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Habitual Snoring in Primary School Children: Prevalence and Association with Sleep-Related Disorders and School Performance

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Key Words
Habitual snoring prevalence · Sleep problem questionnaire · Sleep-related disorders, children

Abstract
Objectives: To determine the prevalence of habitual snoring (HS) and its association with both day- and nighttime symptoms, school performance and behavioral disturbances in a sample of primary school children. ***Subjects and Methods:*** A cross-sectional study was performed on 1,605 children (819 boys and 786 girls) aged 7–13 years from 9 randomly selected primary schools located within the city limits of Isparta, Turkey. HS and sleep problems were assessed using a 55-item multiple-choice questionnaire. ***Results:*** Of the 1,605 questionnaires, 1,164 were fully completed and returned, giving a response rate of 72.5%. The overall prevalence of snoring was 38.9%, while HS accounted for 3.5%. The prevalence of HS among boys (25, 3.0%) was higher than among girls (16, 2.0%; χ^2 for trend: $p < 0.001$, OR: 1.92, 95% CI: 1.01–3.66). There was an association between younger age and HS, as children aged 7–8 years had the highest prevalence (χ^2 for trend: 0.054, OR: 1.85, 95% CI: 0.81–4.22). Habitual snorers had more daytime and nighttime symptoms. Allergic symptoms, daytime mouth breathing, shaking the child for apnea, restless sleep and hyperactivity were significant and independent risk factors and sleep-related symptoms for HS. A significant and independent association was found between poor school performance and hyperactivity, nocturnal enuresis, tooth grinding and low parental/maternal education in multivariate analysis. ***Conclusion:*** Children with HS were more likely to have sleep-related daytime and nighttime symptoms. No significant association was determined between HS and poor school performance.

Introduction

Habitual snoring (HS) is recognized as an important manifestation of obstructive sleep apnea syndrome (OSAS) in children, which is similar to that of adults [1]. Numerous risk factors for HS and OSAS have been reported, including adenotonsillar hypertrophy, obesity, allergies or other causes of nasal obstruction, and exposure to tobacco smoke [2, 3]. HS in primary school children, associated with daytime and nighttime symptoms and neurobehavioral problems [1], has been reported to range from 3.2 to 12.1% [4–8] in various countries.

The aims of the present study were to investigate the prevalence of HS and determine its association with sleep-related disorders, school performance and behavioral disturbances in a sample of primary school students in Isparta, Turkey.

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Subjects and Methods

The survey was conducted between March and June 2007 in the province of Isparta, Turkey, which has a population of approximately 160,000 and 52 primary schools in two school districts with 27 and 25 schools in each district. All schools agreed to participate in the study. Nine schools, 5 from the first and 4 from the second district, were randomly chosen by systematic sampling. The population of these 9 schools was 4,586. A total of 1,605 children were randomly chosen from the classes in a proportion of 1/3. The sample size was calculated as 1,506, which would ensure an estimate of prevalence of HS of 5%, with a precision of 1.5%. The power of the study was 80%, and α- and β-values were taken as 5 and 20%, respectively. A letter explaining the aims of the study, an informed consent form, and a questionnaire on signs and symptoms of snoring and sleep-disordered breathing were given to the children to be filled in by their parents. To increase the accuracy of the responses, we asked parents to follow their children's sleep for a week before answering the questions. The questionnaires were collected by the classroom teachers and picked up by one of the investigators (2 physicians, 2 nurses and 1 member of staff) during the periodic visits.

The study protocol and questionnaire were approved by the Research and Ethics Committee of the Süleyman Demirel University. Permission for the study was obtained from the Isparta Elementary and Secondary Education Authorities. A 55-item, multiple-choice questionnaire formulated by Ersu et al. [1] according to the guidelines of Carroll et al. [9] and Brouillette et al. [10, 11] was used. Questions were answered by yes/no or by a 5-point frequency scale: never = 0; seldom = 1; occasionally = 2; frequently = 3, and almost every day = 4. HS was considered present if parents reported snoring as occurring either frequently or almost every day. The validity of the questionnaire was tested on an independent sample of 38 school-aged students prior to the survey.

All parents completed a questionnaire that included questions regarding their Epworth Sleep Scale questionnaire, which Snow et al. [12] adapted for children (the item 'falling asleep while driving a car' was changed to 'falling asleep at school'). In this questionnaire, the chances of falling asleep in 8 different conditions was estimated on a scale of 0–3 in each condition, and the total score is the sum of the scores for the 8 items. A child with an Epworth Sleep Scale score >12 was considered as suffering from excessive daytime sleepiness (+) [12].

The body mass index (BMI) was calculated using a standard formula. Standardized percentile curves of BMI for children were calculated using the percentile curves for males and females aged 1–19 years of Hammer et al. [13]. Overall academic performance of the children was determined using the preceding class results. Academic results were ranked as good, fair and poor. The study population consisted of middle-class families and, thus, was quite homogeneous regarding socioeconomic status. However, parental education was taken as an index of socioeconomic status as reported in a previous study [6].

Statistical Analysis

Of the 1,605 questionnaires distributed, 1,417 were collected; of these, 253 were either incomplete or improperly completed and were therefore excluded from the analysis. Hence, 1,164 questionnaires were analyzed. Statistical analyses were carried out by using a statistical software package (SPSS package version 11.0 for Windows; SPSS, Chicago, Ill., USA). The comparison of habitual snorers with occasional snorers plus nonsnorers for continuous variables was completed using Student's t test and for categorical characteristics using the Pearson χ^2 and χ^2 trend test to verify the presence of a significant trend. The association between the presence of symptoms and the presence of HS was detected by Fisher's exact test when there were fewer than 5 subjects in 1 cell. Results were given as odds ratios (ORs) with 95% confidence intervals (95% CIs). Multivariate analysis was applied to evaluate the contribution of the various factors identified by univariate analysis. Factors with statistically significant associations by univariate analysis were entered into a logistic regression model, and adjusted ORs with 95% CIs were estimated. A p value of less than 0.05 was considered to achieve statistical significance.

Results

The overall response rate was 72.5% (1,164/1,605). The prevalences of snoring as well as personal characteristics are given in table 1. Of the 1,164 questionnaires analyzed, 589 were from boys and 575 from girls. The mean age was 9.73 ± 1.49 years, the range 7–13 for boys. Of the 1,164 children, 41 (3.5%) snored 'frequently' or 'almost every day' and were categorized as habitual snorers, 412 (35.4%) as occasional snorers and 711 (61.1%) as nonsnorers. Hence, the overall prevalence of snoring was 38.9%. Among the 41 children with HS, snoring loudness was rated as follows: rather quiet = 10; medium loud = 23; loud = 7, and very loud = 1.

Witnessed sleep apnea was found in 42 children (3.4%); the frequency was significantly higher in habitual snorers. The prevalence of HS among boys (25, 3.0%) was higher than among girls (16, 2.0%). There was an association between younger age and HS: children aged 7–8 years had the highest prevalence of snoring.

Snoring increased significantly from children with BMI <5th percentile to those with BMI from the 75th to 90th percentile and to those with BMI above the 90th percentile. The prevalence of HS in children within these percentiles was more than double in those with a BMI in the 5th–75th percentiles. The OR reached a weak statistical significance only within the BMI 75th–90th percentile category (95% CI: 1.01–5.53).

Regarding the data for passive smoking, 52.5% of the children lived in a household where at least one member of the family currently smoked. Maternal and paternal smoking was reported in 18 and 44.8%, respectively. HS was closely associated with smoking habits of parents with an OR of 1.90. No statistically significant association was found between HS and household crowding. The

Table 1. Prevalence (%) of snoring in groups of children (589 boys/575 girls) defined according to demographic and personal characteristics

		All subjects	Non-snorers	Occasional snorers	Habitual snorers	p value	Unadjusted ORs
Total		100.0	61.1	35.4	3.5		
Sex	boys	50.6	54.2	41.6	4.2	<0.001	1.92 (1.01–3.66)
	girls	49.4	68.2	29.0	2.8		1
Age	7–8 years	24.4	58.8	36.6	4.6	0.054	1.85 (0.81–4.22)
	9–10 years	41.1	59.2	37.2	3.6		1.42 (0.66–3.10)
	≥11 years	34.5	64.3	32.3	2.7		1
BMI	<5th perc.	9.8	72.8	21.9	5.3	0.014	1.69 (0.66–4.31)
	5th–75th perc.	69.4	60.8	36.5	2.7		1
	75th–90th perc.	11.3	60.6	34.1	5.3		2.37 (1.01–5.53)
	>90th perc.	9.5	51.8	42.7	5.5		2.42 (0.94–6.24)
Maternal smoking	+	18.0	54.5	40.7	4.8	0.027	1.69 (0.81–3.54)
	–	82.0	62.5	34.2	3.2		
Paternal smoking	+	44.8	56.1	39.7	4.2	0.002	1.65 (0.88–3.11)
	–	55.2	65.1	31.9	3.0		
Household smoking	+	52.5	55.5	40.3	4.3	<0.001	1.90 (0.99–3.65)
	–		67.3	30.0	2.7		
Household crowding	+	52.8	62.1	33.7	4.2	0.834	1.49 (0.78–2.87)
	–		59.9	37.3	2.7		
Low maternal education	≤8 years	33.8	62.9	33.5	3.6	0.426	0.97 (0.50–1.88)
Low paternal education	≤8 years	22.6	61.6	34.6	3.8	0.939	1.10 (0.52–2.28)
Mother's job	housewife	60.5	62.8	34.4	2.8	0.073	0.58 (0.31–1.11)

p values were determined by the χ^2 trend test; 95% CIs are indicated in parentheses. perc. = Percentile.

prevalence of HS in children who sleep alone was not different from those who sleep with the parents (p = 0.467).

Socioeconomic status did not seem to have a significant effect on the prevalence of HS (p = 0.939). The prevalences of risk factors and sleep-related symptoms in children who never snored, snored occasionally and snored habitually are given in table 2.

The prevalence of diurnal symptoms increased across the snoring groups and was highest in the group of habitual snorers. Habitual snorers had significantly more nighttime symptoms, such as observed apneas, difficulty breathing during sleep, profuse sweating during sleep, blue color during sleep, parental shaking for apnea, increased parental anxiety, restless sleep, nocturnal enuresis and tooth grinding. The prevalence of daytime symptoms including daytime mouth breathing, excessive daytime sleepiness, morning headaches and hyperactivity also increased.

No difference was found for sleep habits and sleep duration in children, during the week or weekend; the bedtime and wake-up times were similar in the two groups. The average sleep duration in habitual snorers was 9.42 ± 0.55 as opposed to 9.41 ± 0.61 h in the others. No significant correlation was determined between total sleep duration and HS. No significant association was found between boys and girls in total sleep duration. The mean sleep duration was shorter in children with excessive daytime sleepiness (p = 0.029).

Eighteen (1.5%) children had excessive daytime sleepiness that included falling asleep while watching television or in public places, during class at school and as a passenger in a car, which was significantly higher in habitual snorers with an OR of 8.56 (95% CI: 2.69–27.28). Other risk factors for excessive daytime sleepiness included daytime mouth breathing (p = 0.026) and shorter sleep duration. Children with nocturnal enuresis had approximately 4 times increased excessive daytime sleepiness (p = 0.052). Household smoking, household crowding and tooth grinding did not have a significant effect on excessive daytime sleepiness.

Table 2. Prevalence (%) of sleep-related symptoms according to snoring categories in univariate analysis (unadjusted ORs)

Variables	Nonsnorers (n = 711)	Occasional snorers (n = 412)	Habitual snorers (n = 41)	p value	OR
Witnessed sleep apnea	1.4	6.1	17.1	<0.001	6.40 (2.65–15.43)
Excessive daytime sleepiness	0.7	2.2	9.8	<0.001	8.56 (2.69–27.28)
Difficulty breathing during sleep	1.3	8.0	22.0	<0.001	7.24 (3.25–16.13)
Increased parental anxiety about child's sleep	5.5	9.5	19.5	<0.001	3.25 (1.45–7.27)
Restless sleep/irritability	9.4	16.7	34.1	<0.001	3.76 (1.93–7.35)
Profuse sweating	35.6	45.9	58.5	<0.001	2.16 (1.16–4.09)
Blue color during sleep	0.3	1.7	4.9	0.001	6.35 (1.33–30.36)
Parental shaking for apnea	0.7	1.9	17.1	<0.001	17.58 (6.60–46.85)
Throat infections	12.2	24.5	34.1	<0.001	2.58 (1.33–5.01)
Tonsillectomy	6.3	5.3	7.3	0.708	1.24 (0.37–4.14)
Night awakenings	22.2	32.0	34.0	<0.001	1.49 (0.77–2.88)
Adenoidectomy	9.4	13.4	29.3	<0.001	3.33 (1.66–6.70)
Daytime mouth breathing	18.4	34.0	65.9	<0.001	6.06 (3.13–11.73)
Morning headaches	21.1	33.5	48.8	<0.001	2.76 (1.48–5.17)
Rhinitis	7.0	12.4	12.2	0.004	1.41 (0.54–3.66)
Asthma	3.4	2.9	2.4	0.612	0.76 (0.10–5.64)
Allergic symptoms	28.1	41.7	68.3	<0.001	4.35 (2.23–8.49)
Hyperactivity	21.1	30.1	58.5	<0.001	4.37 (2.32–8.26)
Sleep with parents	10.8	11.7	14.6	0.467	1.37 (0.56–3.32)
Sleep talking	28.8	42.0	56.1	<0.001	2.52 (1.34–4.72)
Sleep walking	3.4	5.6	7.3	0.045	1.81 (0.54–6.07)
Tooth grinding	17.3	28.7	34.1	<0.001	1.93 (0.99–3.74)
Nightmares	24.6	31.5	36.8	0.006	1.48 (0.77–2.87)
Nocturnal enuresis	3.5	5.8	17.1	0.001	4.51 (1.91–10.69)
Reading problems	6.3	9.0	4.9	0.280	0.65 (0.15–2.74)
Writing problems	4.9	6.8	7.3	0.176	1.33 (0.39–4.42)
Poor school performance	14.5	18.0	22.0	0.063	1.50 (0.71–3.20)

p values were determined by the χ^2 trend test; 95% CIs are indicated in parentheses.

Tooth grinding was noted by the parents in 21.6% of children. There was no gender difference in tooth grinding. Habitual snorers had a twice greater probability of tooth grinding (95% CI: 0.99–3.74) than nonsnorers. Younger children showed more tooth grinding than older ones (p = 0.006). Tooth grinding was closely associated with poor school performance (p = 0.006) but not household smoking (p > 0.05). Also, no association was found between tooth grinding and socioeconomic status and household crowding.

Nocturnal enuresis was found in 4.8% of children. There was a marked male predominance (p = 0.004). It was 4 times more frequent in children 7–8 years (8.8%) of age than in children aged 11–13 years (2.0%; p = 0.000). Habitual snorers had a history of nocturnal enuresis more often (95% CI: 1.91–10.69). In Fischer's exact test, nocturnal enuresis was closely associated with male gender (p = 0.004), younger age (p = 0.000), HS (p = 0.001), excessive daytime sleepiness (p = 0.052), poor school performance (p = 0.001) and socioeconomic status (p = 0.000).

Habitual snorers had a history of daytime mouth breathing more often than did others (95% CI: 3.13–11.73). Daytime mouth breathing was significantly associated with socioeconomic status (p = 0.030), excessive daytime sleepiness (p = 0.026) and poor school performance (p = 0.017). Daytime mouth breathing was also significantly and independently associated with HS in multivariate analysis.

The prevalence of headache was 48.8% in habitual snorers. The prevalence was similar for both males and

Table 3. Univariate and multivariate analyses of school performance for personal characteristics and associated symptoms

	Percentage	Poor school performance			
		unadjusted		adjusted	
		p[a]	OR	p	OR
Snoring					
None	14.5	0.063	1	0.757	1
Occasional	18.0		1.29 (0.93–1.79)		1.15 (0.80–1.65)
Habitual	22.0		1.66 (0.77–3.58)		1.01 (0.43–2.40)
Apnea	23.8	0.160	1.68 (0.81–3.48)	0.917	0.94 (0.28–3.11)
Excessive daytime sleepiness	38.9	0.008	3.44 (1.32–8.99)	0.129	2.43 (0.77–7.62)
Male sex	16.5	0.645	1.08 (0.79–1.48)	0.526	0.89 (0.63–1.26)
Adenoidectomy	16.9	0.752	1.08 (0.67–1.74)	0.843	1.05 (0.63–1.77)
Low maternal education (≤8 years)	25.1	0.000	2.64 (1.92–3.62)	0.002	1.90 (1.26–2.87)
Low paternal education (≤8 years)	25.9	0.000	2.31 (1.65–3.24)	0.043	1.52 (1.01–2.27)
Mother's job (housewife)	19.6	0.000	2.09 (1.47–2.98)	0.123	1.40 (0.91–2.17)
Household smoking	16.4	0.749[b]	1.06 (0.78–1.46)	0.944	0.99 (0.71–1.39)
Household crowding	16.1	0.936[b]	1.02 (0.74–1.40)	0.638	1.09 (0.77–1.53)
Restless sleep	23.3	0.012[b]	1.74 (1.15–2.64)	0.542	1.16 (0.73–1.84)
Headaches	20.8	0.009[b]	1.58 (1.13–2.21)	0.245	1.25 (0.86–1.81)
Hyperactivity	24.5	0.000[b]	2.16 (1.56–3.01)	0.000	1.89 (1.30–2.73)
Nocturnal enuresis	33.9	0.001[b]	2.89 (1.63–5.15)	0.040	1.98 (1.03–3.81)
Tooth grinding	21.8	0.006[b]	1.66 (1.17–2.37)	0.021	1.57 (1.07–2.31)

Analysis with adjusted ORs was the enter method; 95% CIs are indicated in parentheses.
[a] Determined by Pearson's χ^2 test. [b] Determined by Fisher's exact test.

females, and frequency increased with age for both sexes (p = 0.001). A significant association was found between headache and daytime mouth breathing (p = 0.000), difficulty breathing during sleep (p = 0.002), witnessed sleep apnea (p = 0.004), hyperactivity (p = 0.000) and poor school performance (p = 0.009). There was no significant association between headache and household smoking and crowding.

While previous adenoidectomy was strongly associated with snoring (95% CI: 1.66–6.70), a history of tonsillectomy was not (95% CI: 0.37–4.14). When allergic symptoms were correlated with HS, no significant association was found between HS and physician-diagnosed asthma. Children who had physician-diagnosed rhinitis were more likely to snore habitually, even if the OR within the single categories failed to reach statistical significance (OR: 1.41; 95% CI: 0.54–3.66). Allergic symptoms were retained as independent risk factor in multivariate analysis (95% CI: 1.02–4.40). Hyperactivity was significantly more common in habitual snorers. It was also retained as a significant factor for HS in multivariate analysis (95% CI: 1.28–5.11).

No significant association was determined between HS and poor school performance. There was no significant difference in mean sleep duration and school performance; children with good academic results did not sleep longer than those with poor school performance (p = 0.419). Univariate analysis identified the following risk factors for poor school performance: shorter parental and maternal education time, the mother being a housewife, restless sleep, excessive daytime sleepiness, headaches, hyperactivity, nocturnal enuresis and tooth grinding. In multivariate analysis, restless sleep and excessive daytime sleepiness lost their significance. Further analysis by logistic regression showed a significant correlation between poor school performance and low parental and maternal education, hyperactivity, nocturnal enuresis and tooth grinding (table 3). The logistic regression analysis of risk factors and sleep-related symptoms in habitual snorers versus nonsnorers plus occasional snorers is given in table 4.

Table 4. Logistic regressions of risk factors and sleep-related symptoms in habitual snorers versus nonsnorers plus occasional snorers

Variables	β	SE of β	p	OR
Age	–0.22	0.12	0.076	0.81 (0.63–1.02)
Daytime mouth breathing	1.44	0.36	0.000	4.24 (2.07–8.67)
Shaking child during sleep for apnea	1.82	0.57	0.001	6.17 (2.02–18.85)
Nocturnal enuresis	0.92	0.50	0.065	2.50 (0.94–6.65)
Restless sleep	0.91	0.38	0.017	2.49 (1.18–5.24)
Mother's job (housewife)	–0.72	0.35	0.040	0.49 (0.25–0.97)
Allergic symptoms	0.75	0.37	0.045	2.11 (1.02–4.40)
Hyperactivity	0.94	0.35	0.008	2.56 (1.28–5.11)
Constant	–2.66	1.19	0.025	

The analysis was carried out using the backward stepwise Wald method; 95% CIs are indicated in parentheses.

Discussion

Snoring is an important symptom and major risk factor of sleep-disordered breathing. Sleep-disordered breathing has been found to occur in children of all ages from neonates to adolescents. Early diagnosis and treatment is important to prevent morbidity and sequelae.

The frequency of 3.5% of HS among primary school children in Isparta in the current study is lower than that reported in other countries, e.g in Italian children [5, 6, 14] (10.9%), Hong Kong [7], Thai [8, 15], Turkish [1, 16, 17], Portuguese [4], American [18], German [19], Greek [20] and Australian children [21]. Prevalence rates vary according to study design and study population characteristics, such as age and sex, and the description and perception of HS [16]. The prevalence of 3.5% for HS reported in this study is in agreement with the previous studies from Turkey [16, 17].

The gender difference in the prevalence of HS among children is highly variable. While some of the studies showed that HS was found to be more common in boys [1, 6, 14, 18], findings of equal sex distribution amongst habitual snorers were also reported [4, 5, 8]. The prevalence of snoring tended to decrease with age because of an increase in the pharyngeal cross-sectional area with growth [14]. However, there was no trend association with age and HS in the study of Lu et al. [22]. We found a higher prevalence of HS more frequently in boys than girls. The strength of the association between gender difference and HS was reduced and the significance lost in multivariate analysis. There was an association between younger age and HS; children aged 7–8 years had the highest prevalence of HS.

Passive smoking was identified as a major risk factor for HS [21]. An association between the father's smoking and HS was identified in an epidemiologic study of 6- to 13-year-old children in Thailand [8]. Corbo et al. [14] also found a highly significant association between parental smoking, the number of cigarettes consumed by parents and HS. Ersu et al. [1] determined that maternal smoking had more impact on HS. In our study, the prevalence of HS was approximately twice higher in the children with a history of at least one member smoking in the home.

Strong associations were found between snoring and atopy in previous studies [14, 21]. A history of allergic conjunctivitis or rhinitis was clearly associated with snoring [6, 23]. In our study, children who had rhinitis were more likely to snore habitually, even if the OR failed to reach statistical significance. However, allergic symptoms were independent risk factors for HS in multivariate analysis (OR: 2.11, 95% CI: 1.02–4.40). Contrary to previous studies [1, 24], we could not identify asthma as a risk factor for HS.

A history of adenoidectomy was found more commonly in children who snore. However, tonsillectomy did not significantly affect the prevalence of snoring [6]. Kaditis et al. [20] found the frequency of HS to be 6.1% among the subjects with a history of adenoidectomy and/or tonsillectomy. In the current study, while tonsillectomy did not increase the risk of HS, a previous adenoidectomy was strongly associated with HS (χ^2 test, $p = 0.004$). Regarding the association between adenoidectomy and HS, statistical significance was lost in the multivariate model.

Although the association between obesity and OSAS in adults has been widely described, the prevalence of OSAS among obese children is highly variable [25, 26]. Anuntaseree et al. [8] and Leach et al. [27] reported that obesity was not significantly associated with snoring and OSAS. Our study did not confirm the association of obesity and HS.

Apnea events are less frequent and shorter, and, as a result, arousals are also less frequent in children. Hyperactivity, on the other hand, is more likely to occur in children and may be an attempt to keep from falling asleep during the day [28]. Children with HS were reported as hyperactive by their parents more commonly than nonsnorers in previous studies [1, 4]. A similar association was identified in the current study and also remained a significant factor for HS in multivariate analysis.

Statistical analysis showed a higher prevalence of poor school performance in habitual snorers compared to occasional snorers or nonsnorers [29, 30]. However, no significant association was determined between HS and academic results, similar to other investigations [7, 31]. Excessive daytime sleepiness was associated with learning problems in our study, similar to the reports of Ng et al. [7] and Goodwin et al. [18]. However, excessive daytime sleepiness was not entered into the logistic regression model of poor school performance with an OR of 2.43 (CI: 0.77–7.62). A positive correlation was determined between academic performance and tooth grinding. The positive correlation was explained by longer homework hours and, hence, stress in those higher achievers [7]. This was exactly the opposite of that reported by Agargun et al. [31] and Gozal [32], who suggested that tooth grinding might be associated with learning difficulties. In the current study, a significant and independent association was found between tooth grinding and poor school performance.

The main limitation of this study is that it was based on parental reports. Parental reports were found to be poorly predictive of whether a child snored during a specific night [33, 34]. However, a recent study [22] showed a significant association between parentally reported HS and objectively measured pathologic snoring. Further studies should be done with polysomnography or videotaping of sleep to verify the symptoms reported by parents.

Conclusion

Children with HS were more likely to have sleep-related daytime and nighttime symptoms. No significant association was determined between HS and poor school performance.

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