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Prevalence of upper respiratory tract infections in habitually snoring and mouth breathing children

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ABSTRACT

Objectives: The aim of the study was to investigate the prevalence of upper respiratory tract infections (URI) – as indicated by rhinosinusitis (RS), ear infections (EI), and antibiotic consumption – in a general pediatric population and evaluate the relationship between these conditions and habitual snoring and mouth breathing during sleep.**Methods:** A population-based cross-sectional study was performed in three medium-sized Polish cities from 2011 to 2015.**Results:** 4837/6963 questionnaires (69.5%) were completed, returned and analyzed. Mean age of studied group was 7.07 ± 0.72 and 7.14 ± 0.73 in girls and boys, respectively. Habitual mouth breathing during sleep (MB) was reported in 907 (18.7%) children and habitual snoring (HS) in 290 (6.0%). 230/290 (79.3%) of children with HS were also MB. Both HS and MB were more prevalent in boys than in girls ($p = 0.027$ and $p < 0.0001$, respectively) and neither was associated with BMI ($p = 0.11$ and $p = 0.07$, respectively).Habitual snoring and habitual mouth breathing were highly associated with more frequent bouts of rhinosinusitis, ear infections, and antibiotic use ($p < 0.0001$ for each parameter).**Conclusions:** Higher rates of rhinosinusitis, ear infections, and antibiotic consumption were similarly associated with HS and MB. MB is over three times more prevalent in the pediatric population relative to HS, therefore it might be considered as a risk factor for URI and may be included in history of URI.

1. Introduction

Mouth breathing (MB) is a common condition in children which leads to abnormal functional and aesthetic craniofacial development [1,2]. It may also cause other medical, sociological and behavioral problems (i.e. growth impairment, poor academic performance, attention deficit disorder, hyperactivity, etc.) [3]. The prevalence of MB is estimated solely based on questionnaires, as there is no easy tool to establish this diagnosis objectively. According to literature, MB occurs in 12%–55% of children [4–7]. In normal children, MB during sleep measured objectively with polysomnography would occur in about 4% of sleep with a maximum of 10% of total-sleep-time [8].

It is also suggested that MB is associated with sleep disordered breathing (SDB) [9], which in children manifests mostly as habitual snoring (HS). Moreover, craniofacial abnormalities are also noticed in snoring children [10]. The cephalometric alterations in mouth

breathing children are found to resemble those in adults with obstructive sleep apnea [11].

On the other hand, hypertrophies of the tonsils and adenoids, which are the main causes of habitual snoring and mouth breathing in children, are often consequences of frequent upper respiratory tract infections (URI) left untreated.

The aim of this study was to analyze the coexistence of MB and HS, and the prevalence of URI in relation to habitual snoring and mouth breathing during sleep, as observed by caregivers.

2. Materials and methods

2.1. Participants

From 2011 to 2015, 6963 questionnaires were distributed by primary-school authorities to the parents of first-grade children residing in

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List of abbreviations

BMI	body mass index
EI	ear infection
ENT	ear, nose, throat
HS	habitual snoring
MB	habitual mouth breathing
RS	rhinosinusitis
SDB	sleep disordered breathing
URI	upper respiratory tract infections

3 Polish cities. The questionnaires included a statement on the voluntary nature of the questionnaire and the details of informed consent. The bioethical committee of the Medical University of Warsaw approved the study protocol.

2.2. Procedure

In this population-based, cross-sectional study, parents of the recruited first-grade primary-school children were asked to fill out a specially designed questionnaire inquiring about participants' demographic information, symptoms of sleep disordered breathing (SDB), and history of ENT conditions.

Body mass index (BMI) was calculated based on the children's height and weight as reported by parents.

The information extracted for analysis included demographics (age, weight, height, BMI – calculated), SDB symptoms (snoring frequency, MB during sleep, observed breathing pauses), ENT disorders (rhinosinusitis, ear infections), history of antibiotic intake for ENT infections, and family history of snoring. Parents were asked to rate their children's observed symptoms of SDB and ENT disorders on a Likert-type five-point scale (1 – never; 2 – occasionally; 3 – sometimes; 4 – often; 5 – very often/always). No additional instruction was given on the descriptors in the questionnaire. The subjects were divided into habitual snorers (HS) and non-habitual snorers (non-HS), and into habitual mouth breathers (MB) and non-habitual mouth breathers during sleep (non-MB). Those children with scores of 4 and 5 on questions about snoring frequency and observed MB during sleep were considered habitual snorers and habitual mouth breathers, respectively. Occasional snorers and occasional mouth breathers were those children whose parents chose a score of 3 (sometimes) in response to the question about snoring and MB during sleep. Children with scores of 4 and 5 on questions about URI were considered to have high frequency.

All data were stored in a specially designed computer database and checked for errors by a trained technician.

2.3. Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics 20.0 software (IBM Corp.). Continuous variables were compared for statistically significant differences using a *t*-test, and ordinal variables using a Mann-Whitney test. Differences between groups with respect to nominal variables were identified with Pearson's χ^2 test. P-values below 0.05 were considered statistically significant.

3. Results

In total, 4837 completed questionnaires (69.47%) were returned and analyzed. Mean age of studied group was 7.07 ± 0.72 and 7.14 ± 0.73 in girls and boys, respectively. Demographic data and answers to questionnaire by sex are presented in Table 1. Questionnaire responses identified 290 habitual snorers (6.0%) and 984 occasional snorers (20.3%). Habitual mouth breathing was mentioned in 907 children (18.7%), whereas 1436 (29.3%) reported occasional mouth

Table 1
Child characteristics by sex.

Characteristics	Girls (n = 2356)	Boys (n = 2481)	p-value
Demographics			
Age (y)	7.07 ± 0.72	7.14 ± 0.73	< 0.0001
Height (cm)	126.42 ± 7.25	127.34 ± 7.04	< 0.0001
Weight (kg)	25.24 ± 5.15	26.56 ± 5.6	< 0.0001
BMI	15.72 ± 2.34	16.28 ± 2.46	< 0.0001
SDB symptoms			
Snoring frequency	1.87 ± 0.96	1.93 ± 0.98	0.027
Mouth breathing	2.49 ± 1.11	2.63 ± 1.14	< 0.0001
Breathing pauses	1.21 ± 0.58	1.24 ± 0.63	0.192
URI symptoms			
Rhinosinusitis	3.10 ± 1.00	3.14 ± 1.02	0.191
Ear infections	1.65 ± 0.89	1.71 ± 0.92	0.026
Antibiotic intake for URI	2.65 ± 1.14	2.68 ± 1.17	0.503
Parental snoring	3.03 ± 1.33	2.96 ± 1.32	0.137

SDB – sleep disordered breathing; URI – upper respiratory tract infections.

breathing during sleep. 230 children were reported to be both HS and MB; this overlapping group is shown in Fig. 1. There were almost no HS who did not breath through the mouth. The most numerous group consisted of children who never or only occasionally snored and at the same time occasionally or sometimes breathed through the mouth (Fig. 2).

Both HS and MB were reported as more prevalent in boys than in girls (6.5% vs. 5.4%, $P = 0.027$, for snoring; 20.4% vs. 16.9%, $P < 0.0001$, for MB). There was no association between HS, MB and BMI (16.29 for HS and 15.99 for non-HS, $P = 0.11$; 16.15 for MB and 15.98 for non-MB, $P = 0.07$).

HS and MB were similarly associated with the frequency of URI. The proportions of rhinosinusitis, ear infections, and antibiotic use were similarly related to the increase in the reported intensity of snoring and reported frequency of MB (see Tables 2 and 3). Likewise, reported rates of increased antibiotic use were comparable between children with HS and MB (Table 4). The separate analysis according to male and female did not show any differences in relation to ear infections, snoring and mouth breathing (data not shown).

There was a statistically significant correlation (Spearman's rank correlation coefficient) between MB and HS group ($r = 0,53$). The correlation between MB group and recurrent ear infections; rhinosinusitis; antibiotic consumption for upper respiratory tract infections was statistically significant, but weak ($r: 0,15; 0,3; 0,22$, respectively). Similarly, the correlation between HS group and recurrent ear infections; rhinosinusitis; antibiotic consumption for upper respiratory tract

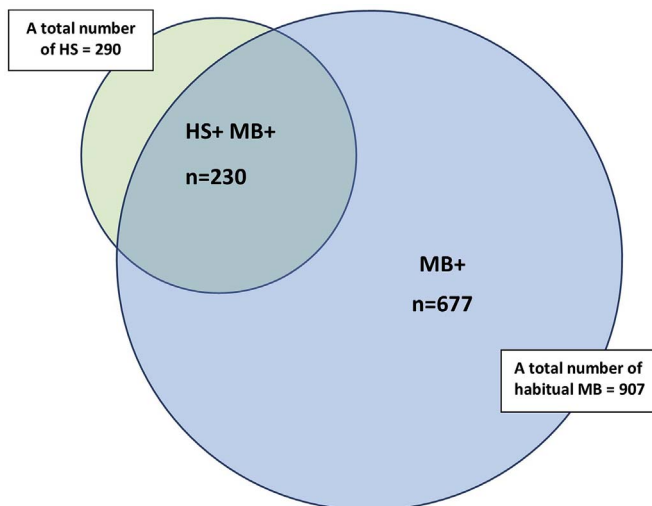


Fig. 1. Overlapping of habitual mouth breathers (MB) and habitual snorers (HS).

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