Clinical Risk Factors for Obstructive Sleep Apnoea in Children

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ABSTRACT

Objective: To identify the clinical factor(s) that identify obstructive sleep apnoea syndrome (OSAS) in children.

Methods: A prospective study of children referred to the sleep clinic of the paediatric department was conducted in a public non-teaching regional hospital in Hong Kong. A standard questionnaire was administered and overnight sleep polysomnography was performed in a consecutive series of patients. Logistic regression analysis was performed to obtain significant risk factors for prediction of OSAS in this series of patients.

Results: Sixty-two children were enrolled into the study and 22 were diagnosed to have OSAS. Logistic regression analysis showed that, among all the answers, 'snoring every night' is the single most significant risk factor ($p<0.0001$) to predict OSAS. 'Snoring every night' has a sensitivity of 91% and specificity of 75% for OSAS patients. It also has a positive predictive value of 67% and negative predictive value of 94%.

Conclusion: Snoring every night is an important risk factor in identifying OSAS in children. Priority for an overnight sleep polysomnogram should be given to those with this symptom.

Keywords: children, obstructive sleep apnoea, OSAS, risk factors, questionnaire

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INTRODUCTION

Obstructive sleep apnoea syndrome (OSAS) in children was estimated to affect 1-4% of children[1,2]. The underlying pathogenesis involves an interaction of anatomical factors (e.g. adenotonsillar hypertrophy, subtle retrognathia, craniofacial malformation) and dynamic factors such as muscle tone of the pharyngeal airway[3]. Snoring is the cardinal symptom. Other typical clinical features include difficulty in breathing during sleep, observed apnoea, restlessness, enuresis, and daytime symptoms like sleepiness, hyperactivity, behavioural and learning problems. However, previous studies showed that clinical risk factors are not well-related to OSAS[4-6]. Among the snoring children, only about 10 to 30% of them[1,7-10] were actually found to have OSAS as diagnosed by the sleep polysomnograph (PSG). Given the potentially serious sequel of untreated OSAS, e.g. cor pulmonale, respiratory failure and intellectual impairment[11], and the expenses of performing PSG, identification of significant clinical risk factors in different population remains an important task. This study aims at identification of clinical risk factors for OSAS in Chinese children in Hong Kong.

METHODS

Sixty-two children were referred to our sleep clinic for suspected OSAS by paediatricians or general practitioners from January 1998 to December 1999. All of them presented with snoring with or without other symptoms of OSAS. A questionnaire modified from a validated questionnaire by Brouillette et al[12] was filled in by one of the three authors. If the informants, usually the parents, were not sure about some of the answers, they would undertake an observation period of a few weeks. The clinician would also perform a standard clinical assessment for them. Those children who had neurological abnormalities or craniofacial syndromes were excluded from the study.

All of them underwent an overnight polysomnogragh (PSG) in our sleep laboratory. Alice 3 (Respironics, Pittsburgh, USA) computerised sleep monitoring system was used. Sleep stages were scored according to the Rechtschaffen & Kales criteria by one of the following authors (DN,KC,KK)[13]. The scorers were not blinded. The following 15 channels were monitored: 4 electroencephalogram (EEG) channels, 2 electrooculogram (EOG) channels, chin and leg electromyogram (EMG) channels, oro-nasal airflow thermistor, chest and abdominal respiratory impedance plethysmography, electrocardiogram, oxygen saturation, snoring and body positioning sensor. An obstructive apnoeic episode was defined by the decrease of airflow by more than 80% for more than two respiratory cycles

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Table I. Demographic data of 62 children with and without OSAS.

	OSAS	Non-OSAS	p-value
Male: Female	12:10	24:16	0.79
Age, mean+/-S.D.	6.24 yrs +/- 3.15 yrs	6.98yrs+/- 3.45 yrs	0.35

Table II. Common symptoms of OSAS and non-OSAS groups.

	AHI>1 (n=22)	AHI≤1 (n=40)	RR	95% CI
Observed apnoea				
always	4	1	2.53	1.42-4.53
sometimes	8	3	3.45	1.86-6.39
rarely	1	1	3.53	1.84-6.76
never	9	35		
Snoring				
always	20	10	10.67	2.72-41.8
sometimes	1	27	1.45	0.26-8.18
rarely	1	3		
never	0	0		
Breathing difficulty				
always	9	3	2.89	1.63-5.1
sometimes	6	5	3.63	1.74-7.58
rarely	0	8	2.14	1.02-4.52
never	7	23		
Tonsillar hypertrophy				
grade 4	4	5	1.31	0.58-2.98
grade 3	14	12	3.47	1.31-9.1
grade 2	2	11	2.92	0.78-11.0
grade 1	2	12		
Obesity	4	8	0.93	0.38-2.24
Poor academic performance or behavioural problems	4	6	1.16	0.5-2.69

RR= relative risk, expressed at various levels with cumulative numbers of cases.
CI= confidence interval.

Table III. Logistic regression analysis of significance of various factors in relation to OSAS.

Effect	Significance (p)
Difficult breathing	0.966
Observed apnoea	0.055
Regular snoring	<0.001
Restlessness during sleep	0.317
Obesity	0.300
Poor academic performance	0.066
Enlarged tonsils	0.722

in the presence of respiratory effort. Obstructive hypopnoea was defined as a decrease in airflow by 50 to 80% in the presence of respiratory effort, together with the presence of desaturation of more than 4% or EEG arousal. Each PSG was scored by one of the authors blindly in the absence of any clinical data. For the current study, the diagnostic criteria of OSAS is an obstructive apnoea-hypopnoea index (AHI) of more than one[14].

To find out the possible risk factors for OSAS, answers to the questionnaire and physical finding of tonsil size were compared between those with and without OSAS (Appendix 1). Tonsil size was classified from grade 1 to 5. Grade 1 means that the tonsils are not visible. Grade 2 is between grade 1 and 3. Grade 3 means they are at the midline between the anterior faucial pillar and the uvula. Grade 4 is between 3 and 5. Grade 5 means both tonsils touching each other.

Data were analysed by the Statistical Programs for Social Science (SPSS Inc., Chicago, IL, USA). Mean and standard deviations (S.D) were used to describe continuous variables. Logistic regression analysis of the risk factors for OSAS (i.e. AHI >1) were performed. A p-value of less than 0.05 was considered significant.

RESULTS

Sixty-two children were recruited consecutively from the sleep clinic. The mean age was 6.79 years +/- 3.6 years (range: 2-13 years). Male to female ratio was 36 to 26 (1.38 : 1). Twenty-two of them (12 boys and 10 girls) were diagnosed to have OSAS. AHI ranged from 1.62 to 72.4, mean AHI 8.62 +/- 8.12. There was no statistically significant difference in gender and age distribution between the OSAS and the non-OSAS group (Table I). The common symptoms of the two groups were listed in Table II. Logistic regression analysis for various factors that contribute to OSAS was performed. Snoring every night turned out to be the only significant risk factors although observed apnea was found to approach significance with a p value of 0.055. (Table III) All other factors were not statistically significant. Regular snoring every night was found to be the most significant risk factor of OSAS. The odds ratio was 10.67 (95% C.I. 2.72-41.8). For the current studied population of children suspected to have OSAS, the positive predictive value of nightly snoring was of 67% and absence of nightly snoring had a negative predictive value of 94%. Its sensitivity was 91% and the specificity was 75%.

DISCUSSION

There are several important observations in the current prospective study. Firstly, the overall prevalence of OSAS in our patients is 36%. This is much higher than the reported OSAS prevalence of 0.7 to 10.3% in the literature. The reasons are several-fold. Our patients were of higher risk groups as all were referrals from the inpatient service, the outpatient clinics and community-based doctors because of sleep disordered breathing symptoms. Moreover, the heterogeneity of diagnostic criteria of OSAS in children in the worldwide literature also contributes to a wide difference in the prevalence of this disease. Some studies did

Appendix 1

Key : Rarely = Monthly
Sometimes = Weekly
Always ≥ Every other day to daily

	Never	Rarely	Sometimes	Always	Don't know
1. Difficulty of breathing during sleep?	(1)	(2)	(3)	(4)	(5)
2. Stop breathing during sleep?	(1)	(2)	(3)	(4)	(5)
3. Snoring during sleep	(1)	(2)	(3)	(4)	(5)
4. Restless sleep?	(1)	(2)	(3)	(4)	(5)
5. Chronic rhinorrhoea or nasal symptoms?	(1)	(2)	(3)	(4)	(5)
6. Mouth-breathing when awake?	(1)	(2)	(3)	(4)	(5)
7. Frequent upper respiratory tact infections?	(1)	(2)	(3)	(4)	(5)
8. Increased difficulty of breathing during URTI?	(1)	(2)	(3)	(4)	(5)
9. Frequent nausea and vomiting?	(1)	(2)	(3)	(4)	(5)
10. Swallowing difficulty?	(1)	(2)	(3)	(4)	(5)
11. Excessive sweating during sleep?	(1)	(2)	(3)	(4)	(5)
12. Excessive daytime somnolence?	(1)	(2)	(3)	(4)	(5)
13. Any nightmares?	(1)	(2)	(3)	(4)	(5)
14. Early morning headache?	(1)	(2)	(3)	(4)	(5)
15. Secondary Nocturnal enuresis/Nocturia?	(1)	(2)	(3)	(4)	(5)
16. Hearing problems?	Yes / No				
17. Poor appetite?	Yes / No				
18. Recurrent middle ear disease?	Yes / No				
19. Speech problems?	Yes / No				
20. Delayed development?	Yes / No				
21. Obesity	Yes / No (i.e. body weight >120% of weight for height)				
22. Tonsil size	Grade 1 to 4				

not use PSG for the diagnosis. For example, Ali et al[1] reported an estimated prevalence of sleep-disordered breathing of 0.7% in a group of children without PSG. For studies that employed PSG as diagnostic criteria, Gislason et al[8] reported a prevalence of 2.9% among a group of habitual snorers and their diagnostic criteria was an apnoea-hypopnoea index of greater than 3. Redline et al[15] reported the prevalence in a general population of children to be 1.6% and 10.3% by using a diagnostic criteria of AHI more than 10 and 5 respectively. Hence, our high prevalence results from both our lower threshold of diagnosing OSAS, i.e. AHI >1 and our patients came from a selected high-risk group of children. The sex ratio showed no statistically significant difference between the OSAS and non-OSAS groups and this is in line with the worldwide literature about the equal sex ratio of OSAS in children[15,16]. The mean age of our OSAS patients was 6.24 years and 14 out of 22 of them (63.6%) were within three to six years old, the reported peak age group of OSAS[2].

Mallory et al[17] studied 41 obese children with the mean age of 10.3 years and 24% of these children had AHI more than five. Marcus et al[18] studied 22 obese children with the mean age of 10-year and 27% of these children were found to have OSAS. Redline et al[15] reported that obesity increased the risk for OSAS by four to five folds in 364 children with the mean age of 11 years. In contrast to these previous studies, the current series showed no difference in prevalence of obesity in the OSAS and non-OSAS group. These could be explained by the following factors: the relatively small sample size in the current series; the younger age of children in the current series (mean age of 6.2-year vs. 10-year in the previous series); the high risk OSAS status of the children in the current series may obscure the effect of obesity on OSAS.

In children, normal value of obstructive apnoea of any duration was found to be 0.1 +/- 0.5 per hour[14]. However, OSAS is best quantified by the combined apnoea and hyponoea episodes per hour, apnoea-

hyponoea index (AHI). Unfortunately, normal values of AHI are not available for children. AHI values of 5,10,15, 20 or 30 were used as indicative of OSAS in different studies[19]. AHI more than one was regarded as OSAS in the authors' department because all the cases were referred for suspected OSAS and represented a high risk group and a high sensitivity was desirable.

Considering the individual risk factors, snoring every night is the most powerful predictor for OSAS and the presence of it signified a significantly increased risk of OSAS. It also gives a very good sensitivity (91%) and a reasonable specificity (75%) when used as a screening question for suspected OSAS. Enlarged tonsils are a common finding in children and no difference was found in the current study regarding size of tonsils as judged by clinical assessment and OSAS status. However, a recent study of volume measurement of tonsils by magnetic resonance imaging study showed that the volume of tonsils were indeed larger in children with OSAS compared with control, 9.1 ml vs. 5.8 ml ($p<0.0005$)[20]. It reflects clearly that clinical estimation of tonsil volume is far too inaccurate to be useful as a risk estimate. We did also evaluate the relative risks of some other well-known features in OSAS like restlessness, daytime sleepiness, enuresis (see questionnaire) but none of them were significantly related to OSAS.

Previous studies showed that symptoms and signs were not reliable in the diagnosis of OSAS[4,21]. The inaccuracy was attributed to the fact that questionnaire depends highly on the accuracy of reporting by the caretakers who could be quite ignorant about the sleep symptoms. For example, it is well known that the apnoeic episodes occur more during the latter half of the night when children are in rapid-eye movement (REM) sleep. Their parents who would be asleep would not note such symptoms. However, it is evident from our present study that a carefully administered standardised questionnaire by trained clinicians together with an observation period in cases of doubt would help select out the high risk cases of OSAS in children.

There are some limitations in our study. We had not measured the intrascorer and interscorer variability although all the scorers had received a standard training programme and followed a standard scoring protocol under close supervision of the consultant, DKN. The second limitation was the selection bias that was introduced when parents who could not give answers to the questions at the first contact were allowed to take a further observation again. The third limitation is the small number of patients studied.

In conclusion, our study showed that nightly snoring is an important risk factor of OSAS. PSG should be arranged to those children who have this symptom.

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