Prevalence of Sleep Problems in Hong Kong Primary School Children*

A Community-Based Telephone Survey

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Study objectives: **To estimate the prevalence of snoring, witnessed sleep apnea, teeth grinding, primary and secondary nocturnal enuresis, and sleep duration in Hong Kong primary school children.**
Design: **Cross-sectional telephone questionnaire survey in a community.**
Participants: **A total of 3,047 6- to 12-year-old apparently healthy children.**
Intervention: **Those who agreed to the study were contacted by telephone. Survey questions were asked about the symptoms of the different sleep disorders, and the frequency of each positive symptom was noted for the preceding 1 week.**
Outcome measures: **Prevalence and risk factors of sleep disorders in Hong Kong primary school children.**
Results: **The prevalence of the following sleep symptoms was listed as follows: habitual snoring (10.9%), witnessed sleep apnea (1.5%), nocturnal enuresis (5.1%), and sleep teeth grinding (20.5%). Significant risk factors for habitual snoring included witnessed sleep apnea, mouth breathing during sleep, snoring in first-degree relatives, headache on rising, male gender, allergic rhinitis, and sleep teeth grinding. Significant risk factors for witnessed sleep apnea included habitual snoring, allergic rhinitis, tiredness on rising, and excessive daytime sleepiness. Poor academic results were associated with present of witnessed sleep apnea and absence of sleep teeth grinding. None of the sleep problem was associated with poor conduct results. The mean sleep duration was 8.79 h (SD 0.96).**
Conclusions: **This study provides epidemiologic data of sleep-disordered breathing, enuresis, sleep teeth grinding, and duration of sleep in Chinese primary school children in Hong Kong.**
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Key words: child; enuresis; epidemiology; sleep apnea, obstructive; snoring

Abbreviations: CI = confidence interval; *df* = degrees of freedom; EDS = excessive daytime sleepiness; NE = nocturnal enuresis; NS = not significant; OR = odds ratio; OSAS = obstructive sleep apnea syndrome; TuCASA = Tucson Children's Assessment of Sleep Apnea

There are few published studies of the prevalence of sleep-related health problems in children. An excellent review on the epidemiology of obstructive sleep apnea in children was prepared by Young et al.[1] Frequent snoring was reported to occur in 10 to 14% in children ≤ 6 years old from different studies from Europe and the United States.[1] Prevalence rates for obstructive sleep apnea syndrome (OSAS) were estimated at 0.7% in the preschool age group[2] and 1.6% in the 2- to 18-year age group.[3] As the prevalence of OSAS and other sleep-related health problems is related to the ethnic origin of the population,[4] its prevalence in individual ethnic groups needs to be ascertained. One study on sleep-related health problems in Chinese children was

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reported by Liu et al,[5] who found sleep walking to be the most common sleep problem (14.2%). In the same study, excessive daytime sleepiness (EDS), *ie*, sleep in class, was found in 9.4% and nocturnal enuresis (NE) was found in 4.5%. The prevalence of snoring and witnessed sleep apnea was not addressed in that study. NE was found to occur in 3.5% of Hong Kong children aged 4 to 12 years.[6] We report here a community-based, structured telephone interview to estimate the prevalence of snoring, witnessed sleep apnea, teeth grinding, EDS, primary and secondary NE, and sleep duration in a group of randomly selected primary school Chinese students in Hong Kong.

Materials and Methods

Primary schools were randomly selected from each district of Hong Kong, namely Hong Kong Island, Kowloon, and New Territory, by assigning each primary school a unique number, and all number were entered into a statistical program (SPSS, Release 10.1 for Windows; SPSS; Chicago, IL) for random selection. The number of schools selected from each district was on a *pro rata* basis. Ten primary schools were included in this study. All included primary schools that admitted students of both genders, with ages ranging from 5 to 16 years. In this study, students aged 6 to 12 years were enrolled. The total population of the 10 schools was 6,020 students. The primary school population in Hong Kong at the time of survey was 494,000. A letter (Appendix 1) was sent to all parents explaining the purpose of the study and inviting them to join the study. Parents gave their consent by returning the consent form together with their telephone numbers. Within 3 to 7 months of receiving the consent forms, a modified version of Tucson Children's Assessment of Sleep Apnea (TuCASA) screening questionnaire[7] (Appendix 2) was administered by trained workers (J.M.C. and S.Y.L.) over the telephone during the weekdays. The language used for interview was Cantonese, which is the dialect of Hong Kong Chinese. More than 95% of the citizens in Hong Kong can understand, listen, and speak Cantonese. English and Mandarin were used by the investigators if needed. Although this questionnaire was not previously validated, it was developed from the TuCASA screening questionnaire.[7] The revision and Cantonese translation of the TuCASA screening questionnaire was based on the collective opinion of two pediatric pulmonologists (D.K.N. and K.L.K.).

Parents who had impaired hearing or a speech impediment were excluded. The occurrence of symptoms of different sleep disorders was asked with the reference period being the preceding 1 week or 1 day, depending on the question. If the parents were not sure of the answers, they received an explanation of the different symptoms, and were contacted 1 week later.

Habitual snoring was defined as snoring for 6 to 7 nights a week. EDS was defined as the coexistence of two or more daytime sleepiness symptoms (*ie*, falling asleep while watching television, falling asleep during a lesson, falling asleep while doing homework, and falling asleep in a vehicle). Primary NE was defined as nocturnal bed-wetting beyond the age of 5 years and never having a period of dryness. Secondary NE was defined as bed-wetting after a period of at least 6 months of dryness. Parents were asked about the overall examination and conduct results in the preceding school term. Academic results were ranked as good (grade A/B), fair (grade C/D), or poor (grade E). Conduct was graded by the class teacher in charge, with the scores from A to F. Those who scored E or F were classified as bad conduct. The protocol of this study was approved by the ethic committee of Kwong Wah Hospital.

Statistical Analysis

All analyses were done using statistical software (SPSS, Release 10.1 for Windows; SPSS; Chicago, IL). Distribution of data was assessed by one-sample Kolmogorov-Smirnov test. Comparisons of continuous variables were conducted with unpaired Student *t* test or one-way analysis of variance. A Pearson χ^2 test was used for categorical variables.

Risk factors for snoring, witnessed sleep apnea, EDS, NE, poor academic results, and poor conduct were analyzed by logistic regression. Significant risk factors were defined as a Wald statistic gave a p value < 0.05. The adjusted odds ratio (OR) of each significant factor was reported.

Results

All 10 schools contacted initially agreed to the study. A total of 6,020 invitation letters were sent to all eligible students in 10 schools, and there were 4,432 responses (73.6%). Of all 4,432 eligible students, 3,139 agreed (70.8%) to a phone interview and 1,293 refused (26.1%). Of the 3,139 students who agreed, 92 were excluded (2.93%) because they were $>$ 12 years old. Therefore, 3,047 students were interviewed. The successful interview rate was 68.8% (3,047 of 4,432 students). Interviews were finished at the first successful contact in all cases, and no further contact was required. All interviews were completed in Cantonese. The mean age was 8.90 years (SD, 1.72; range, 6 to 12 years) [Fig 1]. The distribution of age was significantly deviated from normal distribution (one-sample Kolmogorov-Smirnov test, Kolmogorov-Smirnov $Z = 8.315$, $p < 0.001$) Student were categorized into groups of < 9 years old ($n = 1,409$, 46.2%) and ≥ 9 years old ($n = 1,638$, 53.8%). The male/female ratio was 1.32:1. The gender distribution in the two age groups was similar (Table 1) There was significantly more boys than girls in the study population when compared to the general population of the same age (male/female ratio, 1.07:1) [$p < 0.001$].

In our cohort of primary school children, prevalence rates of "no snoring," "snore 1 to 2 nights per week," and "snore 3 to 5 nights per week" were 63.2% ($n = 1,926$), 17.9% ($n = 544$), and 8.0% ($n = 244$) respectively. Habitual snoring was found in 333 subjects (10.9%, 95% confidence interval [CI], 10 to 12%). The male/female ratio of habitual snorers was 2.40:1. Significant risk factors for habitual snoring derived by logistic regression are listed in Table 2. Boys were 1.61 times more likely than girls to snore habitually,

Witnessed sleep apnea was found in 45 children (1.5%; 95% CI, 1 to 2%). Significant risk factors for

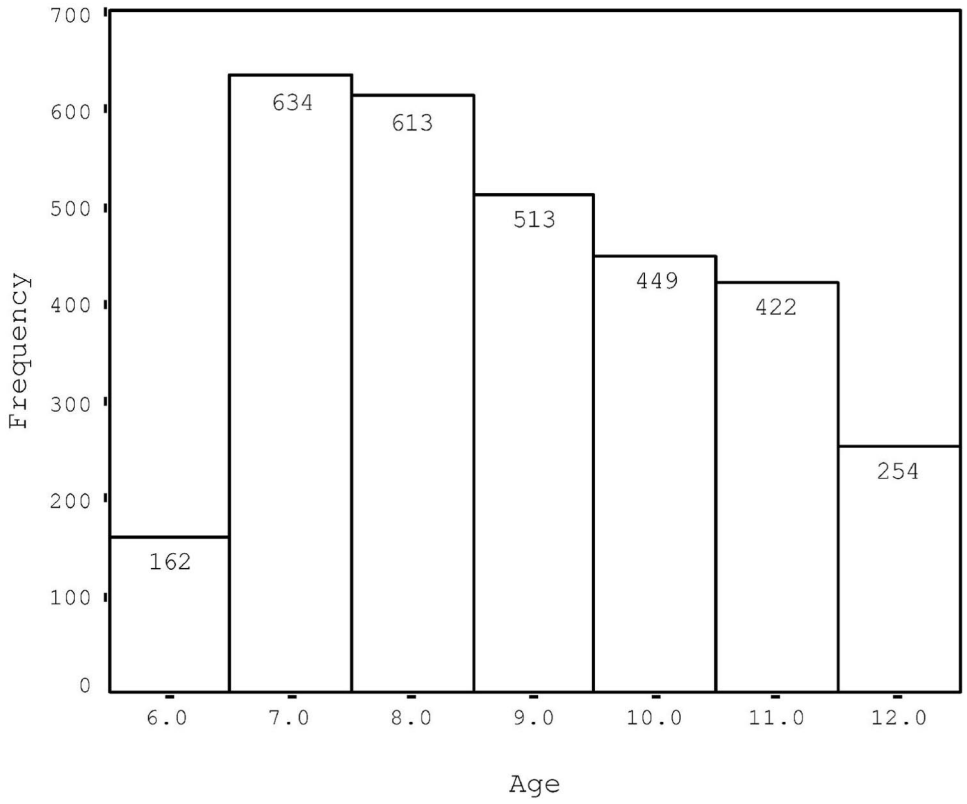

FIGURE 1. Age distribution (years) of study children.

witnessed sleep apnea are listed in Table 3. The prevalence of other sleep problems (*ie*, NE, sleep teeth grinding, EDS) is summarized in Table 1.

Sleep Duration

During the telephone interview, the parents were asked for the time of going to bed the previous night and the waking time the next morning. Sleep duration is summarized in Figure 2 and Table 4. Mean sleep duration of all subjects in the current study population was 8.79 h (SD, 0.96). Hong Kong primary school children slept significantly less than their American counterparts from 6 to 12 years of age (Table 4).[8] Hong Kong primary school boys slept significantly more than did girls: 8.84 h (SD, 0.95) vs 8.74 h (SD, 0.97; $t = 2.94$; degrees of freedom [*df*], 3045; $p = 0.003$). The biological significance of this difference remains to be ascertained.

Table 1—*Sleep-Related Symptoms and Other Related Problems

Variables	Male Gender (n = 1,732)	Female Gender (n = 1,315)	Total (n = 3,047)	Male/Female Ratio, OR (95% CI)
Age > 8 yr	930 (53.7)	708 (53.8)	1,638 (53.8)	0.99 (0.86–1.15)
Sleep problems				
Primary NE†	83 (4.8)	30 (2.3)	115 (3.8)	2.16 (1.41–3.29)
Secondary NE	32 (1.9)	14 (1.1)	46 (1.5)	1.75 (0.93–3.29)
EDS	120 (6.9)	83 (6.3)	203 (6.7)	1.11 (0.83–1.48)
Teeth grinding†	383 (22.1)	242 (18.4)	625 (20.5)	1.26 (1.05–1.51)
Other problems				
Asthma†	195 (11.3)	119 (9.0)	314 (10.3)	1.28 (1.00–1.62)
Allergic rhinitis†	798 (46.1)	444 (33.8)	1,242 (40.8)	1.68 (1.45–1.94)
Bad academic results (grade E)†	169 (9.8)	92 (7.0)	261 (8.6)	1.44 (1.10–1.87)
Bad conduct results (grade E or F)†	38 (2.2)	10 (0.8)	48 (1.6)	2.93 (1.45–5.90)

*Data are presented as No. (%) unless otherwise indicated.
†Significant higher prevalence in male vs female patients by χ^2 test ($p < 0.05$).

Table 2—*Significant Risks Factors of Habitual Snoring

Factors	β	p Value	Adjusted OR (95% CI)
Witnessed apnea	1.431	> 0.001	4.19 (2.21–7.93)
Mouth breathing during sleep	0.893	> 0.001	2.44 (2.00–2.98)
No family members snore		> 0.001	Referent
Father snores	0.718	> 0.001	2.05 (1.60–2.62)
Both parents snore	0.931	> 0.001	2.54 (1.76–3.66)
Father and siblings snore	0.732	0.001	2.08 (1.34–3.23)
Other family members snore	1.441	> 0.001	4.23 (2.44–7.32)
Male gender	0.477	> 0.001	1.61 (1.32–1.97)
Teeth grinding	0.442	> 0.001	1.56 (1.25–1.94)
Morning headache	0.423	0.025	1.53 (1.05–2.21)

*Other confounding factors have been adjusted by this model but have not emerged as significant risk factors: allergic rhinitis, mouth dryness when rising, age, and asthma.

Academic Performance

There was significant difference in mean sleep duration among children with different academic results (one-way analysis of variance, $F = 6.428$; $df = 3046$; $p = 0.002$) Scheffe *post hoc* tests showed that subjects with good academic results slept significantly longer than those with poor academic results, 13.76 min ($p = 0.002$). No significant difference was identified between other groups. A logistic regression model identified the following risk factors for poor academic results: absence of teeth grinding at night, falling asleep during a lesson, fall asleep while doing homework, and poor conduct. Witnessed sleep apnea was marginally significant as a risk factor for poor academic results, as the adjusted OR included one ($p = 0.050$) [Table 5].

Behavioral Problems

Logistic regression analysis found the following significant risk factors for bad conduct: poor academic results, falling asleep during a lesson, falling asleep while doing homework, and male gender (Table 6).

Table 3—*Significant Risks Factors for Witnessed Apnea

Factors	β	p Value	Adjusted OR (95% CI)
Habitual snoring	1.330	> 0.001	3.79 (2.01–7.14)
EDS	0.118	0.043	2.26 (1.03–4.97)
Allergic rhinitis	0.783	0.024	2.19 (1.11–4.32)
Tiredness on rising†	0.606	0.084	1.83 (0.92–3.65)

*Other confounding factors have been adjusted by this model but have not emerged as significant risk factors: gender, teeth grinding, mouth breathing, asthma, family history of sleep apnea, and sleep duration.

†Approaching significance.

EDS

Daytime sleepiness symptoms (*ie*, falling asleep while watching television, falling asleep during a lesson, falling asleep while doing homework, and falling asleep in a vehicle) in primary school students were assessed. In this study, the number of students with no symptoms, one symptom, and two symptoms were 1,317 (43.2%), 1,005 (33.0%), and 522 (17.1%), respectively. Two hundred three children (6.7%; 95% CI, 6 to 8%) had EDS. Risk factors for EDS included younger age, shorter sleep duration, witnessed sleep apnea, headache on rising, tiredness on rising, allergic rhinitis, and habitual snoring (Table 7).

Sleep Teeth Grinding

Sleep teeth grinding was noted by the parents in the preceding week in 625 children (20.5%; 95% CI, 19 to 22%). Sleep teeth grinding was closely associated with habitual snoring (Table 2). The mean age of children with teeth grinding (8.59 years; SD, 1.72) was significantly younger than those without teeth grinding (8.98 years; SD, 1.71) [$t = 4.98$; $df = 3045$; $p < 0.001$].

NE

NE was found in 159 children (5.2%; 95% CI, 4 to 6%) Primary NE was found in 113 children (3.7%; 95% CI, 3 to 4%), whereas secondary NE was reported in 46 children (1.5%; 95% CI, 1 to 2%). The mean age for primary NE was 8.1 years (SD, 1.51). Mean age for secondary NE was 8.04 years (SD, 1.41). There was a marked male predominance in both enuretic groups (male/female ratio, 115:44; $\chi^2 = 15.651$; $df = 2$; $p < 0.001$; OR, 2.05; 95% CI, 1.44 to 2.93). For primary NE, the only significant risk factor identified by logistics model was witnessed sleep apnea ($p = 0.033$; adjusted OR, 3.18; 95% CI, 1.23 to 8.19). For secondary NE, no significant risk factor was identified.

Discussion

The modified TuCASA telephone questionnaire survey provided information about sleep-related symptoms in Hong Kong Chinese children. A structured telephone interview to probe for sleep problems in community-based sample was used previously in an adult population.[9] The main strength of the current study was the telephone interview that allowed explanation of symptoms, *eg*, sleep apnea, snoring, or NE. The accuracy of the data was further enhanced by allowing the parents to observe for 1 week before answering the questions. The preva-

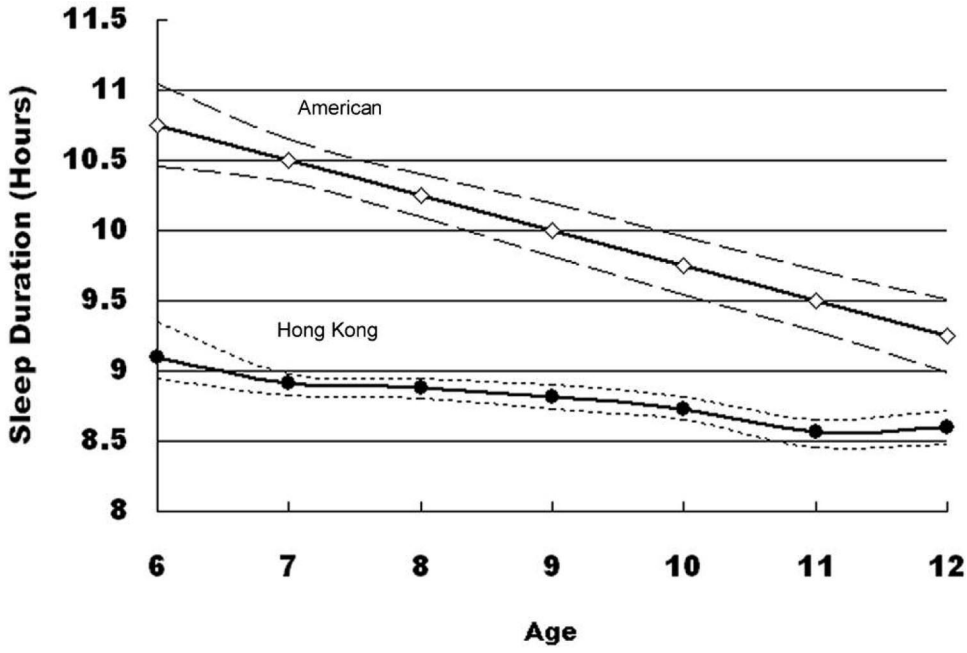

FIGURE 2. Mean parental sleep duration and 95% CI of Hong Kong primary school children and American children.[8]

lence of habitual snoring was 10.9%, which was similar to that reported previously: 3 to 12% of preschool-aged children.[10] Unlike the previous report, the current study identified male gender to be a significant risk factor. This might be attributed to the fact that male Hong Kong children were more likely to have allergic rhinitis as shown in the current study (Table 1) and in a previous report.[11]

Witnessed sleep apnea was reported to occur in 1.5% (95% CI, 1 to 2%) of the studied population. This prevalence was similar to that in white children found by Goodwin et al,[7] who reported the prevalence of witnessed apnea to be 1.9% in white children and 4.7% in Hispanic children with similar age groups as the current study. Assuming most of these children would have OSAS, the prevalence would be similar to the 1.6% reported by Redline et al[3] in a similar age group. Allergic rhinitis was found to be a significant risk factor for witnessed sleep apnea in the present study. This was similar to the findings by Redline et al.[3] Hence, it would not be surprising that treatment of allergic rhinitis helped control OSAS as demonstrated by Brouillette et al.[12]

Lower academic performance was shown by the current study to be associated with the presence of witnessed sleep apnea, which was a cardinal symptom of OSAS. This finding was similar to that of

Table 4—*Sleep Duration in Hong Kong Primary School Children*

Age, yr	Children, No.	Sleep Duration, h	Reference American Sleep Duration, h*	p Value†
6	162	9.10 (0.98)	10.75 (1.88)	< 0.001
7	634	8.90 (0.93)	10.50 (1.88)	< 0.001
8	613	8.87 (0.93)	10.25 (1.75)	< 0.001
9	513	8.80 (0.95)	10.00 (2.19)	< 0.001
10	449	8.72 (0.92)	9.75 (2.31)	< 0.001
11	422	8.55 (0.98)	9.50 (2.13)	< 0.001
12	254	8.60 (0.98)	9.25 (2.13)	< 0.001

*According to Weissbluth et al.[8]

†One-sample *t* test, mean sleep duration of Hong Kong students vs reference American values.

Table 5—*Significant Risk Factors for Poor Academic Results**

Factors	β	p Value	Adjusted OR (95% CI)
Bad conduct	− 2.357	> 0.001	10.31 (8.27–12.99)
Witnessed apnea	− 0.674	0.050	1.96 (1.00–3.86)
Falling asleep during a lesson	− 0.445	0.005	1.56 (1.15–2.12)
Falling asleep while doing homework	− 0.343	< 0.001	1.41 (1.15–1.70)
Teeth grinding	0.215	0.036	0.81 (0.66–0.99)
Male gender†	− 0.158	0.074	1.38 (1.00–1.38)

*Other confounding factors have been adjusted by this model but have not emerged as significant risk factors: sleep duration, mouth breathing while sleeping, tiredness on rising, and falling asleep in a vehicle.

†Approaching significance.

Table 6—*Significant Risks Factors for Poor Conduct

Factors	β	p Value	Adjusted OR (95% CI)
Poor academic results	2.342	> 0.001	10.42 (8.33–12.99)
Male gender	0.642	> 0.001	1.90 (1.58–2.29)
Falling asleep while doing homework	0.327	0.001	1.39 (1.14–1.70)
Falling asleep during a lesson	0.319	0.041	1.38 (1.01–1.87)

*Other confounding factors have been adjusted by this model but have not emerged as significant risk factors: sleep duration, witnessed apnea, tiredness on rising, teeth grinding, mouth breathing while sleeping, and habitual snoring.

Gozal,[13] who reported that children with features of OSAS had better academic results after tonsillectomy and adenoidectomy than a similar group without tonsillectomy and adenoidectomy. Further studies are warranted to shed light on the relationship between OSAS and academic performance. It was interesting to note, in the current study, that sleep teeth grinding was associated with good academic performance in the current study. This was exactly the opposite of that reported by Agargun et al,[14] who suggested that bruxism might be associated with learning difficulties. We noted that teeth grinding was closely associated with habitual snoring in the current study and habitual snoring was a common symptom of OSAS that was associated with a learning problem.[13] The current study suggests that the two closely associated conditions, *ie*, habitual snoring and sleep teeth grinding, had an opposite effect on academic results. This probably explained why Urschitz et al[15] found no association between habitual snoring and academic results in primary school children, as the confounding effect of sleep teeth grinding was not investigated. Similar to Urschitz et al,[15] we also found no association between habitual snoring and academic performance (χ^2 test, $p = 0.406$; data not shown here). Thus, habitual snoring was not entered into the logistic regression model of academic results (Table 5). Stress may be involved in the development of nocturnal bruxism.[16–18] Cheung and Leung-Ngai[19] found that primary school students in Hong Kong spent 1.5 to 2 h daily doing homework, which was longer than that reported from America and Asia.[20] In addition, anxiety symptoms and depression symptoms were significantly associated with homework hours in Hong Kong students.[19] The better academic results of those with teeth grinding in the current study could be mediated through the longer homework hours and, hence, stress in those higher achievers. Further studies to examine this relationship are warranted. The significant association between academic results and sleepiness during class or homework was similar to that found by Goodwin et al,[7] who found daytime sleepiness to be associated with learning problems.

Table 7—*Significant Risk Factors for EDS

Factors	β	p Value	Adjusted OR (95% CI)
Witnessed sleep apnea	0.795	0.048	2.21 (1.01–4.88)
Headache on rising	0.609	0.007	1.97 (1.21–3.22)
Tiredness on rising	0.609	0.001	1.84 (1.30–2.60)
Allergic rhinitis	0.557	> 0.001	1.75 (1.29–2.36)
Habitual snoring	0.546	0.001	1.73 (1.25–2.39)
Sleep duration	− 0.354	> 0.001	0.70 (0.60–0.82)
Age > 8 yr	− 0.497	0.001	0.61 (0.45–0.82)

*Other confounding factors have been adjusted by this model but have not emerged as significant risk factors: gender and asthma.

Chervin et al[21] reported that inattention and hyperactivity were more common in habitual snorers (OR, 2.2; 95% CI, 1.4 to 3.6), and they showed that boys < 8 years old accounted for most of the association between hyperactivity and habitual snoring (but not sleepiness). A similar association was not identified by the current study using poor conduct as a marker for inattention and hyperactivity. This is most probably due to the difference in the study population, as 53.8% of the current study population is ≥ 8 year old (Fig 1), compared to 35% in the study by Chervin et al.[21] Variations in conduct scores could be attributed to different factors; in other words, personality traits, peer pressure, and assessment criteria of teachers and conduct scores might not be appropriate surrogate markers of inattention and hyperactivity.

In the current study, EDS, defined as the presence of more than two daytime sleep symptoms, was found to be 6.7%. This was similar to that reported by Goodwin et al,[7] who found EDS in 5.8% of white children and 9.6% of Hispanic children. In the current study, significant risk factors for EDS were similar to the clinical features of OSAS, *ie*, witnessed sleep apnea, habitual snoring, headache on rising, allergic rhinitis. This was similar to the findings of Gottlieb et al,[22] who found a strong association between symptoms of OSAS and EDS, defined as overly sleepy during the daytime at least once a week, in a group of 5-year-old children.

Hong Kong is a modern city with around-the-clock activities. It is common for both parents to work, and they often come home late for dinner. This results in a routine that encourages children to sleep late but wake up early for school because of heavy traffic. Hence, it is not surprising that the parent-reported sleep duration of 8.79 h (SD, 0.96) in our study is much shorter than the parent-reported sleep dura-

tion in American children in 1981.[8] It is also similar to the shortest sleep duration reported in the literature, that of the Israeli pupils.[23] Acute sleep restriction to 5 h of sleep for 1 night has been shown to impair higher cognitive functions, *eg*, verbal creativity and abstract thinking.[24] Sadeh et al[25] reported no correlation between total sleep duration and neurobehavioral functioning in 135 7- to 13-year-old Israeli children, although they did show a significant adverse impact of decreased sleep percentage, *ie*, percentage of true sleep time over total sleep period, on neurobehavioral functioning in the 7- to 9-year-age group. Gau and Soong[26] also reported nighttime sleep duration on school days was significantly related to alertness in the morning. These reported findings might well explain the finding in the current study that those scored poorly in the academic results had a shorter duration of sleep, an average reduction of 13.76 min. This result echoes the findings by Epstein et al,[27] that a 24-min reduction in sleep duration resulted in "increased prevalence of difficulties in concentrating and paying attention during classes." In the current study, sleepiness during class and homework, which might be an indirect marker for sleep inadequacy, were shown to be significant risk factors for poor academic results.

In the current study population, primary school boys slept significantly more than girls. This was exactly opposite to that reported for American children[8] and Israeli children.[26] The Hong Kong girls slept less than their American and Israeli counterparts, and this may be attributed to the heavier academic workload in Hong Kong.[19]

The prevalence of NE was similar to that reported previously in Hong Kong[6] and China.[5] Similar to a previous report,[6] boys were found to be twice as likely to be enuretic as girls. As previously reported by Brooks and Topol,[28] we found witnessed sleep apnea to be a significant risk factor that approached significance for primary NE. Hence, OSAS should be actively looked for in enuretic children.

The prevalence of sleep teeth grinding was higher than that reported previously from students in Turkey with similar age groups.[14] However, the prevalence in the current study was similar to that reported in Canadian children (aged 3 to 10 years)[18] and American college students.[29,30] The sleep teeth grinding was found to be associated with habitual snoring in the current study. This was similar to that reported previously.[30,31] Further study into the mechanism underlying this association is warranted.

The main limitation of the current study was the rather low participation rate, as only 68.8% of those approached agreed to the study, and this might invoke a degree of selection bias in favor of recruiting those who had sleep symptoms. This was reflected by significantly more boys than girls in the studied population. This would result in an overestimation of the snoring symptom as allergic rhinitis; a main risk factor for snoring was more likely to occur in boys.[11] Nonetheless, the prevalence of doctor-diagnosed asthma and allergic rhinitis were comparable with that obtained previously in Hong Kong children. Hence, the population selection might not be significantly different from the general population. This leads us to believe that our survey return rate of 68.8% was a good representation of the general primary school population in Hong Kong.

Symptoms in children were reported by parents without any independent verification (*eg*, overnight polysomnography, nocturnal home pulse oximetry, and actigraphy) in the current study. This was the intrinsic problem of all postal or telephonic questionnaires. Subjective reporting of symptoms by parents might underestimate the incidence and severity of sleep-disordered breathing.[32] Moreover, overlapping of sleep time of parents and children decreased the likelihood of parental witnessing of sleep problems. Further similar study should be augmented with polysomnography or videotaping of sleep to verify the symptoms reported by parents. A drawback in the current study involved the lack of data on obesity, a well-known risk factor for sleep disordered breathing.[33] Future epidemiologic study should address the issue of obesity and sleep problems.

In conclusion, the current study identified the prevalence of habitual snoring and witnessed apnea in Chinese children, and it was similar to the white population. Sleep deprivation is a common phenomenon in Hong Kong children. Daytime sleepiness and witnessed sleep apnea were associated with poor academic results.

Appendix I: Letter Sent to the Family (English Translation)

Dear Parents,

I am the consultant pediatrician of the "Children Sleep Disorder Service" of Kwong Wah Hospital. I am inviting you to participate in a research program in our hospital. Approximately 10% of children are found to have snoring at night in many surveys. Among them, OSAS was diagnosed in 10%. In our Children Sleep Disorder Unit, we have seen 109 children with OSAS in 352 snoring children since 1997.

The aim of this sleep survey is to investigate the sleep problems of primary school children in Hong Kong. You need to observe your child's sleep habits for 1 week. Our researcher will call you and ask some questions. All the information provided is only for research purpose, and it will be kept strictly confidential. You have the right to reject this survey. In addition, you may withdraw at any time during the survey. Thank you for your participation.

Yours faithfully,

Dr. Daniel Ng Kwok Keung

Reply

I _____ agree/disagree that my child _____ to join the "Hong Kong Children Sleep Survey Questionnaire." If you agree to join the survey, please kindly leave your contact number and choose a convenient time for the telephone questionnaire.

Telephone No. _____

Time to call

1. Monday to Friday 9 AM to 5 PM
2. Monday to Friday 6 PM to 9 PM

Appendix II: Hong Kong Children Sleep Survey Questionnaire (English Translation)

Age of child: _____

Gender of child: _____

1. In the preceding week, how often has your child snored (snoring is audible)? (no/1–2 nights/3–5 nights/6–7 nights)
2. In the preceding week, has your child been grinding his/her teeth while asleep? (yes/no)
3. In the preceding week, has your child wet the bed? (yes/no)

An additional question for enuretic children: Has your child ever been dry (absence of bed-wetting) for 6 months? (yes/no)

4. In the preceding week, have you observed your child to have apnea while asleep (apnea means to stop breathing for few seconds, as evidenced by movement of rib cage without any sound of breathing; additional evidence includes a struggle to breathe)? (yes/no)
5. In the preceding week, have you observed your child to have mouth breathing while sleeping? (yes/no)
6. In the preceding week, has your child complained of restless sleep (restless sleep means tiredness on rising or unrefreshed sleep)? (yes/no)
7. In the preceding week, has your child complained of morning headaches? (yes/no)
8. Has allergic rhinitis been diagnosed in your child by a doctor? (yes/no)
9. Has asthma been diagnosed in your child by a doctor? (yes/no)
10. In the preceding week, has your child fallen asleep while watching television? (yes/no)
11. In the preceding week, has your child fallen asleep while doing homework? (yes/no)
12. In the preceding week, has you child fallen asleep in a vehicle? (yes/no)
13. In the preceding week, have any teachers complained that your child has fallen asleep during a lesson? (yes/no)
14. What was your child's academic result in the last academic year (good = grades A–B, fair = grades C–D, and poor = grades E–F)? (good/fair/poor)
15. What is the conduct assessment of your child in the last academic year (good = grades A–B, fair = grades C–D, poor = grades E–F)? (good/fair/poor)
16. What time did your child go to bed last night? _____
17. When did your child wake up this morning? _____
18. Are there any family members who snore at night? (yes [which member: father, mother, siblings, other]/no)
19. Are there any family members who have diagnosed sleep apnea? (yes [which member: father, mother, siblings, other]/no)

References

1 Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea: a population health perspective. Am J Respir Crit Care Med 2002; 165:1217–1239

2 Ali NJ, Pitson DJ, Stradling JR. The prevalence of snoring, sleep disturbance, and sleep related breathing disorders and their relationship to daytime sleepiness in 4–5 year old children. Arch Dis Child 1993; 68:360–366

3 Redline S, Tishler PV, Schluchter M, et al. Risk factors for sleep-disordered breathing in children: associations with obesity, race and respiratory problems. Am J Respir Crit Care Med 1999; 159:1527–1532

4 Redline S, Tishler PV, Hans MG, et al. Racial differences in sleep disordered breathing in African Americans and Caucasians. Am J Respir Crit Care Med 1997; 155:186–192

5 Liu X, Sun Z, Uchiyama M, et al. Prevalence and correlates of sleep problems in Chinese schoolchildren. Sleep 2000; 23: 1053–1062

6 Yeung CK. Nocturnal enuresis in Hong Kong: different Chinese phenotypes. Scand J Urol Nephrol Suppl 1997; 31:12–21

7 Goodwin JL, Babar SI, Kaemingk KL, et al. Symptoms related to sleep-disordered breathing in white and Hispanic children: the Tucson Children's Assessment of Sleep Apnea Study. Chest 2003; 124:196–203

8 Weissbluth M, Poncher J, Given G, et al. Sleep duration and television viewing. J Pediatr 1981; 99:486–488

9 Ohayon MM, Guilleminault C, Priest RG, et al. Snoring and breathing pauses during sleep: telephone interview survey of a United Kingdom population sample. BMJ 1997; 314:860–863

10 Schechter MS, Section on Pediatric Pulmonology, Subcommittee on Obstructive Sleep Apnea Syndrome. Clinical practice guideline: diagnosis and management of childhood obstructive sleep apnea syndrome. Pediatrics 2002; 109:e69

11 Lau YL, Karlberg J. Prevalence and risk factors of childhood asthma, rhinitis and eczema in Hong Kong. J Paediatr Child Health 1998; 34:47–62

12 Brouillette RT, Manoukian JJ, Ducharme FM, et al. Efficacy of fluticasone nasal spray for pediatric obstructive sleep apnea. J Pediatr 2001; 138:838–844

13 Gozal D. Sleep-disordered breathing and school performance in children. Pediatrics 1998; 102:616–620

14 Agargun MY, Cilli AS, Sener S, et al. The prevalence of parasomnias in preadolescent school-aged children: a Turkish sample. Sleep 2004; 27:701–705

15 Urschitz MS, Eitner S, Guenther A, et al. Habitual snoring, intermittent hypoxia, and impaired behavior in primary school children. Pediatrics 2004; 114:1041–1048

16 Manfredini D, Landi N, Ronmagnoli M, et al. Psychic and occlusal factors in bruxers. Aust Dent J 2004; 49:84–89

17 Hicks RA, Conti PA, Bragg HR. Increases in nocturnal bruxism among college students implicate stress. Med Hypotheses 1990; 33:239–240

18 Laberge L, Tremblay RE, Vitaro F, et al. Development of parasomnias from childhood to early adolescence. Pediatrics 2000; 106:67–74

19 Cheung SK, Leung-Ngai JMY. Impact of homework stress on children's physical and psychological well-being. J Hong Kong Med Assoc 1992; 44:146–150

20 Chen CS, Stevenson HW. Homework: a cross-cultural examination. Child Dev 1989; 60:551–561

21 Chervin RD, Archbold KH, Dillon JE, et al. Inattention, hyperactivity and symptoms of sleep-disordered breathing. Pediatrics 2002; 109:449–456

22 Gottlieb DJ, Vezina RM, Chase C, et al. Symptoms of sleep-disordered breathing in 5-year-old children are associated with sleepiness and problem behaviors. Pediatrics 2003; 112:870–877

23 Tynjala J, Kannas L, Valimaa R. How do young Europeans sleep? Health Educ Res 1993; 8:69–80

24 Randazzo AC, Muehlbach MJ, Schweitzer PK, et al. Cognitive function following acute sleep restriction in children ages 10–14. Sleep 1998; 21:861–868
25 Sadeh A, Gruber R, Raviv A. Sleep, neurobehavioral functioning, and behaviour problems in School-age children. Child Dev 2002; 73:405–417
26 Gau SF, Soong WT. Sleep problems of junior high school students in Taipei. Sleep 1995; 18:667–673
27 Epstein R, Chillag N, Lavie P. Starting times of school: effects on daytime functioning of fifth-grade children in Israel. Sleep 1998; 21:250–256
28 Brooks LJ, Topol HI. Enuresis in children with sleep apnea. J Pediatr 2003; 142:515–518
29 Granada S, Hicks RA. Changes in self-reported incidence of nocturnal bruxism in college students: 1966–2002. Percept Mot Skills 2003; 97:777–778
30 Ng DK, Kwok KL, Poon G, et al. Habitual snoring and sleep bruxism in a paediatric outpatient population in Hong Kong. Singapore Med J 2002; 43:509–516
31 Sjoholm TT, Lowe AA, Miyamoto K, et al. Sleep bruxism in patients with sleep-disordered breathing. Arch Oral Biol 2000; 45:889–896
32 Sivan Y, Korneck A, Schonfeld T. Screening obstructive sleep apnoea syndrome by home videotape recording in children. Eur Respir J 1996; 9:2127–2131
33 Ng DK, Lam YY, Kwok KL, et al. Obstructive sleep apnoea syndrome and obesity in children. Hong Kong Med J 2004; 10:44–48