



## Sleep Clinical Record application in Brazilian children and its comparison with Italian children<sup>☆</sup>



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### ABSTRACT

**Objective:** To apply the Sleep Clinical Record (SCR) to a sample of Brazilian children with sleep complaints, to compare the results with Italian children, and to identify variables that influence phenotype.

**Methods:** Brazilian and Italian children, 4–11 years of age and matched for age, gender, obesity, and apnea–hypopnea index and who presented with complaints related to sleep, were selected. The instrument used was the SCR, and the procedure used was full-night cardiorespiratory monitoring.

**Results:** The sample consisted of 51 Brazilian children and 102 Italian children. Brazilian children presented with oral breathing (55%), tonsillar hypertrophy (69%), Friedman palate position (88%), malocclusion (84%), and OSAS score (Brouillette questionnaire) (55%). The SCR among obese Brazilian children was higher as compared to that in nonobese subjects (obese, 10.84 vs nonobese, 9.13;  $p = 0.03$ ). In the comparison between Brazilian and Italian children, the total Brazilian SCR was higher than the Italian SCR score (Brazilian SCR,  $10.21 \pm 7.56$ ; Italian SCR,  $8.95 \pm 2.55$ ;  $p = 0.002$ ). The Italian SCR score was influenced by obesity, whereas the Brazilian SCR was influenced by others symptoms (daytime sleepiness, enuresis, nocturnal choking, headache, limb movements).

**Conclusion:** Brazilian children with sleep-disordered breathing show a higher SCR score as compared to Italian children. Obesity and tonsillar hypertrophy, Friedman palate position alteration, and dental malocclusion further influenced the total SCR score among Brazilian children. This may be due to access difficulties in Brazil where children should have more assistance to obtain medical care.

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### 1. Introduction

Obstructive sleep apnea (OSA) is characterized by partial or complete obstruction of the upper airways during sleep associated with increased respiratory effort, fragmented sleep, or abnormal gas exchange [1]. OSA may affect children in terms of behavioral alterations [2], cardiovascular alterations [3], pulmonary hypertension [4], somatic growth impairment [5], craniofacial alteration,

malocclusion [6], and language abilities [7]. Early diagnosis and treatment are recommended.

Few studies have been conducted on the different phenotypes of pediatric OSA, which might improve the classification of pediatric sleep-disordered breathing. OSA is recognized as a multifactorial disorder, in addition to the dependence of genotype–phenotype interactions [8]. The common phenotype of pediatric OSA is characterized by tonsillar hypertrophy, long face, narrow palate, and dental malocclusion [9]. However, obesity should also be considered as an important factor causing OSA in children [10]. This is justified by the connections between sleep disturbance and the metabolism–obesity complex, and the potential interactive roles of OSA and obesity in metabolic phenotype [11].

OSA is diagnosed by carrying out clinical and instrumental examinations, with full-night, complete polysomnography (PSG) the gold standard for the diagnosis [1]. However, the high costs and the

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limited resources for type 1 PSG preclude its use in children affected by nocturnal respiratory complaints. Type 3 PSG (cardiorespiratory monitoring) has recently been validated as a diagnostic tool to increase screening in sleep-related breathing disorders [12].

Type 3 PSG showed high sensitivity and specificity and is considered as a suitable tool for predicting the presence and the severity of OSA in children, especially for mild to moderate disease [13].

Screening protocols that evaluate various clinical parameters related to respiratory functions and to physical examinations can be valuable tools to assess the child's risk of OSA, especially in low-resource settings [14–16]. The protocol Sleep Clinical Record (SCR) was developed in Italy as a simple screening tool for sleep-disordered breathing in an attempt to optimize the use of PSG [17].

The SCR is a validated instrument that allows large-scale evaluation of pediatric patients for the diagnosis of OSA, by combining the symptoms of patient's anamnesis with the signs of the physical examination. It should also be emphasized that the instrument is validated for diagnosis of preschool children. Its validity also applies to children after tonsillectomy, thus showing its wide utility for the follow-up of children affected by obstructive disorders. Nevertheless, the SCR has not been used in a different cultural environment [18,19].

The objective of this study was to apply the SCR to a sample of Brazilian children with sleep complaints, to compare the results with Italian children and to identify variables that influence phenotype.

## 2. Methods

This study was approved by a local Ethic Commission (process number CAAE 47871115.2.0000.5411).

### 2.1. Brazilian subjects

Children from the southern region of Brazil affected by sleep-disordered breathing who attended the Sleep Disorders outpatient clinic of the department of otorhinolaryngology, in a reference center in Botucatu, Sao Paulo, Brazil, comprised the Brazilian sample.

### 2.2. Italian subjects

Children affected by sleep-disordered breathing and attended a sleep center in Rome, Italy, comprised the Italian sample.

Both groups were matched for age, gender, weight, and apnea–hypopnea index (AHI).

### 2.3. Inclusion and exclusion criteria

Inclusion criteria were as follows: children aged 4–11 years of age of either gender; children who were assessed through protocols previously established; children whose consent from their parents/guardians allowed them to participate in the research (Term of Consent); and children who submitted their approval to participate in the research (Term of Assent).

Exclusion criteria were as follows: children affected by neurological disorders, genetic syndromes, neuromuscular disorders, or drugs depressing the respiratory system. Exclusion criteria were identified based on history and clinical examination.

### 2.4. Procedures

#### 2.4.1. Cardiorespiratory monitoring

Cardiorespiratory monitoring was accomplished by full-night type 3 polygraphy performed in hospital, which evaluated the following biological variables: nasal airflow, thoracic respiratory

effort measurement, percutaneous oxygen saturation measurement, heart rate, bed position, and snoring record. The AHI was used to classify OSA severity by considering mild  $1 > \text{AHI} < 5$  events/h, moderate  $5 > \text{AHI} < 10$  events/h, and severe  $\text{AHI} > 10$  events/h [1].

#### 2.4.2. Clinical evaluation

A clinical examination was performed and the SCR was obtained for all patients. To combine subjective and objective parameters, the SCR consisted of 11 items from a range of 0–2: nasal septum deviation, nasal obstruction, oral breathing, tonsillar hypertrophy, Friedman palate position, dental/skeletal malocclusion, arched palate and phenotype. Inattentive and hyperactive symptoms ranged from 0 to 1. Other symptoms along with OSAS score (Brouillette questionnaire) ranged from 0 to 0.5. The sum of all of these items generated the total SCR score, which ranged from 0 to 18 points. An SCR score  $\geq 6.5$  was considered positive [17].

### 2.5. Statistical analysis of outcomes

The SPSS package (PASW Statistics for Windows, Version 24.0; IBM SPSS Inc., Armonk, NY) was used for statistical analysis. All tests were 2-tailed, with significance considered for  $p$  values  $< 0.05$ . The Shapiro–Wilk test for normality was used. Categorical variables were described as number and percentage; continuous variables were expressed as mean  $\pm$  standard deviation or as median. Comparisons between the groups were based on  $\chi^2$  or Fisher test for categorical variables and the Mann–Whitney test for continuous variables, according to data distribution. The Spearman test was used for data correlation.

## 3. Results

### 3.1. Brazilian children

The sample included 51 Brazilian children, 26 girls and 25 boys, 4–11 years of age (mean age  $6.92 \pm 2.08$  years). The results for each item of the SCR are shown in Table 1.

In sum, 63% of children were obese, and the total SCR score showed a difference between them and nonobese children (obese, 10.84; nonobese, 9.13;  $p = 0.03$ ).

Mild OSA was found in 31% of the children; 31% had moderate OSA and 38% were diagnosed with severe OSA, accounting for a total SCR score of 9.75, 10.13, and 10.66, respectively.

### 3.2. Comparison between Brazilian and Italian children

The Italian sample included 102 children, 50 girls and 52 boys, 4–11 years of age, 61% of whom were obese. With regard to OSA

**Table 1**  
Results of the Sleep Clinical Record in Brazilian children.

SCR item	%	Mean of SCR total	SD
Nasal septum deviation	3.92	0.08	3.44
Nasal obstruction	41.18	0.82	0.99
Oral breathing	54.90	1.10	1.00
Tonsillar hypertrophy	68.63	1.37	0.94
Friedman palate position alteration	88.24	1.76	0.65
Dental/skeletal malocclusion	84.31	1.69	0.73
Arched palate	54.90	1.10	1.00
ADHD	15.69	0.16	3.44
Other symptoms <sup>a</sup>	45.10	0.23	0.25
OSAS score (Brouillette) positive	66.67	0.33	0.24
SCR score positive	86.27	10.21	3.44

ADHD, attention-deficit/hyperactivity disorder; OSAS score, Brouillette's questionnaire; SCR, Sleep Clinical Record; SD, standard deviation.

<sup>a</sup> Other symptoms: daytime sleepiness, enuresis, nocturnal choking, headache, limb movements.

**Table 2**

Minimum, maximum, median, and mean age, apnea–hypopnea index, mean saturation, and oxygen nadir of cardiorespiratory monitoring.

Characteristic	Country	Minimum	Maximum	Median	Mean	SD	<i>p</i>
Age, y	Brazil	4	11	7	6.92	2.08	1.00
	Italy	4	11	7	6.92	2.07	
AHI	Brazil	1.8	20.44	7.6	9.14	5.74	0.17
	Italy	1.2	25.20	6.7	8.27	6.44	
Mean saturation	Brazil	91	99	96.0	96.80	1.69	0.07
	Italy	90.6	98	97.2	96.96	1.12	
Oxygen nadir	Brazil	61	96	86	84.20	7.47	0.11
	Italy	62	96	88	87.32	6.18	
SCR score of all children	Brazil	2	16	10.5	10.21	3.44	0.002*
	Italy	1	14	8.5	8.95	2.55	
SCR score of obese children	Brazil	2	16	11.5	10.84	3.58	0.01*
	Italy	1	14	9.25	9.14	2.79	

AHI, apnea–hypopnea index; SD, standard deviation.

\* Statistically significant ( $P < 0.05$ , Mann–Whitney test).

severity, 37% was classified as mild, 32% moderate, and 31% severe, and the SCR total mean was 7.94, 9.17, and 10.37 respectively. Both Brazilian and Italian children's cardiorespiratory monitoring data are shown in Table 2.

In general, the Brazilian children's SCR score was higher as compared to that of Italian children, and obese Brazilian children showed a higher SCR score. The results of each item of the SCR and a comparison between Brazilian and Italian children are shown in Table 3.

Brazilian and Italian children showed similar symptoms associated with OSA, such as attention-deficit/hyperactivity disorder (ADHD), oral breathing, and OSAS score. The Brazilian children included more cases of tonsillar hypertrophy (69%), alteration of Friedman palate position (88%), and malocclusion (84%) whereas the Italian children included more cases of nasal septum deviation (23%), nasal obstruction (68%), and arched palate (86%).

The regression analysis of risk factors influencing the SCR score is shown in Table 4.

The regression analysis showed that the SCR in Italian children was more influenced by obesity, whereas the SCR in Brazilian

children was affected by the presence of other symptoms (daytime sleepiness, enuresis, nocturnal choking, headache, limb movements). Nasal septum deviation, nasal obstruction, oral breathing, tonsillar hypertrophy, Friedman palate position alteration, malocclusion, arched palate, and presence of ADHD affected Brazilian and Italian children alike.

#### 4. Discussion

The application of SCR in Brazilian children has demonstrated the use of this protocol in various ethnic groups and in different countries. Using the same protocol for this kind of analysis may facilitate data comparison and allow more children affected by OSA to be included in future studies. This goal is important in order to better define disease characteristics (prevalence, cause, and diagnosis) that might improve the definition of treatment and prevention or awareness actions.

Multicenter studies demonstrate the relevance of understanding pediatric OSA, for example, in diagnosis to identify the metabolic biomarkers [20] and treatments, after tonsillectomy, to help reverse IQ deficits [21], to reduce sleepiness [22], to improve the quality of life, and to reduce OSA symptoms [23]. The Childhood Adenotonsillectomy Trial (CHAT) is an important study aiming to identify children who most need PSG prior to tonsillectomy using a combination of factors (demographics, physical examination findings, and caregivers' reports) [16].

This study demonstrated that Brazilian children presented with a high frequency of oral breathing, tonsillar hypertrophy, Friedman palate position, malocclusion, and OSAS score (Brouillette questionnaire). The incidence of oral breathing, habitual snoring, reported apneas, and excessive daytime sleepiness reported in this study was higher than in a previous study of schoolchildren from southern Brazil [24].

Risk factors for obesity in Brazilian children are the highest in intermediate socioeconomic status [25], sex (male), living in the urban area, and living in the south, central/west and southeast regions [26]. The high prevalence of obese children in our study allows one to hypothesize that OSA could be a risk factor for obesity. Socioeconomic status was not evaluated, as it was considered as a limiting factor. A study population should be randomized on the basis of the factors considered in this research by adding socioeconomic status and increasing the number of subjects for future investigations.

In the comparison between Brazilian and Italian children, the SCR score was higher in Brazilian children as a result of more clinical alterations and complaints, possibly due to greater tonsillar hypertrophy, as also observed in a previous Brazilian study, which correlated with the presence of OSA [27]. The mean SCR in obese

**Table 3**

Data comparison between Brazilian and Italian samples: Number of children, frequency, and coefficient of association of each item of Sleep Clinical Record.

Item of the SCR	Country	n	%	<i>p</i>
Nasal septum deviation	Brazil	2	3.92	<b>0.003*</b>
	Italy	23	22.55	
Nasal obstruction	Brazil	21	41.18	<b>0.002*</b>
	Italy	69	67.65	
Oral breathing	Brazil	28	54.90	0.31
	Italy	47	46.08	
Tonsillar hypertrophy	Brazil	35	68.63	<b>0.002*</b>
	Italy	43	42.16	
Friedman palate position	Brazil	45	88.24	< <b>0.01*</b>
	Italy	21	20.59	
Alteration	Brazil	43	84.31	< <b>0.01*</b>
	Italy	50	49.02	
Arched palate	Brazil	28	54.90	< <b>0.01*</b>
	Italy	88	86.27	
ADHD	Brazil	8	15.69	0.11
	Italy	28	27.45	
Other symptoms <sup>a</sup>	Brazil	23	45.10	0.82
	Italy	44	43.14	
OSAS score positive	Brazil	34	66.67	0.25
	Italy	72	70.59	
SCR score positive	Brazil	44	86.27	1.00
	Italy	90	88.24	

ADHD, attention-deficit/hyperactivity disorder; OSAS score, Brouillette questionnaire; SCR, Sleep Clinical Record.

\* Statistically significant ( $p < 0.05$ ,  $\chi^2$  and Fisher tests).<sup>a</sup> Other symptoms: daytime sleepiness, enuresis, nocturnal choking, headache, limb movements.

**Table 4**  
Regression analysis of risk factors for Sleep Clinical Record in Brazilian and Italian children.

SCR item	Country	No standardized coefficient		Standardized coefficient	t	Sign	95% Confidence interval	
		B	SE	$\beta$			Lower limit	Upper limit
Constant	Brazil	1.173	0.795		1.476	0.148	-0.437	2.783
	Italy	1.081	0.947		1.141	0.257	-0.802	2.963
Obese	Brazil	0.084	0.302	0.012	0.277	0.783	-0.528	0.695
	Italy	0.530	0.252	0.104	2.103	<b>0.038</b>	0.029	1.031
Age	Brazil	0.043	0.072	0.026	0.601	0.551	-0.102	0.189
	Italy	0.092	0.073	0.075	1.254	0.213	-0.054	0.238
Gender	Brazil	0.083	0.290	0.012	0.285	0.777	-0.505	0.670
	Italy	-0.307	0.256	-0.060	-1.197	0.235	-0.816	0.203
Nasal septum deviation	Brazil	1.229	0.396	0.140	3.102	<b>0.004</b>	0.426	2.031
	Italy	0.816	0.165	0.269	4.936	<b>0.000</b>	0.487	1.144
Nasal obstruction	Brazil	0.929	0.150	0.268	6.194	<b>0.000</b>	0.625	1.233
	Italy	0.880	0.135	0.325	6.518	<b>0.000</b>	0.612	1.148
Oral breathing	Brazil	1.065	0.151	0.311	7.033	<b>0.000</b>	0.758	1.372
	Italy	1.071	0.133	0.421	8.068	<b>0.000</b>	0.807	1.335
Tonsillar hypertrophy	Brazil	0.901	0.166	0.245	5.415	<b>0.000</b>	0.564	1.238
	Italy	1.073	0.137	0.418	7.831	<b>0.000</b>	0.800	1.345
Friedman palate position alteration	Brazil	0.873	0.253	0.165	3.452	<b>0.001</b>	0.360	1.385
	Italy	0.609	0.153	0.194	3.977	<b>0.000</b>	0.305	0.913
Malocclusion	Brazil	0.959	0.244	0.205	3.936	<b>0.000</b>	0.465	1.452
	Italy	0.712	0.132	0.281	5.400	<b>0.000</b>	0.450	0.974
Arched palate	Brazil	0.870	0.153	0.254	5.692	<b>0.000</b>	0.560	1.180
	Italy	1.271	0.186	0.345	6.821	<b>0.000</b>	0.901	1.641
ADHD	Brazil	1.444	0.403	0.154	3.586	<b>0.001</b>	0.628	2.259
	Italy	-0.533	0.339	-0.094	-1.575	0.119	-1.206	0.140
Other symptoms	Brazil	1.846	0.546	0.135	3.383	<b>0.002</b>	0.740	2.951
	Italy	0.299	0.548	0.029	0.546	0.587	-0.790	1.389

\* Statistically significant ( $p < 0.05$ ).

Brazilian children was also higher as compared to that in Italian children. Nevertheless, the regression analysis showed that the Italian SCR was affected more by obesity, whereas the Brazilian SCR was more influenced by other symptoms (eg, daytime sleepiness, enuresis, nocturnal choking, headache, limb movements). Therefore, new studies should be carried out to understand the influence of obesity in children with OSA in different countries.

Brazilian children showed a higher frequency of tonsillar hypertrophy, malocclusion, and alteration of Friedman palate position, whereas Italian children presented with a higher incidence of nasal alterations and arched palate. Previous Italian studies showed an influence of malocclusion, nasal obstruction, and arched palate in the SCR evaluation [10,19]. As far as the influence of race in pediatric OSA is concerned, existing literature shows a correlation between the African American race and OSA severity [16]. However, the percentage of African immigration in the southern region of Brazil, where this research was carried out, is lower as compared to the northern/northeastern regions of Brazil.

The importance of this study lies in demonstrating the impact of its applicability in different countries as an efficient way to determine clinical repercussions and to define the OSA phenotype among different populations. A similar direction for future studies is suggested, although there is a need to include more subjects and to further investigate the characteristics of the phenotype in children affected by OSA in different countries.

## 5. Conclusion

In this study, a higher frequency was found in Brazilian children with nasal obstruction, oral breathing, tonsillar hypertrophy, Friedman palate position, malocclusion, and OSAS score/Brouillette questionnaire. Obesity was found to influence the total SCR.

Tonsillar hypertrophy, Friedman palate position, and malocclusion were frequent among Brazilian children, whereas nasal and

palate alterations were frequent among Italian children. As significant differences were noted between Brazilian and Italian children, there is a need to expand the sample to define the phenotype of pediatric OSA in different countries.

From a comparative perspective, the mean of the total SCR was higher among Brazilian children as compared to Italian children. This may be due to access difficulties in Brazil, where children should have more health assistance to obtain medical care.

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## Conflict of interest

The authors declare no conflict of interest in regard to this work. The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <https://doi.org/10.1016/j.sleepx.2019.100008>.

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