Original Research

Investigation of the Relationship between Sleep Habits and Sleep Structure by Polysomnography in 3-10 Year-Old Children Referring to the Sleep Department of Qazvin Children's Hospital, Iran

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Abstract

Background and Objective: Improper sleeping habits can affect children's sleep structure and reduce the quantity and quality of sleep. In this study, we aimed to investigate the relationship between sleep habits and sleep structure in children.

Materials and Methods: The population of this cross-sectional descriptive-analytical study included children aged 3-10 years who were referred to the sleep department of Children's Hospital in Qazvin City, Iran, during 2015-2021 and had undergone standard polysomnography (PSG). The Iranian version of the Children's Sleep Habits Questionnaire (CSHQ) was completed by parents. Sleep structure parameters of PSG were used. Statistical tests included mean, standard deviation (SD), and independent t-test.

Results: Among 163 patients, 102 (62.6%) were boys. The average age of the children was 6.35±3.72 years. According to CSHQ, the average score of "resistance before sleep" was 2.08±0.38 and the highest score was related to "falling asleep in your bed" (2.50±0.81). The highest score of "sleep duration" was related to "sleeping the same amount each day" (2.54±0.75). The comparison of PSG findings showed that the mean score of bedtime resistance had a statistically significant relationship with increased stage N1 and decreased sleep efficiency (SE) (P = 0.01). Moreover, the mean score of "sleep duration" was associated with abnormal Arousal Index (AI) (P = 0.01).

Conclusion: According to the results, children who were reported to be sleep-deprived had a higher percentage of light sleep and frequent night awakenings, and less SE in the PSG. Appropriate health strategies are needed to improve children's sleep habits.

Keywords: Sleep habits; Child; Sleep; Polysomnography

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Introduction

Adequate and quality sleep is essential for a person's physical and mental health (1). Sleep in children is a dynamic process that grows in parallel with the child's physical, behavioral, and neurological development, and the most significant change in sleep occurs during the first 12 months of life so that children sleep 9500 hours against 8000 hours of wakefulness until the age of 2 years. At the age of 2-5 years, the sleep and wakefulness are equal, and after the age of 5 years, the sleep reaches 40% (2, 3). Inadequate sleep (in terms of quantity and quality), which is defined as a reduction in sleep duration, high sleep onset delay, and low sleep efficiency (SE) (4), causes behavioral and cognitive disorders in children (5), and increases the risk of obesity, blood pressure, type 2 diabetes, and daily dysfunction of children (1, 4, 6, 7). According to the evidence, the duration of night sleep in children has reduced by at least 1 hour during the last decade (6). According to studies, 10-75 percent of children in the world

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suffer from sleep problems, a simple form of which can be bedtime resistance, night awakening, parasomnias, and/or obstructive sleep apnea (OSA) (8). Children's sleep patterns are different in different countries and influenced by cultural, social, income, and environmental differences (8). For example, the total sleep time in Asian countries is almost 1 hour less than American children. The prevalence of sleep problems in 4-5-year-old American children is 4.3%. The prevalence of mild to severe sleep problems in Australian preschool children was 13.8%, and 5% slept less than 3 hours a night (8).

In a study conducted in Qazvin City, Iran, 41.4% of children had the problem of sleep latency, and in the next study in 2010, 21.9% reported long sleep laency (8). In a study conducted by Mohammadi et al., the prevalence of sleep problems was 56.4% and respiratory problems were 17.8% in Iranian children aged 2-6 years (9).

Information about children's sleep structure can help researchers to solve their sleep problems. Sleep consists of two stages of non-rapid eye movement (NREM) and rapid eye movement (REM), which are repeated continuously throughout the night; each sleep cycle is 50-60 minutes in term infants and 90-110 minutes in school-aged children, the clinical importance of which justifies the more frequent awakenings of children after the end of each cycle at a younger age (9). Except for the beginning of life, sleep begins with NREM, which itself includes stages N1, N2, and N3 (slow wave sleep). Sleep begins with N1, which is very light sleep, has a low arousal threshold, and is easily interrupted. An increase in stage N1 is a common sign of severe sleep fragmentation, and after a few minutes, the person enters stage N2. After about 50 minutes, he enters stage N3 or deep sleep, which is the most restorative and its maximum is in the pre-school age. Then, the person enters REM or dream sleep, which is necessary for improving cognitive, mental, and brain function. N3 predominates in the first half of sleep and REM in the last half of sleep (2).

Parameters related to the quantity and quality of sleep can be measured through polysomnography (PSG). PSG is the gold standard for objectively measuring sleep parameters and determining sleep disorders, which requires the child to be present and sleep overnight in a sleep lab (7). Given that PSG is relatively expensive, most doctors and researchers use questionnaires to investigate children's sleep habits and behavioral problems (5, 7, 8, 10).

Due to the lack of sufficient studies in Iran on the relationship between children's sleep habits and parameters of sleep structure [SE, Arousal Index (AI), REM, and NREM] (11-14), the present study was conducted to compare the sleep habits of children aged 3-10 years who referred to the sleep department of Qazvin Children's Hospital.

Materials and Methods

This was a cross-sectional descriptive-analytical study. The statistical population included children aged 3-10 years and the sample included all children aged 3-10 years referred to the sleep department of Qazvin Children's Hospital during 2015-2021. Due to sleep problems, PSG was performed and Children's Sleep Habits Questionnaire (CSHQ) was completed by their parents (11).

In the present study, the exclusion criteria included children with chronic physical and mental diseases, neurodevelopmental disorders, the use of hypnotic drugs, and the parents' chronic mental diseases and drug use.

In this study, sleep structure parameters (N1, N2, N3, REM, SE, AI, and sleep latency) were collected using PSG. PSG includes a recording of electroencephalography (EEG), electrooculography (EOG), electromyography (EMG) of the chin, EMG of the limbs, nasal-oral airflow, respiratory plethysmography (chest and abdomen), arterial blood oxygen saturation, body position, snoring, and video recording of the patient. For PSG, the test room is equipped with a suitable bed, a standard space with a suitable temperature and echogenic so that the patient has a comfortable sleeping environment similar to his sleeping room at home. Patients came to the center at least 4 hours before going to bed for the test. For PSG, gold electrodes were connected by an experienced nurse according to the latest recommendations of the American Academy of Sleep Medicine (AASM). Patients went to bed according to their usual sleeping hours at home. The test started when the lamp was turned off and lasted an average of 300 minutes (6-7 hours) and ended in the morning when the lamp was turned on. Computer analysis and recording of the data collected by the center's sleep fellowship physician was done manually and according to AASM standards in 2023 (15).

Additionally, to evaluate the sleep habits of the

studied children, the Iranian version of the CSHQ was used. CSHQ is a 45-question questionnaire including 8 sub-scales that are completed by the child's parents and describe the child's sleeping habits in the last week. The eight items include bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night waking, parasomnias, sleep-disordered breathing, and daytime sleepiness. Answers to the questions are based on a 3-point Likert scale: usually = 3 (5-7 nights a week), sometimes = 2 (2-4 nights per week), and rarely = 1 (0-1 nights per week) (5, 8). In the present study, bedtime resistance, sleep onset delay, sleep duration, and daytime sleepiness were investigated (5-8). The CSHQ questionnaire was validated by Shoghi et al. in Iran (13).

Mean and standard deviation (SD) were used to describe quantitative variables, as well as frequency and percentage for qualitative variables. Independent t-test was used to compare the mean scores of bedtime resistance, sleep onset delay, sleep duration, and daily sleepiness based on the stages of sleep structure examined in this study. The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. The normality test results showed that the variables met the normality assumption ($P > 0.05$). To ensure the power of study, the following formula was used to determine the needed sample size. The parameters were extracted from the Westerlund et al. study (16). The minimum needed sample size was determined 115 in each group.

$$n = \frac{2\delta^2(Z\alpha/2 - Z\beta)^{\ 2}}{(\mu 1 - \mu 2)}$$

All analyses were performed using SPSS software (version 20, IBM Corporation, Armonk, NY, USA). The significance level of the tests was considered to be 0.05.

The study was approved by the ethical code of IR.QUMS.REC.1402.117 at Qazvin University of Medical Sciences.

Results

A total of 163 patients participated in the study. Of them, 102 patients (62.6%) were boys. The mean age of the children was 6.35 ± 3.72 years. Table 1 shows descriptive findings related to bedtime resistance, sleep onset delay, sleep duration, and daily sleepiness based on CSHQ.

As shown in table 1, according to CSHQ, for "bedtime resistance", the highest mean was related to "falling asleep in his bed" (2.50 ± 0.81). For "sleep duration", the highest mean was related to the "sleeping the same amount each day" (2.27 ± 0.75). For "daytime sleepiness", the highest mean was related to "waking by himself" (2.32 ± 0.86) (Table 1).

Table 1. Descriptive findings of the samples about bedtime resistance, sleep onset delay, sleep duration, and daytime sleepiness based on Children's Sleep Habits Questionnaire (CSHQ)

Scale	Sub-scale	Minimum	Maximum	Mean ± SD
Bedtime resistance	Going to bed at the same time	1.00	3.00	2.31 ± 0.82
	Falling asleep in his/her bed	1.00	3.00	2.50 ± 0.81
	Falling asleep in other bed	1.00	3.00	1.65 ± 0.88
	Needing parent in room to sleep	1.00	3.00	2.42 ± 0.86
	Struggling at bedtime	1.00	3.00	1.42 ± 0.76
	Being afraid of sleeping alone	1.00	3.00	2.00 ± 0.95
	Total mean	1.00	3.00	2.08 ± 0.38
Sleep onset delay	Falling asleep in 20 minutes	1.00	3.00	2.34 ± 0.86
Sleep duration	Sleeping too little	1.00	3.00	1.31 ± 0.67
	Sleeping the right amount	1.00	3.00	2.27 ± 0.89
	Sleeping the same amount each day	1.00	3.00	2.54 ± 0.75
	Total mean	1.00	3.00	2.12 ± 0.41
Daytime sleepiness	Waking up himself	1.00	3.00	2.32 ± 0.86
	Waking up in a negative mood	1.00	3.00	1.71 ± 0.83
	Woken up by others	1.00	3.00	1.71 ± 0.84
	Hard time getting out of bed	1.00	3.00	1.60 ± 0.85
	Taking a long time to be alert	1.00	3.00	1.62 ± 0.82
	Seeming tired	1.00	3.00	1.35 ± 0.70
	Watching TV	1.00	3.00	1.27 ± 0.58
	Riding in car	1.00	3.00	1.18 ± 0.51
	Total mean	1.00	3.00	1.60 ± 0.39

SD: Standard deviation

Comparing the average scores of "resistance before sleep", "sleep onset delay", "sleep duration", and "sleepiness during the day" in CSHQ and the percentage of stage N1 sleep in PSG showed that except for the average score of "resistance before sleep" which was associated with an abnormal amount of stage N1 sleep (N1 > 5%) and was statistically significant (P = 0.01), in other scales, no significant difference was observed in terms of N1 sleep percentage (P > 0.05) (Table 2).

Table 2. Comparison of the mean scores of bedtime resistance, sleep onset delay, sleep duration, and daytime sleepiness in Children's Sleep Habits Questionnaire (CSHQ) and N1 in polysomnography (PSG)

	N1 percentage	Mean ± SD	P-value
Bedtime resistance-total	Normal	1.96 ± 0.40	0.01
	Abnormal > 5	2.17 ± 0.35	
Falling asleep in 20 minutes	Normal	2.43 ± 0.82	0.10
	Abnormal > 5	2.28 ± 0.88	
Sleep duration-total	Normal	2.09 ± 0.46	0.30
	Abnormal > 5	2.14 ± 0.39	
Daytime sleepiness-total	Normal	1.63 ± 0.36	0.50
	Abnormal > 5	1.57 ± 0.41	

SD: Standard deviation

The comparison of the mean scores of bedtime resistance, sleep onset delay, sleep duration, and daytime sleepiness in CSHQ and stage N2 in PSG showed that the difference in the mean observed in none of the scales was statistically significant (P > 0.05) (Table 3).

The comparison of the mean scores of bedtime resistance, sleep onset delay, sleep duration, and daytime sleepiness in N3 showed that the mean difference observed in none of the scales was statistically significant (P > 0.05) (Table 4).

For REM, the results showed that the mean difference observed in any subscale was not statistically significant (P > 0.05) (Table 5).

According to the results of the study, the relationship between the average score of "sleep duration" and the level of abnormal AI (AI > 16) was statistically significant (0.29 ± 2.20 vs. 0.52 ± 1.90) (P = 0.01).

Comparing the average scores of "resistance before sleep", "sleep onset delay", "sleep duration", and "daily sleepiness" in CSHQ and SE in PSG showed that the mean score of "resistance before sleep" had a statistically significant relationship with abnormal SE (SE < 89%) (2.14 ± 0.39 vs. 1.80 ± 0.28) (P = 0.01).

Discussion

Children's sleep problems are one of the most common problems in the field of children's health, which affect the physical and mental health and performance of children and parents. Sleep habits related to children's insomnia include bedtime resistance, the time required for sleep onset (sleep onset delay), night waking and the frequency of waking, and daily complications including daytime sleepiness and loss of performance (1-4).

The objective of this study was to compare the sleep habits of children aged 3-10 years referred to the sleep department of Qazvin Children's Hospital with the objective findings of PSG to confirm the quality of sleep (SE, sleep duration, AI, and sleep onset delay and the percentage of each sleep stage) (11-14).

In this study, the mean resistance before sleep is consistent with another study conducted by Jalilolghadr et al. in Qazvin City (8). However, the average score of resistance before sleep that we obtained was higher than the study by Rahimi Derazi et al. on primary school children in Bushehr City, Iran. In the same study, the highest mean was related to sleep duration (17). This could be due to the difference between climatic and cultural influences on sleep, which needs further studies.

Table 3. Comparison of the mean scores of bedtime resistance, sleep onset delay, sleep duration, and daytime sleepiness in Children's Sleep Habits Questionnaire (CSHQ) and stage N2 in polysomnography (PSG)

	N2 percentage	Mean ± SD	P-value
Bedtime resistance-total	Normal (45-55)	2.13 ± 0.32	0.10
	Abnormal (< 45 & > 55)	2.03 ± 0.43	
Falling asleep in 20 minutes	Normal (45-55)	2.40 ± 0.81	0.30
	Abnormal (< 45 & > 55)	2.29 ± 0.90	
Sleep duration-total	Normal (45-55)	2.17 ± 0.35	0.60
	Abnormal (< 45 & > 55)	2.07 ± 0.47	
Daytime sleepiness-total	Normal (45-55)	1.60 ± 0.35	0.50
	Abnormal (< 45 & > 55)	1.60 ± 0.43	

SD: Standard deviation

Table 4. Comparison of the mean scores of bedtime resistance, sleep onset delay, sleep duration, and daytime sleepiness of Children's Sleep Habits Questionnaire (CSHQ) and stage N3 in polysomnography (PSG)

	N3 percentage	Mean ± SD	P-value
Bedtime resistance-total	Normal (29-32)	2.07 ± 0.38	0.20
	Abnormal (< 29 & > 32)	2.08 ± 0.39	
Falling asleep in 20 minutes	Normal (29-32)	2.45 ± 0.78	0.50
	Abnormal (< 29 & > 32)	2.29 ± 0.89	
Sleep duration-total	Normal (29-32)	2.19 ± 0.37	0.20
	Abnormal (< 29 & > 32)	2.07 ± 0.43	
Daytime sleepiness-total	Normal (29-32)	1.62 ± 0.42	0.90
	Abnormal (< 29 & > 32)	1.59 ± 0.38	

SD: Standard deviation

Given that bedtime resistance is one of the sleep behaviors with high prevalence among children (18), its difference in different cities of the country can be a research field for future studies to identify the reasons for these differences. In the studied fields, the mean sleep onset delay and sleep duration are more than the mean in the study by Rahimi Derazi et al. in Bushehr City (17). However, the mean daytime sleepiness was similar to the study by Rahimi Derazi et al. (17).

Based on the present results, the most complaints of parents in "bedtime resistance" were related to"needing parent in room to sleep" and then "being afraid of sleeping alone". It should be noted that most of the parents stated that the child slept in his bed.

For sleep onset delay, according to parents' statements, they often fell asleep within 20 minutes (mean: 2.3). Of course, it should be noted that sometimes parents underestimate the problem in this regard, especially in older children. Because the child sleeps independently, parents mistakenly think that the child has fallen asleep and even estimate the time of waking up in the morning later (5). For "the child sleeps too little", the answer of the parents was "rarely", i.e., less than 1-2 times a week (1, 3).

The comparison of the parents' statements in CSHQ with the objective findings of PSG showed that in children whose parents reported more problems regarding bedtime resistance, stage N1 was higher and SE was lower. Besides, the group that complained more about sleep duration had higher AI, indicating an increase in light sleep and fragmented sleep, affecting the proper functioning of the body, immunity, endocrine system, and the development and mental and psychological stability of the child (1, 3).

In a study by Markovich et al., no significant relationship was found between the findings of CSHQ and PSG, and for CSHQ and actigraphy, a significant relationship was found between only night waking in CSHQ and waking after sleep onset (WASO) in actigraphy. It was stated that higher scores on sleep onset delay, sleep duration, night waking, and sleep-disordered breathing in CSHQ did not necessarily correlate with problematic sleep parameters measured by PSG and actigraphy (7).

In a study by Perpetuo et al. comparing the findings of CSHQ and actigraphy, a positive correlation was found between bedtime resistance in CSHQ and the total sleep time based on actigraphy and night waking rate in CSHQ and actigraphy (10).

Children's sleep habit problems in bedtime resistance, sleep duration, daytime sleepiness, and sleep onset delay were higher than 1-2 times a week, which indicates the problem of sleep habits in children.

Table 5. Comparison of the mean scores of bedtime resistance, sleep onset delay, sleep duration, and daytime sleepiness of Children's Sleep Habits Questionnaire (CSHQ) and rapid eye movement (REM) stage in polysomnography (PSG)

	REM percentage	Mean ± SD	P-value
Bedtime resistance-total	Normal (17-22)	2.06 ± 0.41	0.80
	Abnormal (< 17 & > 22)	2.09 ± 0.37	
Falling asleep in 20 minutes	Normal (17-22)	2.47 ± 0.79	0.30
	Abnormal (< 17 & > 22)	2.28 ± 0.88	
Sleep duration-total	Normal (17-22)	2.15 ± 0.40	0.20
	Abnormal (< 17 & > 22)	2.11 ± 0.42	
Daytime sleepiness-total	Normal (17-22)	1.66 ± 0.45	0.70
	Abnormal (< 17 & > 22)	1.58 ± 0.37	

SD: Standard deviation

Although no significant difference was observed, these findings can be an alarm for families and health professionals that sleep habit problems are serious. It should be noted that due to the high cost of PSG and the need for the parent and child to be present at the sleep lab for at least one night to perform the test, the statistical population included children who were referred to this center due to breathing problems for a sleep test and the only result of PSG was that 6% were normal in terms of breathing.

Children's sleep-disordered breathing was the main reason for the referral to the sleep clinic, the most common symptom of which was snoring. The most important cause of breathing problems in children is adenotonsillar hypertrophy, which causes obstructive respiratory problems. Due to breathing interruptions and disturbances in arterial gases, sleep problems arise for children, such as frequent night awakenings and daily complications including attention-deficit/hyperactivity disorder (ADHD), academic failure, morning headaches, and daytime sleepiness, which are sometimes ignored by families and considered as the normal sleep habits of the child. Breathing problems cause changes in the normal structure of sleep (19-23). In a study by Durdik et al. on the sleep structure of children with OSA, stage N3 and SE reduced, and stage N1 increased (21), which was consistent with the results of this study.

Conclusion

Based on the findings of this study, in children with incorrect sleeping habits, the percentage of light sleep and the number of night awakenings were higher and SE was lower. Therefore, with timely identification of children's sleep problems, early behavioral interventions, and necessary treatments for underlying causes, it is possible to help improve the physical and mental health and quality of life of the child and his parents. Since this study was conducted on children who were referred to our center due to illness and underwent PSG, more studies are suggested to generalize the results to children in the community.

Conflict of Interests

Authors have no conflict of interests.

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References

1. Afonso A, Jacinto G, Infante P, et al. Primary school children's sleep habits: association with socio-economic factors and physical activity habits. Children (Basel) 2022; 9: 965.
2. Jiang F. Sleep and early brain development. Ann Nutr Metab 2019; 75: 44-54.
3. Matricciani L, Blunden S, Rigney G, et al. Children's sleep needs: Is there sufficient evidence to recommend optimal sleep for children? Sleep 2013; 36: 527-34.
4. Lemola S, Raikkonen K, Scheier MF, et al. Sleep quantity, quality and optimism in children. J Sleep Res 2011; 20: 12-20.
5. Bonuck KA, Goodlin-Jones BL, Schechter C, et al. Modified Children's sleep habits questionnaire for behavioral sleep problems: A validation study. Sleep Health 2017; 3: 136-41.
6. Phillips SR, Johnson AH, Shirey MR, et al. Sleep quality in school-aged children: A concept analysis. J Pediatr Nurs 2020; 52: 54-63.
7. Markovich AN, Gendron MA, Corkum PV. Validating the children's sleep habits questionnaire against polysomnography and actigraphy in school-aged children. Front Psychiatry 2014; 5: 188.
8. Jalilolghadr S, Pakpour-Hajiagha A, Heidaralifard M, et al. Evaluation of sleep habits and sleep patterns among 7-12-year-old students in Qazvin, Iran; a school-based cross-sectional study. J Compr Pe. 2018; 9: e67189.
9. Mohammadi M, Ghalebaghi MD, Bandi MD, et al. Sleep patterns and sleep problems among preschool and school-aged group children in a primary care setting. Iran J Ped 2007; 17: 213-21.
10. Perpetuo C, Fernandes M, Verissimo M. comparison between actigraphy records and parental reports of child's sleep. Front Pediatr 2020; 8: 567390.
11. Javadi M, Kalantari N, Jalilolghadr S, et al. Sleep habits and dietary intake among preschool children in Qazvin. J Compr Ped 2014; 5: e5134.
12. Knoop MS, de Groot ER, Dudink J. Current ideas about the roles of rapid eye movement and non-rapid eye movement sleep in brain development. Acta Paediatr 2021; 110: 36-44.
13. Shoghi M, Farmani F, Hosseini A. Sleep habits of school age children. Iran J Nurs 2005; 18: 131-8. [In Persian].
14. Amintehran E, Ghalehbaghi B, Asghari A, A, et al. High prevalence of sleep problems in school- and preschool-aged children in Tehran: A population based study. Iran J Pediatr 2013; 23: 45-52.
15. Troester MM, Quan SF, Berry RB, et al. The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifi-

cations. Version 3. Darien, IL: American Academy of Sleep Medicine; 2023.
16. Westerlund A, Lagerros YT, Kecklund G, et al. Relationships between questionnaire ratings of sleep quality and polysomnography in healthy adults. Behav Sleep Med 2016; 14: 185-99.
17. Rahimi Derazi Z, Bagherzadeh R, Ravanipour M. Evaluation of sleep habits and some related factors on school age children in Bushehr city in 2019. J Pediatr Nurs 2021; 7: 43-50. [In Persian].
18. Liu X, Liu L, Wang R. Bed sharing, sleep habits, and sleep problems among Chinese school-aged children. Sleep 2003; 26: 839-44.
19. Parsapour Z, Torabi E, Jalilolghadr S, et al. The evaluation of sleep disorders in children with adenotonsillar hypertrophy referring to the otolaryngology clinic of Qazvin Children Hospital, Iran. J Sleep Sci 2019; 4: 24-8.
20. Jalilolghadr S, Taghiloo M, Parsarad E, et al. Evaluation of sleep-disordered breathing in children and adolescents referred to the sleep ward of Qazvin children's hospital during 2014-2019. Int J Pediatr 2022; 10: 15261-70.
21. Durdik P, Sujanska A, Suroviakova S, et al. Sleep architecture in children with common phenotype of obstructive sleep apnea. J Clin Sleep Med 2018; 14: 9-14.
22. Chamnanpet S, Tovichien P, Tanphaichitr A, et al. Prevalence and risk factors for rapid eye movement-related obstructive sleep apnea in children. Front Pediatr 2022; 10: 869986.
23. Spruyt K, Gozal D. REM and NREM sleep-state distribution of respiratory events in habitually snoring school-aged community children. Sleep Med 2012; 13: 178-84.