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Prevalence and Predisposing Factors

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Snoring and Obstructive Sleep Apnea in Thai School-age Children:

Prevalence and Predisposing Factors

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Summary

The prevalence of habitual snoring and its associations with tonsillar size, allergic rhinitis, obesity, and parental smoking as well as the lower limit of OSAS prevalence were studied. A sample of 1,142 children aged 6-13 years (mean 7.25 ± 0.58) from seven randomly-selected schools in Hat yai, Southern Thailand were enrolled. Eighty-five (8.5%) of the children were habitual snorers; the prevalence was the same in boys and girls. Significant and independent association was present between snoring and allergic rhinitis with an odds ratio of 5.27; 95% CI 1.57-17.77. The odds ratio was significantly increased to 2.65; CI 1.31-5.39, 5.72; CI 2.67-12.25 and 11.06; CI 1.91-63.84 in children with tonsillar size of 2+, 3+ and 4+ respectively. Of the eighty-five habitual snorers, sixty-nine could be contacted by telephone call or by hospital visit. Eight of these were reported to have at least one of the following symptoms: difficulty breathing during sleep, stop breathing at night, restless sleeping and frequent awakening, sleeping with the head tipped back and a tendency to breath through the mouth rather than the nose. The polysomnographic studies in these eight children demonstrated an apnea/hypopnea index of 0.6-4.7 per hour. Seven children met the criteria for OSAS. Thus our estimate of the lower limit of OSAS prevalence among the Thai school children was 7/1008 (0.69%). **Conclusion**, we have shown that the prevalence of habitual snoring and the lower limit of prevalence of OSAS in a sample of Asian school-age children in Southern Thailand were 8.5 and 0.69% respectively, which was similar to that from western populations. An association of snoring with tonsillar size or allergic rhinitis was demonstrated. All but one of the snoring children with sleep related symptoms had OSAS, but all were mild cases.

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Key words: Snoring, obstructive sleep apnea

Abbreviations :

OSAS	Obstructive sleep apnea syndrome
CI	Confidence interval
OR	Odds ratio
EKG	Electrocardiography
AHI	Apnea/hypopnea index
TST	Total sleep time

Introduction

Snoring is common in children. It is generally thought to be of little clinical significance, since the majority of snoring children are considered to have primary snoring, which has been defined as snoring without associated hypoxemia, hypercarbia or sleep disturbances. However, it has been recognized that a subgroup of habitual snoring children have obstructive sleep apnea syndrome (OSAS). Very few studies have been published about the prevalence of snoring and OSAS in children; it is reported to be 3-12% for habitual snoring and 0.7-2.9% for OSAS¹⁻⁴. All of this data is from western populations. Adenotonsillar hypertrophy is the major predisposing factor of snoring and OSAS in children. Additionally, craniofacial characteristics have been proved to be another important predisposing factor⁵. Previous studies have demonstrated that racial differences may affect craniofacial character. In comparison to European-Americans, the Japanese people are smaller in anteroposterior facial dimensions and proportionately larger in vertical facial dimensions⁶. Cephalometric comparisons between Chinese and Caucasian adult patients with OSAS revealed more severe craniofacial discrepancies with significantly smaller maxilla and mandibles in the Chinese group⁷. Since racial differences may affect the prevalence and the predisposing factors for snoring as well as the severity of OSAS⁸, this study set out to determine the prevalence of snoring in

Thai school-age children by using a sample survey and noting predisposing factors by case-control study. The selected cases of snoring children underwent polysomnographic study to determine the lower limit of the prevalence of OSAS.

Methods

Subjects

The study population was first grade school children attending school in the area of Hat yai municipality, Hat yai district, Songkla province in Southern Thailand. This area consisted of 23 schools with a total number of 4,333 children. By using stratified cluster sampling, seven schools were randomly selected and all first grade children from these schools (n=1,142) were included in this study.

Questionnaire survey

The sleep and breathing questionnaire survey we used in this study was the same as in Ali's study³. It was translated into the Thai language. After a pilot study, we constructed a questionnaire consisting of the following: age, sex, whom the child sleeps with, snoring and specific questions about allergic rhinitis, adenoidectomy, tonsillectomy, and household members smoking in the home. The parents were asked to follow their child's sleep for 1 week before answering the questionnaire.

The questionnaire included questions such as: (1) Does your child snore at night? (2) Has your child had tonsils removed? (3) Has your child had adenoid removed? (4) Did anyone in your household smoke in the home during the previous month? If yes, specify... (5) Does your child have rhinitis (stuffy, itchy, runny nose and sneezing) without coughs and colds? (6) Have you ever been told by the doctor that your child has allergic rhinitis?

The reply alternatives for the first question were usually formulated as (1) never, (2) only with colds, (3) occasionally, and (4) most nights. For the remaining questions, the alternatives yes or no were used. On the basis of the answer to the first question, the children who snored on most

nights were identified as “cases”. The control children were sampled systemically from those who never snored. A case-control study was performed to identify the predisposing factors of snoring.

Households in which none of the members had smoked were classified as non-smoking; those with at least one of the members smoking at least one cigarette each day during the previous month were classified as smoking.

Children who answered “yes” for both questions about rhinitis and doctor-diagnosed allergic rhinitis were classified as having allergic rhinitis.

Physical examination

The two selected subgroups, 85 children who snored on most nights and 170 children who never snored, were examined at the school by a single ENT specialist who was not aware of the patients' symptoms. Tonsillar size was graded according to the following scale: 0 (not visible), 1 (extending to the pillars), 2 (enlarged beyond the pillars but not meeting the uvula), 3 (meeting the uvula), and 4 ("kissing" at the midline). Body weight, height, nasal patency and craniofacial abnormality, if present, were recorded.

Percent ideal body weight for height was obtained using normal value ideal body weight for height for Thai school children⁹.

Patients selection for polysomnographic study

Because of the limitations of the facility, we could not perform polysomnographic study on all of the snoring children. The selection procedure was as follows: the parents of the children who replied on the questionnaire as snoring on "most nights" were asked for the child's sleep related symptoms by telephone call or by hospital visit if a telephone was not available. An interview was conducted using the following questions: (1) Does your child have difficulty breathing during sleep?

(2) Does your child stop breathing at night? (3) Does your child have restless sleeping and frequent awakening? (4) Does your child sleep with the head tipped back? (5) Does your child tend to breathe through the mouth rather than the nose? (6) Does your child fall asleep during the day, particularly when not active (for example, watching TV or reading)? The snoring children who answered “yes” to at least one of these questions were selected for the polysomnographic study.

The study protocol was approved by the Medical Research Ethics Committee, Faculty of Medicine, Prince of Songkla University. Informed consent was obtained from parents of the children who participated in this study.

Polysomnography

Overnight polysomnography was performed under the surveillance of a trained nurse. A 12-channel polysomnograph (model 8; Grass Instruments) was obtained for each subject. Sleep stages were measured using electro-encephalograms, electro-oculograms and submental electro-myogram. Thoraco-abdominal movement was measured using mercury-filled strain gauges. The remaining channels were EKG, oxygen saturation and nasal-oral airflow with thermistor. The respiratory events were manually edited by one of the authors who is experienced and accredited as a polysomnographer.

Sleep staging was scored with standard criteria¹⁰. Obstructive apnea was defined as a reduction of 80% or more in nasal-oral airflow with continued respiratory efforts, lasting for at least two respiratory cycles, and hypopnea was defined as a reduction of 50% or more in the airflow signal¹¹. Obstructive, mixed apneas and hypopneas were taken into account, and the apnea/hypopnea index (AHI) was counted as total amount of apnea and hypopnea per total sleeping time. Obstructive sleep apnea syndrome was diagnosed when AHI was at least once per hour¹².

Statistical analysis

The association of snoring with continuous variables was assessed by one-way analysis of variance, and with categorical variables by usual univariate tests (odds ratio with 95% confidence interval) and multivariate analysis (multiple logistic regression)

Results

One-thousand and eight (1008/1142; 88.3%) questionnaires were returned. Of these, 518/1008 (50.8%) were boys. Mean age was 7.25 ± 0.58 years, range 6.1-13.1 years. Most of the children (84.5%) slept in the same room as the parents. Eighty-five (85/1008; 8.5%) of the children were reported as snoring on most nights (hereafter labelled "habitual snorers"), 249 (24.7%) snored sometimes even without colds, 139 (13.8%) snored only with colds, and the remaining 535 (53.1%) never snored. For the habitual snorers, the mean duration of snoring was 35.7 ± 26.4 months, range 2-98 months. There was no difference in the prevalence of snoring between girls and boys ($P=0.52$). There was also no difference in the prevalence of snoring between the children who had been sleeping alone and in children sharing a bedroom with siblings or parents ($P = 0.59$).

Of the total sample, only three children had undergone adenoidectomy and four tonsillectomy. Regarding the data of passive smoking, 457/999 (45.7%) of children were reported to live in a household where at least one members currently smoked. Maternal smoking and paternal smoking were reported in 8/997 (0.8%) and 379/968 (39.15%) respectively. The mean percent ideal body weight for height was 120.79 ± 5.3 .

In order to investigate the predisposing factors of snoring, we compared the group of habitual snorers ($n=85$) with the sample group of never snorers ($n=170$). The baseline data between the two groups did not significantly differ by age, sex, weight and height (Table1). The potential predisposing factors of habitual snoring were taken into consideration in univariate analysis (Table

2). Significant association was present between snoring and allergic rhinitis with an odds ratio of 3.96; 95%CI 1.3-12.2. The odds ratio was significantly increased to 2.60; CI 1.3-5.0, 6.33; CI 3.1-13.0 and 10.18; CI 1.9-55.2 in children with tonsillar size of 2+, 3+ and 4+ respectively. The association of snoring with a history of at least one of household members smoking in the home (OR 1.75; CI 1.03-2.99) was also statistically significant. The ideal body weight for height greater than 120% was associated with snoring with an OR of 2.06; CI 0.96-4.4, but this was non-significant. No significant association was present between snoring and the history of the father smoking in the home (OR 1.32; CI 0.73-2.36). As the numbers for maternal smoking and children with a history of adenoidectomy or tonsillectomy were small, we did not take them into consideration.

Multiple logistic regression was applied to evaluate the contribution of the various factors identified by univariate analysis. Two variables, allergic rhinitis and tonsillar size, were retained as significant independent factors (Table 2).

Of eighty-five habitual snorers, sixty-nine could be contacted by the telephone call (n=24) or by the hospital visit (n=45). Eight of these were reported to have at least one of the associated symptoms described previously and had undergone polysomnographic study. All of these cases had tonsillar enlargement (3+-4+) and six children had adenoid hypertrophy evaluated by plain x-ray.

Polysomnographic features

The mean total sleep time was 340.8 ± 50.9 minutes. The lowest oxygen saturation was in the range of 84-99%. The AHI was in the range of 0.6-4.7 per hour of sleep time. Four children had lowest oxygen saturation less than 92% (Table 3). Seven children met the criteria for OSAS. A severe case of OSAS was not found in this study. The lower limit of OSAS prevalence among the Thai school-age children was 7/1008 (0.69%).

Table 1. Characteristics of habitual snorers and never snorers

	Habitual snorers (n = 85)	Never snorers (n = 170)	p Value
Age, yr, mean \pm SD	7.36 \pm 0.65	7.24 \pm 0.61	0.122
Male, %	56.5	45.3	0.092
Weight, Kg, mean \pm SD	23.8 \pm 5.8	22.5 \pm 4.9	0.071
Height, cm, mean \pm SD	120.8 \pm 5.4	120.1 \pm 5.1	0.349

Table 2. Predisposing factors for habitual snoring vs never snoring

** Factor	* Habitual snoring (n = 85)	* Never snoring (n = 170)	Univariate		Multivariate	
			OR	95% CI	OR	95% CI
Allergic rhinitis	9 (10.8)	5 (2.9)	3.96	1.3-12.2	5.27	1.57-17.77
Smoking in household	47 (58.0)	75 (44.1)	1.75	1.03-2.99		
Father smoking	35 (45.5)	64 (38.8)	1.32	0.73-2.36		
Weight for height > 120%	15 (17.6)	16 (9.4)	2.06	0.96-4.4		
Tonsillar size						
2 ⁺	28 (33.3)	114 (67.1)	2.60	1.3-5.0	2.65	1.31-5.39
3 ⁺	23 (27.4)	36 (21.2)	6.33	3.1-13.0	5.72	2.67-12.25
4 ⁺	33 (39.3)	20 (11.8)	10.18	1.9-55.2	11.06	1.91-63.84

* Values are presented as No (%)

** Information not documented in all cases

OR, odds ratio; CI, confidence interval

Table 3. Characteristics, sleep related symptoms and results from polysomnographic studies

Case No/sex	Age (yr)	% wt for ht	sleep related symptoms	TST (min)	lowest O ₂ sat (%)	AHI
1/M	7.5	95.2	1, 3	299	86	2.2
2/M	7.6	93.2	1, 2, 3, 5	289	84	4.7
3/M	7.6	98.7	1, 2, 3, 5	384	94	2.8
4/M	7.3	131.5	1, 5	293	92	3.3
5/M	7.3	95.4	1	396	89	1.4
6/M	7.9	107.5	3, 5	362	95	2.0
7/M	6.8	103.5	1, 2, 3	298	98	0.6
8/F	7.0	94.9	5	406	99	1.2

M, male; F, female; TST, total sleep time; AHI, apnea/hypopnea index,

wt, weight; ht, height, sleep related symptoms, 1 = mouth breathing, 2 = neck hyperextension, 3 = restless sleep, 4 = apnea, 5 = difficulty breathing, 6 = excessive daytime sleepiness

Discussion

Our study is the first school based study to report on the prevalence of snoring, obstructive sleep apnea and the predisposing factors in Asian children. As our study population was very large, a questionnaire survey was used to obtain data. Since reporting on snoring depends largely on the parents and the frequency may be underestimated in children who sleep alone,¹ we tried to increase the accuracy by asking the parents to follow their child's sleep for 1 week before answering. To reduce the chance that the parent might confuse snoring with other respiratory sounds such as wheezing, sneezing or transmitted sounds due to secretion, we added details to explain what we meant in the questionnaire. In the second phase of our study, we interviewed participants again about snoring and found that all parents reported their children to have true snoring. Concerning adenotonsillectomy, we felt that most parents could recall this because it was an unusual event. As our study population was older children, rhinitis symptoms without coughs and colds were more likely to be allergic than infectious.

The prevalence of snoring was 8.5 % which is close to previous studies from western populations of the same age group¹⁻³. Most of the children (84.5%) in our study slept in the same room as the parents. The prevalence of snoring in children who sleep alone is not different from that of children who sleep with the parents ($P = 0.60$). This factor may also help our study to achieve the actual prevalence of snoring. We found the prevalence of snoring was equal in boys and girls, also similar to previous studies¹⁻³. This confirms the lack of association between snoring and sex in the prepubertal age group.

To study the prevalence of OSAS in children, the younger cohorts are more appropriate as they coincide more closely with adenotonsillar hypertrophy. However, we decided to study the older age group because at the time of study our sleep laboratory did not have equipment suitable for children younger than 6 years.

In our study, two predisposing factors significantly and independently associated with habitual snoring were allergic rhinitis and tonsillar size. In Corbo's study¹, significant associations were found with respiratory symptoms such as rhinitis and cough. Teculescu et al.² reported that personal history of allergic conjunctivitis or rhinitis was clearly associated with habitual snoring. In our questionnaire, we added "physician diagnosed allergic rhinitis" to the rhinitis symptoms. This may help to specify that rhinitis was "true allergic rhinitis". In McColley's study¹³, a high prevalence of allergy was found in a group of children with habitual snoring and associated with an increased risk of OSAS. Edema and mucus secretion in the nasal mucosa led to nasal obstruction. An increase in nasal resistance may predispose the child to the development of partial or complete upper airway obstruction. A recent study by DeMain et al.¹⁴ demonstrated improvement in adenoidal obstruction with the use of intranasal beclomethasone. The role of intranasal corticosteroids in improving snoring symptoms in allergic rhinitis children should be further investigated.

Tonsillar size as assessed by an ENT specialist was significantly associated with habitual snoring. Teculescu et al.² reported borderline association with tonsillar hypertrophy with RR of 2.51; 95% CI 0.9-6.9. Our findings more clearly confirmed this association as we had a larger sample size and we analyzed the odds ratio with various sizes of tonsils. We found increasing risk of snoring with increasing tonsillar size.

We found that habitual snoring was not associated with father's smoking. In Corbo's study,¹ the association between parental smoking and snoring was highly significant and they observed a dose-effect relation between the number of cigarettes smoked and the prevalence of snoring. The difference in results may be from the different setting as we had only a small number of maternal smokers and very few fathers smoked more than 20 cigarettes per day. As we analyzed for a dose-related effect, the results remained non-significant.

The striking finding in our study was the very low rate of adenotonsillectomy, only 4 of 1008. Of 1,615 children in Corbo's study¹, 207 (12.8%) had had a tonsillectomy and they found a significant association with habitual snoring. This association was later confirmed by Teculescu's study². During the last two decades, the tonsillectomy rate has decreased dramatically, leading to the suggestion that the prevalence and consequences of sleep related problems are increasing.¹⁵ We did not confirm this finding, as with a very low rate of adenotonsillectomy, the prevalence of snoring and OSAS in our population was not dramatically higher than in other studies.

We did not have a child with craniofacial dysplasia in our study because of the small number of children examined, so we did not confirm the association with snoring.

Obesity has been reported as a risk factor for sleep-related breathing disorders. Our study did not confirm the association of obesity and snoring because our study population was less obese than previous studies.¹⁶⁻¹⁸

We found the lower limit of prevalence of OSAS in Thai school-age children was 0.69 % which is similar to Ali's study³ but lower than that of Gislason.⁴ The prevalence of sleep and breathing disorders in the children aged 4-5 years reported by Ali et al. was 0.7 % while Gislason found a prevalence of 2.9% in children aged 6 months to 6 years old. The different age groups may affect the prevalence of OSAS. Since our method of first selecting children who were snoring then interviewing for the associated symptoms in an individual and selecting for a polysomnographic study, this might lead to underestimation of the prevalence of OSAS because OSAS could be found in a snoring child who had no sleep related symptoms. Polysomnographic study is recommended to differentiate primary snoring from OSAS and it is the standard method for diagnosing OSAS¹¹; however, it is costly and we could not perform the study in all snoring children. Nocturnal pulse oxymetry has been evaluated and recommended as a screening test for OSAS in children. The pulse oxymeter that can provide trend graphs that present 12-hour summaries of SaO₂, pulse rate and pulse amplitude is the most accurate method to distinguish true from false desaturations¹⁹⁻²⁰. This

kind of pulse oxymeter was not available in our hospital, so we did not perform this screening in our children.

Brouillette et al²¹ had recommended a formula for calculating OSA score for predicting OSAS. This formula is based on the following symptoms: difficulty in breathing during sleep, apnea observed during sleep, and snoring. Even though this test was later reevaluated by Carroll et al²² and found to be unable to discriminate accurately between children who have primary snoring and OSAS, we decided to use these symptoms and add other symptoms such as restless sleep, sleeping with head tipped back, mouth breathing and excessive daytime sleepiness in interviewing the snoring children to maximize the possible cases of OSAS. The last four symptoms we added in this study had been evaluated by Nieminen et al²³ to be predicting factors for sleep apnea. Since our study did not do polysomnography on the control group, we can not really agree or disagree with the use of this OSA score for predicting OSAS. We did not identify any children with severe OSAS in this survey. This may reflect that severe cases had already been detected and treated or the possibility that the severity declines when the child gets older because of the increase in the size of the pharynx and nasopharynx.

Although many consequences of OSAS in children have been reported²⁴⁻²⁷ including hyperactivity, inattention, daytime sleepiness, poor school performance, enuresis, poor weight gain, chronic mouth breathing, frequent upper airway infection, acute cardiac failure, cor pulmonale and hypertension, the importance of mild OSAS is still unknown. In our study, all of the parents of OSAS children decided to have their children undergo follow up rather than surgical treatment after we provided details of the disease and treatment.

The natural history of habitual snoring was reported by Ali et al²⁵ that after 2-year follow up, snoring resolved in half of the children, but commenced in a similar proportion of children without previous snoring. In Marcus's study²⁸, only 10% of children with primary snoring showed evidence of mild OSAS after a 1-3 year follow up. However, the actual natural history of snoring and mild

OSAS is still unclear, and further prospective studies are needed to explore any possible connection between these two entities.

Conclusion, we have shown that the prevalence of habitual snoring and the lower limit of prevalence of OSAS in a sample of Asian school-age children in Southern Thailand were 8.5 and 0.69% respectively, which was similar to that from western populations. The risk factors significantly and independently associated with snoring were tonsillar size and allergic rhinitis. Severe OSAS was not found in our study. Clinical and polysomnographic follow ups are needed to determine the natural history of snoring and mild OSAS.

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