0021-7557/08/84-02/123
Jornal de Pediatria

The prevalence of symptoms of sleep-disordered breathing in Brazilian schoolchildren

Carine Petry,[1] Marilyn U. Pereira,[2] Paulo M. C. Pitrez,[3] Marcus H. Jones,[3] Renato T. Stein[3]

Abstract

Objective: To identify the prevalence of symptoms of sleep-disordered breathing among children of low socioeconomic status in the South of Brazil.

Methods: This was a cross-sectional study, carried out in the city of Uruguaiana, RS, in which specific questionnaire about the symptoms of sleep-disordered breathing was completed by the parents of a sample of schoolchildren aged 9 to 14 years, enrolled on the International Study of Asthma and Allergies in Childhood (ISAAC).

Results: From the total of 1,011 eligible schoolchildren, 998 questionnaires were completed. The parents of 27.6% of the children reported habitual snoring, while 0.8% reported apnea, 15.5% described daytime mouth breathing and 7.8% complained of excessive daytime sleepiness. Children with excessive daytime sleepiness were at greater risk of habitual snoring (OR = 2.7; 95%CI 1.4-5.4), apnea (OR = 9.9; 95%CI 1.2-51), mouth breathing (OR = 13.1; 95%CI 6.2-27.4) and learning difficulties (OR = 9.9; 95%CI 1.9-51.0). Rhinitis, maternal smoking and positive allergy skin test results were significantly associated with habitual snoring and daytime mouth breathing.

Conclusions: There is an elevated prevalence of symptoms of sleep-disordered breathing among children from 9 to 14 in the city of Uruguaiana. The prevalence of habitual snoring was almost twice that described in this age group in other populations. Children with excessive daytime sleepiness appear to have almost 10 times the risk of learning difficulties.

J Pediatr (Rio J). 2008;84(2):123-129: Mouth breathing, sleep-disordered breathing, snoring, child.

Introduction

Sleep-disordered breathing (SDB) describes a group of disorders that occur with frequency among children, although very often their symptoms do not receive the attention they merit. Sleep disordered breathing is part of a clinical spectrum that ranges from primary snoring through upper airway resistance syndrome (UARS), and which can even include the obstructive sleep apnea-hypopnea syndrome (OSAS).[1]

Sleep-disordered breathing can affect children of all ages. However, it is more common among preschool children, among whom the pharyngeal and palatine tonsils are larger in relation to the size of the airway.[2] The estimated prevalence of SDB in childhood is 11-12%.[3] The authors performed a search of published literature and were unable to locate any papers that discuss the prevalence of SDB in a representative sample of the pediatric population of Brazil.

Symptoms associated with SDB in children include snoring, apnea, excessive daytime sleepiness (EDS), hyperactivity, nighttime waking, agitated sleep, enuresis, daytime mouth breathing (MB), poor performance at school, headaches in the morning and frequent sore throats.[4,5]

There is a growing recognition that SDB is an important cause of morbidity in children, and that it is associated with

1. Mestre. Instituto de Pesquisas Biomédicas, Hospital São Lucas, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, RS, Brazil.
2. Doutora. Instituto de Pesquisas Biomédicas, Hospital São Lucas, PUCRS, Porto Alegre, RS, Brazil.
3. Doutor. Instituto de Pesquisas Biomédicas, Hospital São Lucas, PUCRS, Porto Alegre, RS, Brazil.

No conflicts of interest declared concerning the publication of this article.

Suggested citation: Petry C, Pereira MU, Pitrez PM, Jones MH, Stein RT. The prevalence of symptoms of sleep-disordered breathing in Brazilian schoolchildren. J Pediatr (Rio J). 2008;84(2):123-129.

Manuscript received Sep 04 2007, accepted for publication Jan 09 2008.

doi:10.2223/JPED.1770

abnormal craniofacial development,[6] cardiovascular problems,[7,8] growth failure[9] and neurocognitive problems, such as attention deficit disorder, hyperactivity and learning problems.[10,11]

The objective of this study was to identify the prevalence of symptoms of SDB in a population of schoolchildren aged 9 to 14 years from the city of Uruguaiana, RS, Brazil, a non-industrialized city where the majority of the population have low levels of socioeconomic development.

The central hypothesis behind the study is that there would be an elevated prevalence of symptoms of SDB in this group of children, due to the influence of factors linked to the low socioeconomic status of the population, such as family overcrowding, passive smoking and recurrent infections of the upper airways (UA).

Methods

Data were collected at public sector schools in the city of Uruguaiana, RS, which is a city whose index of human development is considered moderate (0.788, according to data from the United Nations Development Program in 2000). A randomized and representative sample of 1,011 schoolchildren was taken of the total of 3,049 children aged 9 to 14 enrolled at the city's public schools. The sample responded to questionnaires from the phase 2 International Study of Asthma and Allergies in Childhood (ISAAC) database and underwent skin tests for common environmental allergens in 2004.[12] Later, between June and October of 2005, a single interviewer applied a specific questionnaire about symptoms of SDB to the parents of these schoolchildren. The standardized questionnaire is the same that was used in a similar study in the United States, which investigated SDB in schoolchildren aged 4 to 11 years.[10] The process of translation and validation was carried out based on an article that was published recently in the Revista de Saúde Pública.[13]

Initially, the original English instrument was translated into Portuguese by a language professional, specialized in English; next the instrument was translated back into English by a medical researcher fluent in English and with experience of the subject in question. The third step, technical review and semantic equivalence was carried out independently by two professionals: one a health professional with a certificate of proficiency in English and experience in the area and the other a Portuguese language teacher specialized in English. In this stage the objective was to establish semantic equivalence between the first and second translations and the perspective of the referential meaning of the words/terms, and also the general meaning of each question and the possible answers to the instrument in the translation with relation to the original.

Factors such as socioeconomic and educational level are taken into account when adapting a questionnaire such as this one.[14] The two professionals who carried out the review stage identified certain modifications and corrections to the translated instrument, intended to clear up a small number of ambiguous questions. A corrected version was produced based on these suggestions. In the fourth stage, this version was shown to five professionals from the areas of neurology and pediatric pulmonology and five university students unconnected with the area with the objective of assessing the general content and meaning in the context of the target-population. They were asked to read the instrument and indicate alterations wherever the language did not appear appropriate. Their observations were then used to construct a final version of the questionnaire. In the final stage, this version was presented to the families of 26 patients chosen at random from those consulting at the pediatric clinic of the Hospital São Lucas at the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), in Porto Alegre, RS. The mean educational level and sociocultural characteristics of the participants in this pilot were similar to those of the target-population in Uruguaiana. These people then evaluated the ease of comprehension of the instrument as a whole and of each of the 13 questions using a verbal, five-point numeric scale. The key question was: "Did you understand what was asked?" The minimum score was zero for "I didn't understand anything," and the maximum score of five was for "I understood perfectly and I have no doubts." It was decided that scores of up to 3 would be defined as indicating insufficient understanding. The results of this stage demonstrated that all items on the questionnaire had mean scores on the verbal numerical comprehension scale greater than 4.4. All 13 items scored more than 4.0, indicating comprehension.

Questionnaires were applied by a single interviewer, trained by one of the researchers. The first-choice location for interviews was the child's own home. The 13-point questionnaire on symptoms of SDB (Table 1) was applied to the person responsible for each child, after they had signed a free and informed consent form. Each question could be answered with: 1 – don't know; 2 - never; 3 - rarely; 4 – frequently or 5 - always. Answers "frequently" and "always" were considered positive. The interviewer waited as long as necessary for the child's relative to answer each question asked, following the protocol with neutrality.

Variables were defined based on some of the items on the questionnaire. Excessive daytime sleepiness was considered present if one of the parents replied that their child (frequently or always) exhibited daytime sleepiness or went to sleep while watching television or during lessons or at school. Apnea was considered present if one of the parents reported that the child stopped breathing while asleep, or that their lips went blue or purple while asleep or that it had been necessary to shake the child to make him or her start breathing again when asleep. The child was classed as having learning difficulties if the person responsible for the patient said that the child was doing badly at school. Habitual snoring (HS) was

Table 1 - Questionnaire on symptoms of sleep-disordered breathing

1. Does your child ever stop breathing during sleep?
2. Does your child struggle to breathe during sleep?
3. Do you ever shake your child during sleep to make him/her breathe again?
4. Do your child's lips ever turn blue or purple while he/she is sleeping?
5. Are you concerned about your child's breathing during sleep?
6. How often does your child snore loudly?
7. How often does your child have a sore throat?
8. Does your child complain of morning headaches?
9. Is your child a daytime mouth breather?
10. Is your child sleepy during the daytime?
11. Does your child fall asleep at school?
12. Does your child fall asleep while watching television?
13. Does your child have learning problems?

Possible answers: 1 - don't know; 2 - never; 3 - rarely; 4 - frequently; 5 - always.

considered to be present if the parents reported that the child snored.

The statistical analysis was carried out with the chi-square test (for bivariate variables) and multivariate logistic regression (to control for confounding factors), using SPSS version 12.0®. The sample size was sufficient to detect significant differences between the principal variables with a power of 80% ($p \leq 0.05$).

This study was approved by the Research Ethics Committee at the PUCRS.

Results

From the target-population of 1,011 children, 998 (98.7%) provided complete information by means of the questionnaire on symptoms of SDB. The majority of losses were due to refusal to participate by the schoolchildren's parents or guardians and, in a small number of cases, due to changes of address with no reliable new address recorded.

The mean age of the children was 11.2 years, and there was no significant difference in terms of the proportion of each sex. The characteristics of the study population (Table 2) demonstrate that the population is predominantly from the lower socioeconomic strata, which can be inferred from the low maternal educational level observed in the majority of cases (82.4%), from the majority of the population that reside in poor areas (where there are few parks or trees) and from the high number of siblings in a large proportion of cases. One third of the mothers were smokers at the time of the interview. Almost 20% of the children had histories compatible with active rhinitis ("symptoms of rhinitis during the previous 12 months" and "rhinitis at least once during life"), almost 10% had active asthma ("wheezing during the previous 12 months" and "asthma at least once during life") and 13.3% had a positive skin test result for at least one of the six allergens tested as part of the ISAAC study protocol (Table 2).[12]

Table 3 lists the observed prevalence rates of the symptoms of SDB. Habitual snoring affected 274 (27.6%) of the children in the study sample. The prevalence of daytime MB was 15.5%. Parents/guardians reported apnea in eight cases (0.8%), and EDS in 78 (7.8%) schoolchildren.

The bivariate analysis showed that smoking mothers (OR = 1.6; 95%CI 1.2-2.2; $p < 0.001$), active asthma (OR = 2.2; 95%CI 1.4-3.4; $p < 0.001$) and active rhinitis (OR = 1.9; 95%CI 1.4-2.6; $p < 0.001$) were significantly associated with HS and, in relation to daytime MB: smoking mothers (OR = 1.9; 95%CI 1.1-3.3; $p < 0.05$); active asthma (OR = 2.7; 95%CI 1.3-5.4; $p < 0.001$); and a borderline positive relationship with active rhinitis (OR = 1.7; 95%CI 0.9-3.2).

After correction for age, sex, maternal educational level and number of siblings, the multivariate logistic regression analysis showed that maternal smoking (OR = 1.8; 95%CI 1.3-2.5; $p < 0.001$), active rhinitis (OR = 1.8; 95%CI 1.2-2.7; $p < 0.01$) and positive skin test results (OR = 1.9; 95%CI 1.3-2.9; $p < 0.01$) were significantly associated with HS. The independent predictors of daytime MB were maternal smoking (OR = 2.0; 95%CI 1.3-2.5; $p < 0.01$) and positive skin test results (OR = 4.6; 95%CI 2.3-8.9; $p < 0.001$).

Table 4 illustrates the associations found in our study between the symptoms of SDB and EDS. It can be observed that children who exhibit symptoms of HS, or apnea and MB, have a significantly higher risk of EDS. Additionally, poor performance at school was also associated with EDS.

Table 2 - Characteristics of the study population

Characteristics assessed	n (%)
Age (mean, SD)	11.1 (±0.76)
Male sex	507 (51)
Premature	104 (10.9)
Maternal smoking	329 (33)
Maternal education ≥ 8 years	175 (17.6)
Living in poor a area	937 (94.6)
≥ 2 siblings at home	475 (47.8)
Rhinitis in last 12 months	299 (30)
Active rhinitis	187 (18.9)
Wheezing in last 12 months	255 (25.7)
Active asthma	93 (9.4)
Positive skin test result	124 (13.3)

SD = standard deviation.

Table 3 - Prevalence of symptoms of sleep-disordered breathing in schoolchildren from 9 to 14 years from Uruguaiana, RS, Brazil

Symptom	n (%)
Habitual snoring	274 (27.6)
Stops breathing while asleep	4 (0.4)
Has difficulty breathing while asleep	44 (4.4)
Needs shaking awake	1 (0.1)
Cyanosis while asleep	4 (0.4)
Worries about breathing while asleep	54 (5.4)
Frequent sore throats	46 (4.6)
Morning headaches	99 (10)
Daytime mouth breathing	155 (15.5)
Daytime sleepiness	34 (3.4)
Sleepiness at school	11 (1.1)
Sleepiness watching TV	51 (5.1)
Poor performance at school	8 (0.8)
Apnea	8 (0.8)
Excessive daytime sleepiness	78 (7.8)

Discussion

The prevalence of HS found among Brazilian children was 27.6%, which is significantly higher than rates that have been observed among similar-aged children in other countries. Urschitz et al.[15] studied schoolchildren with a mean age of 9.6 years in Germany and reported a frequency of HS of 10.1%. Goodwin et al.[10] studied children aged 8 to 11 years in Tucson in the United States and found a prevalence of HS of 10.4%, using the same questionnaire we used here. Ng et al.,[16] studied children from 6 to 12 years of age and reported that 10.9% of those children exhibited HS.

Rates of HS vary greatly in the literature, depending upon the age group being studied, the questionnaire employed and the definition adopted. Differences between the populations being studied and cultural factors that influence the perception of what is a loud respiratory noise may also be responsible for the large variations in the rates of snoring and apnea

Table 4 - Symptoms of sleep-disordered breathing associated with excessive daytime sleepiness in schoolchildren from 9 to 14 years of age in Uruguaiana, RS, Brazil

Symptom of SDB studied	EDS OR (95%CI)
Habitual snoring	2.7 (1.4-5.4)*
Apnea	9.9 (1.2-51)†
Daytime mouth breathing	13.1 (6.2-27.4)†
Poor performance at school	9.9 (1.9-51.0)†

95%CI = 95% confidence interval; EDS = excessive daytime sleepiness; OR = odds ratio; SDB = sleep-disordered breathing.
* $p \leq 0.01$.
† $p \leq 0.001$.

reported by parents and guardians. Studies undertaken in the United States and Europe with children aged up to 6 years have demonstrated that around 1/3 of children snore at least occasionally, whereas, in the majority of studies, 10 to 14% have a positive report of HS (variation of 3 to 38%).[17-22] Furthermore, older children are more likely to snore than children in younger age groups.[23-25]

The prevalence of daytime MB in our study was 15.5%. We observed this elevated prevalence of MB even in an age group in which hypertrophy of the pharyngeal and palatine tonsils is not so frequent, since their peak of growth is between 3 and 6 years of age. Furthermore, in the age group studied here (9 to 14 years) the airway is larger. Daytime MB is the result of increased nasal resistance. One of the causes of MB and nighttime snoring in this sample may have been associated with hypertrophy of the pharyngeal tonsils and the lower turbinate bones, sustained by recurrent infections of the UA, which are more common among individuals in large families in small houses, and those exposed to passive smoking among other harmful environmental factors. The increase in lymphatic tissues provoked by recurrent infections may be an etiologic factor associated with increased UA resistance, leading to HS. The children of mothers who smoke are at double the risk of MB and HS, which agrees with a series of reports in the literature.[19,26,27]

Another important finding is the significant association between HS and active rhinitis, independent of asthma and after control for possible confounding variables. Children with rhinitis exhibit double the risk of HS. It is interesting to note that just 21% of the children with rhinitis had positive skin test results, however, variables such as recurrent viral infections, pollutants within and outside of the home, and other environmental factors, are possibly associated with UA symptoms.[28]

The prevalence of apnea was 0.8%, which is lower than has been reported in other studies. Goodwin et al.[10] found an apnea prevalence of 3.8% as reported by the parents of children from 8 to 11 years of age. The prevalence of apnea reported in other studies varies from 0.5 to 9%,[29] depending on the population and age group studied and also on the type of method employed to assess the symptom. According to Nieminem et al.,[30] episodes of apnea reported by parents are the principal risk factor for OSAS. Despite this, the absence of this symptom reported by parents does not rule out the possibility of OSAS. The smaller size of the palatine and pharyngeal tonsils in relation to the airway at this age may explain the lower prevalence of reported apnea in the group studied here.

Our study did not detect any differences between males and females in terms of the prevalence of symptoms of SDB. Redline[31] studied schoolchildren with a mean age of 10.7 years and also did not report significant differences in relation to SDB between sex groups. Among children in the age group studied, sex does not appear to influence the risk of SDB. This finding is consistent with earlier epidemiological data, which did not suggest any difference in the rates of snoring between boys and girls.[19]

Excessive daytime sleepiness affected 8% of the schoolchildren. In Tucson, Goodwin et al.[10] used the same questionnaire that we have translated and adapted for Brazilian children and found EDS in 8.1% of their sample. Comparisons of the prevalence of the symptom EDS with other studies is difficult since there are differences in the way it is defined by different authors. In our study, in common with Goodwin et al.,[10] EDS was considered present if at least one of these three symptoms was reported: daytime sleepiness, sleepiness at school and/or sleepiness in front of the television. Ng et al.[16] found EDS, defined as the presence of at least two of the symptoms of EDS described above, in 6.7% of the schoolchildren they studied.

Excessive daytime sleepiness was almost three times more frequent among children who snored habitually, and among those with apnea it was around 10 times more frequent. Schoolchildren with MB exhibited a 13 times greater risk of manifesting symptoms of EDS than controls. Some

studies report that hyperactivity and other types of neurocognitive problem are common among patients with SDB, while EDS is less frequent.[32,33] The results of our study support the hypothesis that children can also exhibit EDS as a result of SDB. Other studies have also observed this relationship.[10,18,34]

Although our study has shown that the majority of the children studied had low socioeconomic status (maternal educational level > 8 years in less than 17.6% of cases), poor school performance, as reported by parents, occurred in just 0.8% of the schoolchildren. However, it was around 10 times more common among children with EDS, after controlling possible confounding factors (such as maternal educational level and number of siblings – general indicator of overcrowding at home). In the study by Goodwin et al.,[10] learning difficulties were consistently associated with EDS, snoring and apnea. Gozal et al.[35] state that children with learning difficulties are more likely to have snored when young than children who perform better at school.

The limitations of our study are those seen in epidemiological studies in general. Epidemiological studies are for generating hypotheses and have the characteristic of indicating more specific research avenues, based on their results. One of the limitations of our study was that it relied on questionnaires, with no objective measurements of the symptoms studied. An objective measurement of SDB can be made using polysomnography. However, using polysomnography with this number of children was not viable from either a financial or logistic point of view.

Even though the questionnaire was validated for the Portuguese language, we perceived that there was inconsistency in the replies to some of the questions, suggesting some type of difficulty interpreting them on the part of the interviewees. It is important that, in the future, we can improve these questions, aiming to improve their sensitivity. Nevertheless, it is more likely that we would have failed to identify some children with SDB than have overestimated its prevalence.

In order to ensure the representiveness of the schoolchildren aged 9 to 14 years from Uruguaiana, cluster sampling was employed, with schools being clusters. The rate of response to the questionnaires was greater than 90%. This is an excellent response, when compared to other epidemiological studies that have studied SDB in children. One of the factors that resulted in this high level of response was that we sought patients out actively, whereas in other research questionnaires have been returned by post.

The results presented here are relevant since this is the first time an epidemiological study of SDB has been carried out in Brazil. Cross-sectional population studies and cohort studies are needed to better investigate the risk factors and the natural history of HS and SDB in our country. In addition to the data described here, a recent study that was published in this same Jornal de Pediatria indicates that there is an important association between SDB and cardiovascular repercussions.[36] Our findings are important to alert the medical community and the general public to the highly prevalent symptoms related to sleep, which can be investigated and for which treatment exists. The relationship between SDB and poor performance at school detected in this study merits the attention of future studies, due to the impact that this finding could have on the community as a whole. The identification of these risk factors that can potentially be reversed by effective public health measures is the primary objective of studies such as this one.

References

1. Messner AH, Pelayo R. Pediatric sleep-related breathing disorders. Am J Otolaryngol. 2000;21:98-107.
2. Section on Pediatric Pneumology, Subcommittee on Obstructive Sleep Apnea Syndrome. American Academy of Pediatrics. Clinical practice guideline: diagnosis and management of childhood obstructive apnea syndrome. Pediatrics. 2002;109:704-12.
3. Guilleminault C, Pelayo R. Sleep-disordered breathing in children. Ann Med. 1998;30:350-6.
4. Gaultier C. Clinical and therapeutics aspects of obstructive sleep apnea syndrome in infants and children. Sleep. 1992;15;S36-8.
5. Guilleminault C. Obstructive sleep apnea. The clinical syndrome and historical perspective. Med Clin North Am. 1985;69: 1187-203.
6. Warren DW, Spalding PM. Dentofacial morphology and breathing: a century of controversy. In: Melsen B, editor. Controversies in orthodontics. Chicago: Quintessence Publishing; 1991. p. 45 76.
7. Shiomi T, Guilleminault C, Stoohs R, Schnittger I. Obstructed breathing in children during sleep monitored by echocardiography. Acta Paediatr. 1993;82:863-71.
8. Fletcher EC, Bao G. Effect of episodic eucapnic and hypocapnic hypoxia on systemic blood pressure in hypertension-prone rats. J Appl Physiol. 1996;81:2088-94.
9. Valera FC, Demarco RC, Anselmo-Lima WT. Síndrome da apnéia e da hipopnéia obstrutivas do sono (SAHOS) em crianças. Rev Bras Otorrinolaringol. 2004;70:232-7.
10. Goodwin JL, Babar SI, Kaemingk KL, Rosen GM, Morgan WJ, Sherrill DL, et al;Tucson Children's Assessment of Sleep Apnea Study. Symptoms related to sleep-disordered breathing in white and Hispanic children: the Tucson Children´s Assesment on Sleep Apnea Study. Chest. 2003;124:196-203.
11. Schechter MS, Section on Pediatric Pneumology, Subcommittee on Obstructive Sleep Apnea Syndrome. Technical report: diagnosis and management of childhood obstructive sleep apnea syndrome. Pediatrics. 2002;104:e69.
12. Pereira MU, Sly PD, Pitrez PM, Jones MH, Escouto D, Dias AC, et al. Nonatopic asthma is associated with helminth infections and bronchiolitis in poor children. Eur Respir J. 2007;29:1154-60.
13. Grassi-Oliveira R, Stein LM, Pezzi JC. Tradução e validação de conteúdo da versão em português do Childhood Trauma Questionnaire. Rev Saude Publica. 2006;40:249-55.

14. Reichenheim ME, Moraes CL. Buscando a qualidades e informações em pesquisas epidemiológicas. In: Minayo MC, Deslandes SF, editores. Caminhos do pensamento: epistemologia e método. Rio de Janeiro: Fiocruz; 2002. p. 227 54.

15. Urschitz MS, Guenther A, Eitner S, Urschitz-Duprat PM, Schlaud M, Ipsiroglu OS, et al. Risk factors and natural history of habitual snoring. Chest. 2004;126:790-800.

16. Ng DK, Kwok KL, Cheung JM, Leung SY, Chow PY, Wong WH, et al. Prevalence of sleep problems in Hong Kong primary school children: a community-based telephone survey. Chest. 2005; 128:1315-23.

17. Quan SF, Kaemingk KL, Rosen GM, Morgan WJ, Fregosi RF. Prevalence of obstructive sleep apnea in children: preliminary report of the Tucson Children´s Assesment os Sleep Apnea Study (TuCASA). Sleep 2000;23:A195.

18. Ali NJ, Pitson DJ, Stradling JR. Snoring, sleep disturbance, and behaviour in 4-5 years olds. Arch Dis Child. 1993;68:360-6.

19. Teculescu DB, Caillier I, Perrin P, Rebstock E, Rauch A. Snoring in French preschool children. Pediatr Pulmonol. 1992;13: 239-44.

20. Castronovo V, Zucconi M, Nosetti L, Ossola E, Moscatelli D, Calori G, et al. Habitual snoring among children aged 3 to 6 years: an epidemiologic study with objective measurement of snoring and oxygen saturation. Sleep. 1998;21 Suppl:S51.

21. Gislason T, Benediktsdottir B. Snoring, apneic episodes, and nocturnal hypoxemia among children 6 months to 6 years old. An epidemiologic study of lower limit of prevalence. Chest. 1995; 107:963-6.

22. Quan SF, Morgan WJ. Prevalence of sleep disturbances and snoring in children aged 13-14 years. Sleep. 1999;22:S185.

23. Gottlieb DJ, Vezina RM,Chase C, Lesko SM, Heeren TC, Weese-Mayer DE, Auerbach S, Corwin MJ. Symptoms of sleep-disordered breathing in 5-year-old children are associatedassociated with sleepiness and problem behaviors. Pediatrics. 2003;112(4):870-7.

24. Corbo GM, Fuciarelli F, Foresi A, De Benedetto F. Snoring in children: association with respiratory symptoms and passive smoking. BMJ. 1989;299:1491-4.

25. Rosen CL, Arnold JL, DiFiore JM, Surovec SA, Redline S. Prevalence of key clinical features of sleep-disordered breathing in a community-based sample of 8-10 years old US children. Sleep. 2000;23;A194.

26. Corbo GM, Forastiere F, Agabiti N, Pistelli R, Dell'Orco V, Perucci CA, et al. Snoring in 9- to 15-year-old children: risk factors and clinical relevance. Pediatrics. 2001;108:1149-54.

27. Carvalho LM, Pereira ED. Morbidade respiratória em crianças fumantes passivas. J Pneumol. 2002;28:8-14.

28. Guneser S, Atici A, Alparslan N, Cinaz P. Effects of indoor environmental factors on respiratory system of children. J Trop Pediatr. 1994;40:114-6.

29. Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea: a population health perspective. Am J Respir Crit Care Med. 2002;165:1217-39.

30. Nieminem P, Tolonem U, Lopponen H, Luotonen J, Jokinen K. Snoring children: factors predicting sleep apnea. Acta Otolaryngol Suppl. 1997;529:190-4.

31. Redline S, Hans M, Krejcki P. Differences in the age distribution and risk factors for sleep disordered breathing in blacks and whites.Am J Respir Crit Care Med. 1994;149:576.

32. Rosen CL. Obstructive sleep apnea syndrome (OSAS) in children: diagnostic challenges. Sleep. 1996;19:S274-7.

33. Carroll JL, Marcus CL. Reported symptoms of childhood obstructive sleep apnea syndrome vs. primary snoring. Am Rev Respir Dis. 1992;145:A177.

34. Owens JA, Spirito A, McGuin M, Nobile C. Sleep habits and sleep disturbance in elementary school-aged children. J Dev Behav Pediatr. 2000;21:27-36.

35. Gozal D, Pope DW Jr. Snoring during early childhood and academic performance at ages thirteen to fourteen years. Pediatrics. 2001;107:1394-9.

36. Weber SA, Montovani JC, Matsubara B, Fioretto JR. Echocardiographic abnormalities in children with obstructive breathing disorders during sleep. J Pediatr (Rio J). 2007;83: 518-22.

Correspondence:
Carine Petry
SQN 103 Bloco A/506
CEP 70732-010 – Brasília, DF – Brazil
Tel.: +55 (61) 7811.2252
Fax: +55 (61) 3034.4242
E-mail: carinepetry@terra.com.br