DOI: 10.5455/msm.2023.35.201-205
Received: Jul 27 2023; Accepted: Aug 26, 2023

ORIGINAL PAPER

Mater Sociomed. 2023; 35(3): 201-205

Effect of Sleeping Disorders on the Growth Parameters of Lebanese Children

Micheline Katramiz[1], Antoine Saadé[2], Mode Al Ojaimi[3], Mona Nahas Gholmieh[4]

[1]Private Practice in Pediatric Dentistry, Dubai, UAE

[2]Department of Orthodontics and Dentofacial Orthopedics, Lebanese University, Beirut, Lebanon

[3]Clinical Sciences Department, College of Medicine, University of Sharjah, UAE

[4]Department of Pediatric and Community Dentistry, Lebanese University, Beirut, Leb

Corresponding author: Mona Nahas Gholmieh, Associate Professor, Department of Pediatric and Community Dentistry, Lebanese University, Beirut, Lebanon. Phone: +9613765806. E-mail address: monagholmieh@gmail.com. ORCID ID: http//www.orcid.org/0000-0000-0000-0000.

ABSTRACT

Background: Sleep is a vital physiological function for the maintenance of health and quality of life by ensuring body rest and restoring its energy levels. Remarkably, some children have sleep disordered breathing (SDB) that can disturb their normal sleep and affect the quality of their lives. **Objective:** The aim of this study was to assess the correlation between SDB and growth impairments and wether the growth parameters vary among genders. **Methods:** This study was conducted in two steps: 1500 questionnaires were distributed to children aged 3 to 12 years. The questionnaire covered personal information, medical history, and the Pediatric Sleep Questionnaire. The latter was used to evaluate the incidence of sleep-disordered breathing and was completed by parents of the involved children. Growth assessment was then determined for the population to find the correlation between sleep disorders and growth impairments. **Results:** A total of 931 completed questionnaires were returned (70.7% response rate). Among the respondents, 56.3% were females whereas 43.3% were males. The mean age was 8 years. The result showed that 16.11% of children were at high risk of sleep-disordered breathing. A significant effect of SDB syndrome on growth parameters (weight-for-age parameter z-score and BMI for age z-score) was observed among males. Concerning the weight for age z-score, a significant difference was found between the means of control and SDB individuals (P = 0.0302). In male groups, the difference was significant (P=0.043), while non-significant difference was found in female groups (P = 0.69). **Conclusion:** This study highlights a significant effect of SDB on growth parameters among males aged between 3 and 12 years.

Keywords: Sleep-disordered breathing; children; growth.

1. BACKGROUND

Sleep is a physiological function that affects both physical and mental well-being. It is needed to rest the body and restore its energy levels required for healthy functioning and survival (1). Good sleep quality means having a sense of continuous deep sleep throughout the night and feeling refreshed and alerted upon waking up in the morning (2). According to the National Sleep Foundation, on average, children aged between 3 and 12 years should get 10 to 12 hours of sleep per day (3). During childhood, the brain needs more sleeping than awake time in order to develop healthily (1).

Intriguingly, in the past few decades, sleeping studies, especially among children, have increased and revealed a high prevalence in sleep-disordered breathing (SDB) which is the disturbance of normal respiratory patterns and ventilation forms during sleep (4). This prevalence can reach up to 25% at some point during childhood, according to physicians and experts (3). In fact, SDB is more predominant in children and adolescents than adults and can lead to various complications ranging from mild (such as daytime sleepiness, inability to get up in time in the morning, lack of concentration in class) to serious ones (like impairment of the growth, chronic medical and neurocognitive complications as well as significant behavioral and learning disabilities) (5, 6).

It has been well established that SDB, secondary to adenotonsillar hypertrophy, increases the risk of pediatric growth failure (6, 7). Recently published controlled studies have indicated a close association between SDB and growth impairments with neurocognitive impairments such as attention deficit disorder/attention deficit hyperactivity disorder (ADD/ADHD) and other behavioral disorders (6, 7). Hence, it is substantial for both parents and educators to understand the mechanism of sleeping and how interruptions in normal sleep patterns can affect children (8).

Although sleep problems are common, they are usually undiagnosed among children. The gold standard for SDB diagnosis is polysomnography. However, in light of the time, effort, and expense of polysomnography testing, several questionnaires have been developed to identify patients at high risk for SDB (9). Basically, a questionnaire is a first and essential way to detect if the child might have a sleep disorder or not; this should improve the referral process to pediatric sleep specialists. Many questionnaires were published in the literature; nevertheless, the "pediatric sleep questionnaire" (PSQ) had the best diagnostic accuracy of the evaluated tests (9).

2. OBJECTIVE

Given that no study has yet been published regarding the prevalence of SDB among Lebanese children and its impact on their growth, we aimed in this study at: a) determining the prevalence of Lebanese children that have SDB; b) evaluating the impact of sleep disorders on their quality of life; c) and assessing the correlation between SDB and growth impairments.

3. MATERIAL AND METHODS

This is a retrospective cross-sectional study involving 931 school-children aged 3 to 12 years. The study was conducted in two steps. First, 1500 questionnaires were distributed to children in 4 schools in Lebanon. A written informed consent was obtained from the parents prior to distributing the questionnaire which covered demographic characteristics, a focused medical history, and the Pediatric Sleep Questionnaire-PSQ- developed by Chervin et al (10). The questionnaire was used to evaluate the incidence of sleep-disordered breathing and was completed by the parents of the child. Second, the growth parameters (height-for-age, weight-for-age, BMI-for-age) were obtained and compared in both SDB and non-affected groups.

This study was approved by the scientific committee of the Faculty of Dental Medicine at Lebanese University

The inclusion criteria were every Lebanese child aged between 3 to 12 years in any of those 4 schools whose parents have consented to participate in the study. The exclusion criteria were:

• Every child whose parents refused to join the study or have not signed the consent form,

• Every child who has special needs or any other medical condition.

In a first step, and in order to assess the clarity of the questions provided in the questionnaire and avoid confusion, the PSQ was distributed to 20 random parents who were asked to mark any questions that were unclear. Some questions were then adjusted in response to their feedback and when feasible a meeting with parents was done in order to explain the questionnaire.

The pediatric sleep questionnaire (PSQ)

The PSQ consisted of 22 questions rated by parents. It has one scale called Sleep-Related Breathing Disorders Scale (SRBD). Parents were asked to rate these questions with three possible answers: "yes" or "no" or "don't know" (10).

The SRBD scale

The questions included in the SRBD were related to snoring frequency, loud snoring, observed apneas, difficulty in breathing during sleep, daytime sleepiness, inattentive or hyperactive behavior (11). Each question could be answered by yes (referred as 1), no (referred as 0), or don't know (considered a missing answer). All unanswered questions or answered by "don't know" were excluded. The number of items answered by "yes" was divided by the total number of questions answered by "yes" and "no", providing a result ranging from 0 to 1. [10]. When the number was equal or higher to 0.33 (scores of 8 or more), it was indicative of high risk for a pediatric SDB, whereas children with fewer than 30% positive responses (scores less than 8) were considered at low risk of SDB (11).

In our study we added 13 questions to the PSQ related to personal information about the child, his medical history, his educational review, and his dietary habits.

Growth Parameters

Growth parameters (height and weight) were recorded by well-trained school nurses and measurements done privately for each child as follows:

a) Height measurement

Shoes, hair ornaments, buns and braids were removed. The child was asked to stand on footplate portion of height scale with back against stadiometer rule. The school nurse made sure that the legs were brought together with a contact at some point, the knees and body were straight, arms were at sides and the shoulders relaxed. The headpiece was lowered tightly to the crown of the student's head with enough pressure to flatten the hair. The value was read at eye level and recorded in cm (12).

b) Weight measurement

To measure weight accurately in the chosen 4 schools, we adopted the same digital calibrated scale (Secca, Germany). Children were instructed to remove their shoes and only a light school's shirt and pant were allowed on. The child stood in the center of the scale facing the nurse and his weight was recorded to the nearest decimal fraction. Body mass index (BMI) was calculated using the following formula: weight (kg)/height (m2). Z scores and percentiles for the respective growth parameters were calculated using the Medscape calculator which is based on the CDC growth charts released in 2000 (13).

Statistical analysis

SPSS 21.0 software (SPSS Inc, Chicago, IL, USA) was used for data analysis. Continuous data were presented

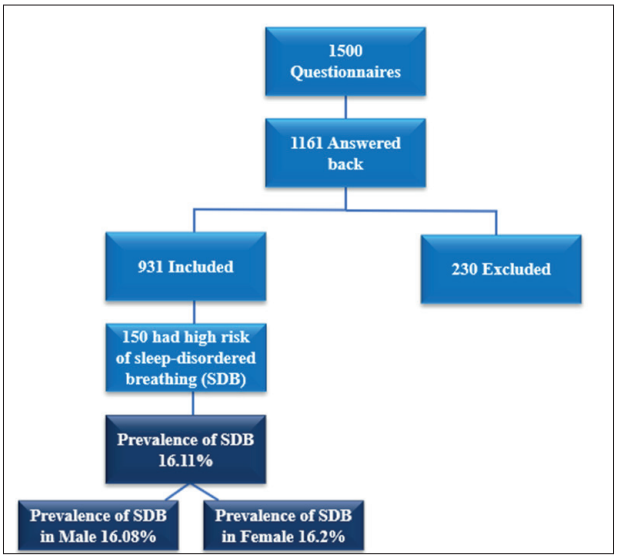

Figure 1. Size of tested sample and prevalence of SDB

as mean ± standard deviation (mean ± SD). Unpaired t-test or Mann-Whitney U test was used to compare the means of two independent groups (Control and SDB). Categorical data were presented as frequencies and proportions, and compared by Hi^2 test. P <0.05 was considered statistically significant.

4. RESULTS

Among 1500 questionnaires distributed, 1161 questionnaires were returned, and 931 (70.7%) were considered properly completed. Out of the 931 respondents, 56.3% were females and 43.3% were males. The mean age was 8 years (SD = ± 2.26) and range 3 to 12 years. Among those 931 children, 150 were at high risk of SDB according to the pediatric sleep questionnaire without specific mean age nor gender, indicating an overall prevalence of 16.11%. The prevalence of SDB in females was 16.2% and the prevalence of SDB in males was 16.08%. (Figure 1).

Height-for-age z-score parameter

Concerning the height for age z-score, no significant difference was found between the means of control and SDB individuals (P = 0.58). Moreover, there was no significant difference between the means of control and SDB in female group nor in male group (P = 0.66 and 0.23 respectively) (Table 1).

Weight-for-age Parameter

Regarding the weight for age z-score, a significant difference was found between the means of control and SDB group (P = 0.0302). The mean of weight for age z-score was higher in SDB male group than in control group (P = 0.043) *, while non-significant difference was found in female groups (P = 0.69) (Table 2).

BMI-for-age z-score

As for the BMI for age z-score, a significant difference was found between the means of control and SDB individuals (P = 0.044) The mean of BMI for age z-score was higher in SDB male group than control group (P=0.0151) *, while non-significant difference was observed in female groups (P = 0.77) (Table 3).

All height	
P value	0,5809
Sum of ranks in column A, B	365611, 68235
Mann-Whitney U	56910
Female height	
P value	0,2333
Sum of ranks in column A, B	118477, 20651
Mann-Whitney U	17080
Male height	
P value	0,6692
Sum of ranks in column A, B	68074, 13736
Mann-Whitney U	10780

Table 1. Characterization of height-for-age z-score

All weight	
P value	0,0302*
Mean ± SEM of column A	0.02830 ± 0.04078 N=781
Mean ± SEM of column B	0.2575 ± 0.1138 N=150
Weight male	
P value	0,0431*
Mean ± SEM of column A	0.1233 ± 0.06242 N=338
Mean ± SEM of column B	0.4432 ± 0.1584 N=66
Difference between means	-0.3198 ± 0.1576
Weight female	
P value	0,6902
Mean ± SEM of column A	-0.04422 ± 0.05367 N=443
Mean ± SEM of column B	-0.09679 ± 0.1072 N=84

Table 2. Characterization of weight-for-age z-score

All BMI	
P value	0,0441*
Mean ± SEM of column A	0.2732 ± 0.04712 N=781
Mean ± SEM of column B	0.5127 ± 0.1153 N=150
Difference between means	-0.2395 ± 0.1188
Male BMI	
P value	0,0151*
Mean ± SEM of column A	0.3033 ± 0.06310 N=338
Mean ± SEM of column B	0.6909 ± 0.1576 N=66
Difference between means	-0.3876 ± 0.1589
Female BMI	
P value	0,7745
Sum of ranks in column A, B	116585, 22543
Mann-Whitney U	18240

Table 3. Characterization of BMI-for-age z-score

5. DISCUSSION

Nowadays, SDB is becoming highly frequent and it should not be neglected especially in the case of children because it will affect not only their normal body development, growth and learning potentials, but also might lead to more critical consequences such as brain damage, hypertension and cardio vascular diseases (14).

In this study, a questionnaire was used to measure the occurrence of SDB symptoms among Lebanese children aged between 3 and 12 years and distributed into 4 schools in Lebanon. The pediatric sleep questionnaire (PSQ) used in this study was considered as a reliable tool with a sensitivity of 81% and specificity of 87%.

We randomly chose 2 private schools and 2 public schools from mountains and coast to eliminate the socio-economical factor. Of the total 1500 children, 931

were included in this study. This number was considered significant according to the population living in Lebanon. The response rate (70.7%) was high among which 56.3% were girls and 43.3% were boys. Only 19.2% of the surveys were not returned back and 10% were omitted because they matched with the exclusion criteria listed above.

In this study, 16.11% of children had high risk of SDB. Interestingly, a previous study conducted in 2014 assessed the prevalence of sleep disorders in children using another questionnaire "the sleep-50 questionnaire" reported that the prevalence of severe sleep disorders all over Lebanon was 5.6% (252 out of 4516) (7). Remarkably, it was noticed that the Northern governorate in Lebanon had the majority of children that might have severe risk of SDB with a rate of 9.3% (141 out of 1538) whereas, the percentage fluctuated between 1.4% and 6% according to the region (7).

On the other side, a wide variation of sleeping disorder in children prevalence rates are reported worldwide. The prevalence of sleep disorders in our study (16.11 %) with 16.2% for female and 16.08% for male. The SDB prevalence was higher than that conducted by Ramli et al. which was 14.9% among children living in Malaysia (15). On the other hand, our prevalence rate was lower than the one reported by Baidas et al., (16) which stated that 21% of children (with a mean age of 9.2 years) in Saudi Arabia had sleep disorder. Moreover, it was lower than those reported for Dutch Children aged between 7 and 12 years (25%) and Brazilian schoolchildren (27.6%) who have sleep problems (17, 18). Moreover, in this study, there was no difference for SDB severity in children between genders, which is in line with most studies [19]. However, in adult, male is at higher risk of having SDB than female, and this may be due to differences in upper airway anatomy, body composition, and hormonal influences (20).

Polysomnography (PSG) is the gold standard for diagnosis of SDB (21); however, its usage in epidemiological research is limited by its expense along with the required time and effort (8). Sleep disorders in children can be assessed by using several questionnaires such as parental interactive bedtime behavior scale (PIBBS), sleep settle questionnaire (SSQ), children's sleep habit questionnaire (CSHQ), the 50-sleep questionnaire, 18-OSA questionnaire and others (22). In this study, the pediatric sleep questionnaire (PSQ) was the questionnaire of choice since it represents the best diagnostic accuracy tool to be used as a screening method for SDB (9, 10, 23). Besides, it has been authorized and used by several studies as an instrument to assess a variety of three prominent symptom-complexes such as snoring, daytime sleepiness, and inattentive/hyperactive comportment (8). It also shows adequate psychometric properties as previously reported (22).

In 2014, a meta-analysis study evaluated the diagnostic capability of physical evaluations and questionnaires compared with the current reference standard (a full PSG) to diagnose SDB in children younger than 18 years (9, 24). It was found that PSQ had the best diagnostic accuracy among the evaluated tests (9, 23). Over the past two decades, PSQ was used to screen many populations and the most recent study using PSQ was conducted among Saudi primary school children aged 6–12 years in Riyadh city (16).

Monitoring growth is a key screening tool that enables us to assess the child's health and wellbeing. Adequate growth implies that children are most probably healthy and well-nourished. Abnormal growth, on the other hand, flags the need for careful diagnostic work up and action (25). A key principle in the clinical assessment of children and adolescents' growth is the expression of their anthropometric parameters as percentiles, percent of medians or as z-scores (26). They are applied in pediatric growth follow up to detect the presence of any growth impairment or disease [26]. For population-based surveys, the z-score has proven more advantageous compared to the other methods (27). It quantifies a measurement's standard deviation from the mean. Based on CDC, 50th percentile corresponds to a z score of 0. A z-score of ± 1.0 corresponds respectively to the 15th or 85th percentiles while a z-score of ± 2 plots at roughly the 3rd or 97th percentile (28).

In our study, the SDB severity group was not different for Height z-score when investigated in the whole group or when classified by gender. However, a significant difference was found between SDB and control groups only in males. (Weight z-score, BMI z-score).

Obesity has been shown to increase the risk for SDB, particularly in older children (29) with more risk factors in obese children compared to children with normal weight. These risk factors include increased neck circumference, enlarged tonsils, and a higher body mass index (BMI), among others. As obesity is a major risk factor for SDB in children, weight management should be cautiously addressed in order to improve symptoms of SDB (21).

It is important to identify and treat SDB in children as early as possible, as untreated patients can lead to a range of negative health outcomes, including poor growth, developmental delays, and behavioral problems.

6. CONCLUSION

Based on our study, SBD significantly affects the growth of male patients aged 3-12 years.

A larger study should be conducted to see if these results are replicated on a larger scale and in different populations. SBD shall be considered in the differential diagnosis of pediatric patients presenting with failure to thrive especially males. Awareness about SBD and its implications on growth should be provided to all health care professionals taking care of pediatric patients.

.

- **Acknowledgements:** The authors would like to acknowledge patients who participated in this study.
- **Patient Consent Form:** The authors certify that they have obtained all appropriate patient consent forms.
- **Author's contribution:** MG designed the study and MK collected the data. All authors analyzed the data and gave final approval of the version to be published and agreed to be accountable for all as-

pects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

- **.Conflict of interest:** There are no conflicts of interest.
- **Financial support and sponsorship:** Nil.

REFERENCES

1. Kiley JP, Twery MJ, Gibbons GH, National Center on Sleep Disorders Research. Progress and promise. Sleep. 2019; 42(6).
2. Smith HA, Smith ML. The role of dentists and primary care physicians in the care of patients with sleep-related breathing disorders. Frontiers in Public Health. 2017 Jun 15; 5: 137.
3. Fuligni AJ, Bai S, Krull JL. Individual Differences in Optimum Sleep for Daily Mood During Adolescence Individual Differences in Optimum Sleep for Daily Mood During Adolescence. 2019; 469-479.
4. Owens J. Classification and epidemiology of childhood sleep disorders. Sleep Medicine Clinics. 2007 Sep 1; 2(3): 353-361.
5. McGrath B, Lerman J. Pediatric sleep-disordered breathing: an update on diagnostic testing. Current Opinion in Anesthesiology. 2017 Jun 1; 30(3): 357-361.
6. Smith HA, Smith ML. The role of dentists and primary care physicians in the care of patients with sleep-related breathing disorders. Frontiers in Public Health. 2017 Jun 15; 5: 137.
7. Habbas M, Rajab M, Ziad F, Merhi B. Sleep disorders in lebanese children: prevalence, relation with dietary habits, and impact on children's behaviors. 2015.
8. Chervin RD, Hedger K, Dillon JE, Pituch KJ. Pediatric sleep questionnaire (PSQ): validity and reliability of scales for sleep-disordered breathing, snoring, sleepiness, and behavioral problems. Sleep medicine. 2000 Feb 1; 1(1): 21-32.
9. Canto GD, Singh V, Major MP, Witmans M, El-Hakim H, Major PW, Flores-Mir C. Diagnostic capability of questionnaires and clinical examinations to assess sleep-disordered breathing in children: a systematic review and meta-analysis. The Journal of the American Dental Association. 2014 Feb 1; 145(2): 165-178.
10. Chervin RD, Weatherly RA, Garetz SL, Ruzicka DL, Giordani BJ, Hodges EK, Dillon JE, Guire KE. Pediatric sleep questionnaire: prediction of sleep apnea and outcomes. Archives of Otolaryngology–Head & Neck Surgery. 2007 Mar 1; 133(3): 216-222.
11. Pabary R, Goubau C, Russo K, Laverty A, Abel F, Samuels M. Screening for sleep□disordered breathing with Pediatric Sleep Questionnaire in children with underlying conditions. Journal of sleep research. 2019 Oct; 28(5): e12826.
12. Cameron N. The methods of auxological anthropometry. In Human growth 1978 (pp. 35-90). Springer, Boston, MA.
13. National health and nutrition survey, (NHANES), CDC/ National Center for Health Statistics. 2000. <http://www.medscape.com>
14. Colten HR, Altevogt BM. Extent and health consequences of chronic sleep loss and sleep disorders. Sleep disorders and sleep deprivation: an unmet public health problem. 2006: 55-135.
15. Ramli Z, Samsinah H. Prevalence of sleep-disordered breathing symptoms among Malay school children in a primary school in Malaysia. Med J Malaysia. 2012 Apr; 67(2): 181.
16. Baidas L, Al-Jobair A, Al-Kawari H, AlShehri A, Al-Madani S, Al-Balbeesi H. Prevalence of sleep-disordered breathing and associations with orofacial symptoms among Saudi primary school children. BMC Oral Health. 2019 Dec; 19(1): 1-8.
17. Petry C, Pereira MU, Pitrez P, Jones MH, Stein RT. The prevalence of symptoms of sleep-disordered breathing in Brazilian schoolchildren. Jornal de pediatria. 2008 Apr; 84(2): 123-129.
18. Van Litsenburg RR, Waumans RC, van den Berg G, Gemke RJ. Sleep habits and sleep disturbances in Dutch children: a population-based study. European journal of pediatrics. 2010 Aug; 169(8): 1009-1015.
19. Horne RS, Ong C, Weichard A, Nixon GM, Davey MJ Are there gender differences in the severity and consequences of sleep disordered in children? Sleep Medicine, 2000; 67:.147-155.
20. Lin Christine M, Davidson TM, Ancoli-Israel S. Gender differences in obstructive sleep apnea and treatment implications. Sleep medicine reviews. 2008; 12(6): 481-496.
21. Marcus CL, Brooks LJ, Ward SD, Draper KA, Gozal D, Halbower AC, Jones J, Lehmann C, Schechter MS, Sheldon S, Shiffman RN. Diagnosis and management of childhood obstructive sleep apnea syndrome. Pediatrics. 2012 Sep 1; 130(3): e714-55.
22. Spruyt K, Gozal D. Development of pediatric sleep questionnaires as diagnostic or epidemiological tools: a brief review of dos and don'ts. Sleep medicine reviews. 2011 Feb 1; 15(1): 7-17.
23. Kadmon G, Shapiro CM, Chung SA, Gozal D. Validation of a pediatric obstructive sleep apnea screening tool. International journal of pediatric otorhinolaryngology. 2013 Sep 1; 77(9): 1461-1464.
24. Ehsan Z, Ishman SL, Kimball TR, Zhang N, Zou Y, Amin RS. Longitudinal cardiovascular outcomes of sleep disordered breathing in children: a meta-analysis and systematic review. Sleep. 2017 Mar 1; 40(3): zsx015.
25. De Onis M, Onyango AW. WHO child growth standards. The Lancet. 2008 Jan 19; 371(9608): 204.
26. Wang Y, Cai L, Wu Y, Wilson RF, Weston C, Fawole O, Bleich SN, Cheskin LJ, Showell NN, Lau BD, Chiu DT. What childhood obesity prevention programmes work? A systematic review and meta□analysis. Obesity reviews. 2015 Jul; 16(7): 547-565.
27. Wang Y, Chen HJ. Use of percentiles and z-scores in anthropometry. In Handbook of anthropometry. Springer, New York, NY. 2012: 29-48.
28. Kuczmarski RJ. 2000 CDC Growth Charts for the United States: methods and development. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 2002.
29. Kohler MJ, Thormaehlen S, Kennedy JD, et al. Differences in the association between obesity and obstructive sleep apnea among children and adolescents. J Clin Sleep Med. 2009; 5(6): 506-511.