables, and HS was the independent variable of interest. Comparison of habitual snorers with non-habitual snorers for continuous variables was conducted using Student’s *t*-tests and for categorical characteristics using the chi-square test (Yates’ correction). The odds ratios and corresponding 95% confidence intervals for ROM and tympanostomy tubes in children with versus without habitual snoring were calculated using univariate logistic regression analysis. Multiple logistic regression analysis was then done to adjust the odds ratio for age, gender, ethnicity, exposure to cigarette smoke (at least one parent smoking), asthma (history of repeated wheezing requiring bronchodilator administration), atopic disease (seasonal symptoms associated with nasal discharge, eczema o other skin rashes, ocular symptoms), and chronic nasal obstruction (mouth breathing and persistent nasal congestion or discharge). A commercially available statistical software package was used for all analyses (Statistical Package for Social Sciences, version 11.5; SPPS Inc., Chicago, Ill.). A p value <0.05 was considered statistically significant.

Results

During the years 1999 to 2004, a total of 48,376 questionnaires were mailed and 16,321 surveys with complete datasets were returned. In addition, 1,422 questionnaires were returned but had data missing regarding either otitis media or tympanostomy tubes. An additional 349 questionnaires were returned with a signed statement that the parents refused to participate in the survey, and 498 questionnaires were returned due to wrong address. Finally, 262 questionnaires were excluded due to the presence of known genetic or craniofacial syndromes. Thus, the overall response rate was 38.9%.

Among the valid surveys, mean age was 6.2±0.7 years, 51.2% were boys, and 18.6% African American (AA). A total of 1,844 of these children (11.3 %) were reported as having HS, and their reported demographic and sleep characteristics are shown in Table 1, as well as those of children who did not habitually snore. Multiple respiratory and sleep symptoms, as well as passive exposure to cigarette smoke were associated with an increased risk for HS (Table 1). Of the 1,844 children with HS, 827 HS had also a positive history of ROM (44.8%), with a slight predominance in males (55%), compared to ROM being reported in 4,247 non-snoring (NS) children (57.6% boys) out of the 14,477 NS children (29.3%; $p<0.000001$; OR: 1.96; CI: 1.77–2.16). Table 2 shows adjusted univariate odds ratios for ROM in relation to some of the more prominent risk factors for habitual snoring. A total of 636 of HS children underwent placement of tympanostomy tubes (i.e., 34.4% of all HS and 76.9% of ROM; Table 3), while 1,969 NS with ROM underwent tympanostomy tube placement (i.e., 46.3% of those with ROM and 13.6% of all non-snoring children). Thus, the risk for tympanostomy tube placement was also greater among HS compared to NS children ($p<0.00001$; OR: 2.19; CI: 1.98–2.43).

When the odds ratio for ROM and the need for tympanostomy tube placement were adjusted for age, sex, ethnicity, chronic nasal obstruction, allergies, and exposure to cigarette smoke in the household, using multivariate analysis, the associations between ROM and habitual snoring (p value <0.0000001, OR 1.54, 95% CI 1.32 to 2.14), and between tympanostomy tube placement and HS (p value <0.0000001, OR 1.77, 95% CI 1.52 to 2.27), remained highly significant.

Discussion

Frequent and loud snoring is the most common clinical manifestation of sleep-disordered breathing in children and in most cases reflects the presence of enlarged adenotonsillar tissues within the upper airway. In the present investigation, significant associations between ROM and tympanostomy tube placement and habitual snoring in childhood were identified, even after correction for other potential confounders in the multivariate analysis. To our knowledge, this is the first population-based study assessing the possible correlation between these variables, and it, furthermore, represents the first attempt to examine the effect of other potential confounders, such as ethnicity, chronic nasal obstruction, allergies, and exposure to cigarette smoke in the household. The overall response rate to the mailed questionnaires was good for a survey of the general pediatric population. We, therefore, believe that the findings are valid for the cohort and essentially provide a very large community survey of sleep-associated snoring in a metropolitan community of children in the United States. Nevertheless, since we can not exclude with certainty the presence of response bias, and since the latter cannot simply be inferred from the relative proportion of non-responders, some degree of caution should be exercised in the extrapolation and generalizability of our findings to other pediatric populations. Of note, the frequency of habitual snoring was 11.3%, which is remarkably similar to our previous report on nearly 6,000 children (13), and essentially reflects the median values found among multiple epidemiological surveys around the world (11,12,14;18–22). As previously reported, we found that passive exposure to cigarette smoke increased the risk for

habitual snoring and that African American children were at higher risk for habitual snoring (13,21,23). While we cannot infer the exact mechanisms underlying the increased prevalence of snoring in the context of exposure to cigarette smoke in the household, the epidemiologic association, however, is strongly supported through the various studies (24–26) and would suggest that passive exposure to cigarette smoke may act as an airway irritant and promote mucosal inflammation, thereby leading to accelerated proliferation of lymphadenoid tissues in the upper airway along with nasal congestion and obstruction symptoms. Thus, this study has allowed for either identification or confirmation of several ethnic and environmental risk factors for snoring during childhood in the United States. Furthermore, we now confirm in a large-scale study previously reported associations between habitual snoring and sleep-disordered breathing, and the presence of chronic nasal obstruction, atopic disease (27,28), and asthma (29).

The prevalence of ROM has been estimated at 34.8% to 41.1% in a recent large survey in the United States involving 8,261 children aged less than six years (5). Our current findings of a prevalence of 31% are certainly within the anticipated frequencies of ROM in the general population. Since the reliability of parental reporting of ROM appears to be relatively high, and inconsistencies in reporting are likely to be associated with less severe disease (30), it is possible that the somewhat lower prevalence found in our survey may reflect recall biases towards more severe ROM in slightly older children. Risk factors previously identified for ROM included the presence of allergic conditions, child care use, early breastfeeding termination, asthma, passive cigarette smoke exposure, and limited access to healthcare (5, 31–34). While we did not specifically examine the impact of socioeconomic status, child healthcare, and breastfeeding duration, our findings strongly support robust associations between passive cigarette smoke exposure, asthma, allergic rhinitis, and atopic conditions and the risk for ROM and tympanostomy tube placement in childhood. The relative contributions of such factors could reside in their known effects on mucus production, mucociliary clearance, and systemic and local immunity responses (34–39). Notwithstanding such considerations, the risk for ROM also appears to be related to the presence of enlarged adenoid tissues, since habitual snoring emerged as an important risk factor in the present study, and especially considering that adenoidectomy at the time of first tympanostomy tube insertion appears to reduce the likelihood of subsequent morbidity associated with ROM (9).

African American children were more likely to snore but less likely to suffer from ROM or to require placement of tympanostomy tubes. While the increased prevalence of snoring has been previously noted for this ethnic group (13,19), the reduced frequency of ROM despite increased prevalence of snoring in African American children may reflect some of the different mechanisms underlying snoring, with potentially greater contributions from craniofacial and neuromuscular factors, rather than adenotonsillar hypertrophy (15). Alternatively, disparities in access to healthcare leading to reduced diagnostic and treatment rates could be operational as well (40).

The increased frequencies of ROM and tympanostomy tube placement among HS children remained highly significant after adjustment for other known significant risk factors, suggesting that operational causative mechanisms underlying HS and ROM may be shared in a proportion of such children. Among those mechanisms, increased proliferation of lymphadenoid tissues in the upper airways appears to be the most logical process, considering the prominent role of enlarged adenoids in increased upper airway resistance as well as in the pathophysiology of eustachian tube dysfunction. Based on our findings, it could be important to screen for HS among all children with ROM, particularly when considering the neurobehavioral implications of HS and ROM (2,41–44).

In summary, we have shown that ROM and the need for tympanostomy tube placement are increasingly prevalent among school-aged children who report frequent and loud snoring during sleep, even when other known risk factors such as atopy, asthma, chronic rhinitis, and passive exposure to cigarette smoke are taken into consideration. Future studies aiming to assess the prevalence and outcomes of sleep-disordered breathing among children with ROM appear, therefore, justified.

Acknowledgements

This study was supported by NIH grant HL-65270, The Children's Foundation Endowment for Sleep Research, and by the Commonwealth of Kentucky Challenge for Excellence Trust Fund.

References

1. Teele DW, Klein JO, Rosner B. Epidemiology of otitis media during the first seven years of life in Children in greater Boston: a prospective, cohort study. J Infect Dis 1989;160:83–94. [PubMed: 2732519]
2. Teele DW, Klein JO, Chase C, Menyuk P, Rosner BA. Greater Boston Otitis Media Study Group. Otitis media in infancy and intellectual ability, school achievement, speech, and language at age 7 years. J Infect Dis 1990;162:685–694. [PubMed: 2387994]
3. Lanphear BP, Byrd RS, Auinger P, Hall CB. Increasing prevalence of recurrent otitis media among children in the United States. Pediatrics 1997;99(3):E1. [PubMed: 9099766]
4. Daly KA, Giebink GS. Clinical epidemiology of otitis media. Pediatr Infect Dis J 2000;19:S31–S36. [PubMed: 10821470]
5. Auinger P, Lanphear BP, Kalkwarf HJ, Mansour ME. Trends in otitis media among children in the United States. Pediatrics 2003;112:514–520. [PubMed: 12949276]
6. Ey JL, Holberg CJ, Aldous MB, Wright AL, Martinez FD, Taussig LM. Passive smoke exposure and otitis media in the first year of life. Pediatrics 1995;95:670–677. [PubMed: 7724301]
7. Duncan B, Ey J, Holberg CJ, Wright AL, Martinez FD, Taussig LM. Exclusive breast-feeding for at least 4 months protects against otitis media. Pediatrics 1993;91:867–872. [PubMed: 8474804]
8. Tainio VM, Savilahti E, Salmenpera L, Arjomaa P, Siimes MA, Perheentupa J. Risk factors for infantile recurrent otitis media: atopy but not type of feeding. Pediatr Res 1988;23:509–512. [PubMed: 3387173]
9. Coyte PC, Croxford R, McIsaac W, Feldman W, Friedberg J. The role of adjuvant adenoidectomy and tonsillectomy in the outcome of the insertion of tympanostomy tubes. N Engl J Med 2001;344:1188–1195. [PubMed: 11309633]
10. Mattila PS. Adenoidectomy and tympanostomy tubes in the management of otitis media. Curr Allergy Asthma Rep 2006;6:321–326. [PubMed: 16822386]
11. Hulcrantz E, Lofstarnd TB, Ahlquist RJ. The epidemiology of sleep related breathing disorders in children. Int J Pediatr Otorhinolaryngol 1995;6:S63–S66.
12. Ferreira AM, Clemente V, Gozal D, Gomes A, Pissarra C, César H, Coelho I, Silva CF, Azevedo MHP. Snoring in Portuguese primary school children. Pediatrics 2000;106(5):e64. [PubMed: 11061801]
13. O'Brien LM, Holbrook CR, Mervis CB, Klaus CJ, Bruner J, Raffield TJ, Rutherford J, Mehl RC, Wang M, Tuell A, Hume BC, Gozal D. Sleep and neurobehavioral characteristics in 5–7-year-old hyperactive children. Pediatrics 2003;111:554–563. [PubMed: 12612236]
14. Urschitz MS, Guenther A, Eitner S, Urschitz-Duprat PM, Schlaud M, Ipsiroglu OS, Poets CF. Risk factors and natural history of habitual snoring. Chest 2004;126:790–800. [PubMed: 15364758]
15. Arens R, Marcus CL. Pathophysiology of upper airway obstruction: a developmental perspective. Sleep 2004;27:997–1019. [PubMed: 15453561]
16. Gozal D. Sleep-disordered breathing and school performance in children. Pediatrics 1998;102:616–620. [PubMed: 9738185]

17. Montgomery-Downs HE, O'Brien LM, Holbrook CR, Gozal D. Snoring and sleep-disordered breathing in young children: subjective and objective correlates. Sleep 2004;27:87–94. [PubMed: 14998242]

18. Castronovo V, Zucconi M, Nosetti L, et al. Prevalence of habitual snoring and sleep-disordered breathing in preschoolaged children in an Italian community. J Pediatr 2003;142:377–382. [PubMed: 12712054]

19. Rosen CL, Larkin EK, Kirchner HL, Emancipator JL, Bivins SF, Surovec SA, Martin RJ, Redline S. Prevalence and risk factors for sleep-disordered breathing in 8- to 11-year-old children: association with race and prematurity. J Pediatr 2003;142:383–389. [PubMed: 12712055]

20. Kaditis AG, Finder J, Alexopoulos EI, Starantzis K, Tanou K, Gampeta S, Agorogiannis E, Christodoulou S, Pantazidou A, Gourgoulianis K, Molyvdas PA. Sleep-disordered breathing in 3,680 Greek children. Pediatr Pulmonol 2004;37:499–509. [PubMed: 15114550]

21. Corbo GM, Fuciarelli F, Foresi A, De Benedetto F. Snoring in children: association with respiratory symptoms and passive smoking. BMJ 1989;299:1491–1494. [PubMed: 2514859]

22. Ersu R, Arman AR, Save D, Karadag B, Karakoc F, Berkem M, Dagli E. Prevalence of snoring and symptoms of sleep-disordered breathing in primary school children in Istanbul. Chest 2004;126:19–24. [PubMed: 15249437]

23. Forastiere F, Corbo GM, Michelozzi P, et al. Effects of environment and passive smoking on the respiratory health of children. Int J Epidemiol 1992;21:66–73. [PubMed: 1544761]

24. Zhang G, Spickett J, Rumchev K, Lee AH, Stick S. Snoring in primary school children and domestic environment: a Perth school based study. Respir Res 2004;5:19. [PubMed: 15527500]

25. Urschitz MS, Guenther A, Eitner S, Urschitz-Duprat PM, Schlaud M, Ipsiroglu OS, Poets CF. Risk factors and natural history of habitual snoring. Chest 2004;126:790–800. [PubMed: 15364758]

26. Forastiere F, Corbo GM, Michelozzi P, Pistelli R, Agabiti N, Brancato G, Ciappi G, Perucci CA. Effects of environment and passive smoking on the respiratory health of children. Int J Epidemiol 1992;21:66–73. [PubMed: 1544761]

27. McColley SA, Carroll JL, Curtis S, Loughlin GM, Sampson HA. High prevalence of allergic sensitization in children with habitual snoring and obstructive sleep apnea. Chest 1997;111:170–173. [PubMed: 8996012]

28. Chng SY, Goh DY, Wang XS, Tan TN, Ong NB. Snoring and atopic disease: a strong association. Pediatr Pulmonol 2004;38:210–216. [PubMed: 15274099]

29. Sulit LG, Storfer-Isser A, Rosen CL, Kirchner HL, Redline S. Associations of obesity, sleep-disordered breathing, and wheezing in children. Am J Respir Crit Care Med 2005;171:659–664. [PubMed: 15591475]

30. Kvestad E, Kvaerner KJ, Roysamb E, Tambs K, Harris JR, Magnus P. The reliability of self-reported childhood otitis media by adults. Int J Pediatr Otorhinolaryngol 2006;70:597–602. [PubMed: 16143406]

31. Uhari M, Mantysaari K, Niemela M. A meta-analytic review of the risk factors for acute otitis media. Clin Infect Dis 1996;22:1079–1083. [PubMed: 8783714]

32. Alles R, Parikh A, Hawk L, Darby Y, Romero JN, Scadding G. The prevalence of atopic disorders in children with chronic otitis media with effusion. Pediatr Allergy Immunol 2001;12:102–106. [PubMed: 11338283]

33. Ilicali OC, Keles N, Deger K, Savas I. Relationship of passive cigarette smoking to otitis media. Arch Otolaryngol Head Neck Surg 1999;125:758–762. [PubMed: 10406313]

34. Lieu JE, Feinstein AR. Effect of gestational and passive smoke exposure on ear infections in children. Arch Pediatr Adolesc Med 2002;156:147–154. [PubMed: 11814376]

35. Ilicali OC, Keles N, Deer K, Saun OF, Guldiken Y. Evaluation of the effect of passive smoking on otitis media in children by an objective method: urinary cotinine analysis. Laryngoscope 2001;111:163–167. [PubMed: 11192887]

36. Gryczynska D, Kobos J, Zakrzewska A. Relationship between passive smoking, recurrent respiratory tract infections and otitis media in children. Int J Pediatr Otorhinolaryngol 1999;49:S275–S278. [PubMed: 10577820]

37. Strachan DP, Cook DG. Health effects of passive smoking. 4. Parental smoking, middle ear disease and adenotonsillectomy in children. Thorax 1998;53:50–56. [PubMed: 9577522]

38. Collet JP, Larson CP, Boivin JF, Suissa S, Pless IB. Parental smoking and risk of otitis media in preschool children. Can J Public Health 1995;86:269–273. [PubMed: 7497415]

39. Kitchens GG. Relationship of environmental tobacco smoke to otitis media in young children. Laryngoscope 1995;105(5 Pt 2):1–13. [PubMed: 7760681]

40. Kogan MD, Overpeck MD, Hoffman HJ, Casselbrant ML. Factors associated with tympanostomy tube insertion among preschool-aged children in the United States. Am J Public Health 2000;90:245–250. [PubMed: 10667186]

41. Majerus S, Amand P, Boniver V, Demanez JP, Demanez L, Van der Linden M. A quantitative and qualitative assessment of verbal short-term memory and phonological processing in 8-year-olds with a history of repetitive otitis media. J Commun Disord 2005;38:473–498. [PubMed: 15950984]

42. O'Brien LM, Mervis CB, Holbrook CR, Bruner JL, Smith NH, McNally N, McClimment MC, Gozal D. Neurobehavioral correlates of sleep disordered breathing in children. J Sleep Res 2004;13:165–172. [PubMed: 15175097]

43. O'Brien LM, Mervis CB, Holbrook CR, Bruner JL, Klaus CJ, Rutherford J, Raffield TJ, Gozal D. Neurobehavioral implications of habitual snoring in children. Pediatrics 2004;114:44–49. [PubMed: 15231906]

44. Kheirandish L, Gozal D. Neurocognitive dysfunction in children with sleep disorders. Dev Sci 2006;9:388–399. [PubMed: 16764612]

Table 1

Demographic characteristics and prevalence of symptoms among 5–7–year-old children with habitual snoring and children who do not snore in Louisville, KY

	Habitual Snorers (N=1844)	Non-Snorers (N=14,477)	P value	Odds Ratio (Confidence Intervals)
Age (years)	6.1±0.6	6.2±0.7	NS	
Males	977 (53%)	7,412 (51.2%)	NS	
African American	477 (25.9%)	2,693 (18.6%)	<0.0000001	1.53 (1.36–1.71)
Witnessed Apnea	147 (8.0%)	14 (0.1%)	<0.0000001	8.49 (3.88–18.62)
Breathing Problems During Sleep	332 (18.1%)	43 (0.3%)	<0.0000001	73.71 (52.85–103.12)
Daytime Sleepiness	118 (6.4%)	246 (1.7%)	<0.0000001	3.95 (3.14–4.98)
Mouth Breathing	1,089 (58.0%)	1,187 (8.2%)	<0.0000001	15.73 (14.08–17.58)
Chronic Nasal Obstruction	756 (41.1%)	2,765 (19.1%)	<0.0000001	2.94 (2.66–3.26)
Asthma	345 (18.7%)	1,188 (8.3%)	<0.0000001	2.57 (2.25–2.94)
Allergies	535 (29.1%)	2,881 (19.9%)	<0.0000001	1.65 (1.48–1.84)
Exposure to Cigarette Smoking in Household	666 (36.1%)	4,184 (28.9%)	<0.0000001	1.39 (1.25–1.54)

All comparisons and univariate adjusted odds ratios between habitual snorers and non-snorers are shown.

Table 2

Logistic Regression Analysis of Variables Associated with the Presence of Recurrent Otitis Media in 5–7–Year Old Children.

	ROM N=5,074	No ROM N=11,247	Adjusted Odds Ratio (Confidence Intervals) P value
Habitual Snoring			
Yes	827 (16.3%)	1,017 (9.0%)	1.96 (1.77–2.16)
No	4,247 (83.7%)	10,230 (91.0%)	<0.0000001
African American			
Yes	818 (16.1%)	2,352 (20.9%)	0.73 (0.67–0.79)
No	4,256 (83.9%)	8,895 (79.1%)	<0.0000001
Chronic Nasal Obstruction			
Yes	1,268 (25.0%)	2,253 (20.0%)	1.33 (1.23–1.44)
No	3,806 (75%)	8,994 (80.0%)	<0.00000001
Allergies			
Yes	1163 (22.9%)	2,253 (20.0%)	1.19 (1.10–1.29)
No	3911 (77.1%)	9,021 (78.2%)	<0.0001
Exposure to Cigarette Smoking			
Yes	1,567 (44.7%)	3,283 (29.1%)	1.08 (1.01–1.17)
No	3,507 (55.3%)	7,964 (70.9%)	<0.03

Table 3

Logistic Regression Analysis of Variables Associated with Surgical Placement of Tympanostomy Tubes in 5–7–Year Old Children.

	Tympanostomy Tubes (+) N=2,605	No Tympanostomy Tubes N=13,716	Adjusted Odds Ratio (Confidence Intervals) P value
Habitual Snoring			
Yes	636 (24.4%)	1,208 (8.8%)	3.34 (3.00–3.73)
No	1,969 (75.6%)	12,508 (91.2%)	<0.0000001
African American			
Yes	459 (21.0%)	2,711 (19.1%)	0.87 (0.78–0.97)
No	2,146 (79.0%)	11,005 (80.9%)	<0.02
Chronic Nasal Obstruction			
Yes	1,088 (41.8%)	2,433 (17.7%)	3.33 (3.04–3.64)
No	1,517 (59.2%)	11,283 (82.3%)	<0.00000001
Allergies			
Yes	978 (37.5%)	2,438 (17.8%)	2.78 (2.54–3.05)
No	1,627 (62.5%)	11,278 (82.2%)	<0.00000001
Exposure to Cigarette Smoking			
Yes	1,069 (41.0%)	3,781 (27.6%)	1.83 (1.68–2.0)
No	1,536 (59%)	9,935 (72.4%)	<0.00000001