

**RESEARCH ARTICLE**

# Assessment of the Association between Sleep Disordered Breathing and Developing Malocclusion in 6-9 Year Old Children - an Observational Pilot Study

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**Abstract**

**Introduction:** Sleep Disordered Breathing (SDB) in children differs from adults in a number of ways, including presenting symptoms and treatment. Children have a varied presentation from snoring and frequent arousals to enuresis, to hyperactivity. Untreated SDB may result in complications such as learning difficulties, memory loss, hypertension, depression as also poor orofacial development and malocclusion.

**Aim:** To assess the association between SDB and developing malocclusion in 6-9 year old children.

**Methodology:** Thirty- five healthy children aged 6-9 years were assessed for IOTN and their parents were administered a pre-validated questionnaire for assessing SDB (University of Michigan) by a single, trained examiner. The questionnaire had 4 domains, related to snoring, SDB, daytime sleepiness, and daytime behaviour problems. The primary variables assessed were SDB (using Pediatric Sleep Questionnaire) and developing malocclusion (using IOTN) and the modifying variables assessed were age and gender.

**Results:** 48.57% of children had SDB. A positive and moderate correlation was observed between SDB and IOTN grade that was statistically significant ( $\rho=0.626$ ;  $p<0.001$ ). Age and gender did not affect this association.

**Conclusion:** SDB has a moderate association with developing malocclusion.

**Keywords:** SDB, IOTN, PSQ, Developing malocclusion.

**Background/Rationale**

Sleep is seen as an important part of the normal physiologic processes of function and healing and is considered essential to life in the physical, neurological and emotional areas, although the biological function of sleep is still largely unrecognized [1]

Sleep Disordered Breathing (SDB) is defined as a disorder of breathing during sleep characterized by snoring, increased upper airway resistance, prolonged and repetitive partial upper airway obstruction, and/ or intermittent complete obstruction essentially disrupting normal ventilation, oxygenation and sleep quality [2].

SDB in infants was first described in 1975 in relation to sudden infant death syndrome and obstructive sleep apnea (OSA) was described in 1976 in school children [3]. SDB, a disease spectrum, ranges from partial upper airway obstruction (as seen in snoring and upper airway resistance syndrome) to complete upper airway obstruction (obstructive sleep apnea) [4]. The spectrum in children can occur throughout childhood from infancy to adolescence. Children in modern societies can suffer from SDB due to early childhood factors such as recurrent respiratory infections, allergies and poor development of muscular functions as a result of insufficient intensity, duration and improper posture of breastfeeding [5].

Children with SDB have been shown to exhibit snoring, witnessed apneas, frequent arousals, mouth breathing/ dry mouth, nocturnal sweating, failure to thrive, nasal congestion, hyperextended neck, recurrent otitis media/ Upper Respiratory Infection (URI), nightmares, sleep talking, confusional arousal, daytime sleepiness, restless sleep, enuresis, hyperactivity, inattention, difficulty waking up in morning, drooling, morning headache, insomnia, learning difficulties, delayed puberty [6].

Orofacial features seen in children with SDB are retrognathia, unilateral or bilateral crossbite, open bite or deep overbite, increased overjet, narrow upper arch, steep mandibular plane, deep hard palate, long oval face etc [7].

With a history and careful clinical examination at each dental

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visit, pediatric dentists may identify signs and symptoms of developing malocclusions as well as those that may raise concern for SDB. Several studies have shown that non-surgical interventions such as oral appliances not only helped in improvising sleep-related breathing symptoms but also corrected the malocclusion [8].

However, there is a paucity of literature regarding SDB and its association with malocclusion among children in Indian population. Hence, a study was planned with the objective of assessing the association between SDB and developing malocclusion using IOTN. The secondary objective was to assess the effect of age and gender on the association between SDB and developing malocclusion.

## Methodology

### Study design

An Observational cross-sectional study design was used for this study.

### Study settings

Ethical clearance was obtained from the Institutional Review Board. Required permissions were taken from the concerned hospital authorities and a written consent was obtained from the parent/s of children prior to the beginning of the study.

Fifty-four, otherwise healthy children aged 6-9 years, attending the OPD of the Department of Paediatric and Preventive Dentistry of a Dr. G. D. Pol's Foundation Y.M.T. Dental College and Hospital, Kharghar, Navi Mumbai and additionally, those who were attending through the school clinic preventive programs of the Department of Paediatric and Preventive Dentistry and Public Health Dentistry from 27<sup>th</sup> June, 2017 to 25<sup>th</sup> July, 2017 were screened of whom 35 were selected as per the selection criteria.

Only children with mixed dentition were included in the study. Children undergoing or completed orthodontic treatment, children with developmental syndromes like cleft lip and/or palate, etc., children in whom tonsillectomy/adenoidectomy had been performed, children undergoing medical care and presenting some type of neurological, neuromuscular or motor disturbances that would hinder their participation and children whose parents refused to give consent were excluded from the study.

### Data sources/ measurement

The primary variables assessed were SDB (using Pediatric Sleep Questionnaire, modified by Kim et al) and developing malocclusion (using IOTN) and the modifying variables assessed were age and gender.

All the children underwent a thorough complete general and oral examination by the same operator. Parents were provided with the PSQ. The PSQ (developed by Chervin et al and modified by Kim et al) is a 23-point questionnaire that assessed parameters such as snoring, SDB, daytime sleepiness, daytime behaviour problems, enuresis and hyperactivity under 3 responses viz. yes/ no/ don't know. Parents were asked to tick the most appropriate answer. More than 8 positive responses

were indicative of the presence of SDB.

Irreversible hydrocolloid impressions were made and study models were prepared in Type IV dental stone to assess IOTN grades. IOTN index comprises of 5 grades, based on treatment needs [9] with Grade 1 indicative of no treatment need and Grade 5 indicative of very great treatment need.

SDB was scored as a binary categorical variable. IOTN was recorded as ordinal grades. Age of the participants was represented as mean with standard deviation. Gender, SDB and IOTN were represented as proportions.

### Statistical methods

The data was organised using MS Excel and assessed for errors. MedCalc Statistical Software version 13.3.1 (MedCalc Software, Ostend, Belgium; <http://www.medcalc.org>; 2014) was used for statistical analysis.

Association between SDB & IOTN was evaluated using Spearman's correlation coefficient. The grade wise association between IOTN grades and SDB scores were evaluated using chi-squared test.

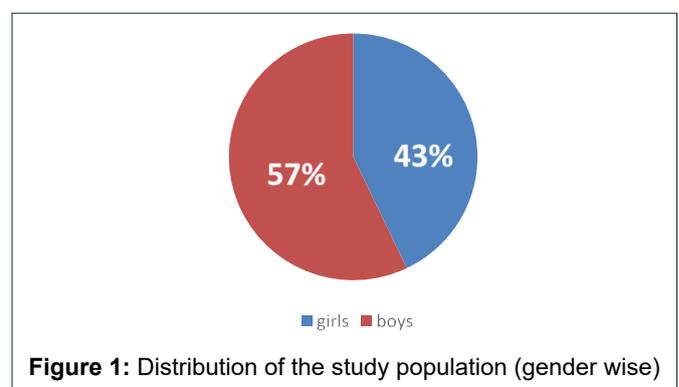
### Results

The study sample comprised of 35 children (57% boys and 43% girls) with a mean age 7.86 + 0.944 years (Table 1 and figure 1).

48.57% of children showed the presence of SDB. 84.62% of children with SDB as against 15.38% of children without SDB presented with grade 4 IOTN. 15.38% of children with SDB as against 84.62% of children without SDB presented with grade 1 IOTN and this was statistically significant ( $\chi^2 = 15.245$ ;  $p < 0.001$ ) (Table 2). The Spearman's test gave a

**Table 1:** Distribution of the study population- Age wise

	N	Minimum	Maximum	Mean	Std. Deviation
AGE	35	6	9	7.86	.944



**Table 2:** Association of SDB and IOTN (grade wise)

		IOTN GRADE (%)					Chi square value	p value
		1	2	3	4	Total		
SDB	Absent	84.62	80	25	15.38	51.42	15.245	0.002**
	Present	15.38	20	75	84.62	48.57		

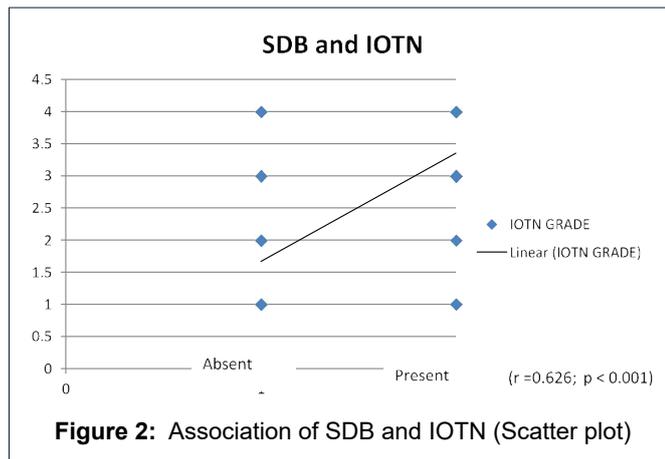


Figure 2: Association of SDB and IOTN (Scatter plot)

rho value of ( $r = 0.626$   $p < 0.001$ ) (Figure 2), indicative of a moderately positive correlation between SDB and developing malocclusion, which was statistically significant.

### Subgroup analyses

There was a positive but slight correlation of age with IOTN grade ( $r = 0.202$ ,  $p = 0.246$ ) and SDB score ( $r = 0.065$   $p = 0.709$ ) which was statistically non-significant. There was a negative but low correlation of gender with IOTN grade ( $r = -0.275$   $p = 0.110$ ) and slight correlation of gender with SDB ( $r = -0.033$   $p = 0.851$ ) statistically non-significant. 90% of children with SDB reported of inattention and hyperactivity.

### Discussion

This study was a pilot cross-sectional questionnaire based study to assess the association of SDB and developing malocclusion. Questionnaires could serve as valid and reliable instruments which can be used to identify SDB, that can be later, if necessary, be confirmed with polysomnography. There are few published questionnaires that have been designed to assess SDB and the associated symptoms that occur in children [10, 11]. We chose PSQ, originally developed by Chervin et al, (2000) and modified by Kim et al (2017) because PSQ may be used over a broad age range and provides more comprehensive assessment compared to other questionnaires [12]. The specific subscales for snoring, sleepiness, and behavior could also be useful.

IOTN index ranks malocclusion in regards to the significance of various occlusal traits for the person's dental health and perceived esthetic impairment, with the intention of identifying those persons who would most likely benefit from orthodontic treatment. The index incorporates dental health and an esthetic component. It can be applied in two ways viz. clinical setting (the patient's lips are retracted with self-retaining lip retractors, and a rating allocated) or on study models (the casts are examined in occlusion from the front and the appearance of the dentition judged as it would be seen in normal day-to-day interaction). In our study, we evaluated IOTN index on study models as they may permit repeat measurements and detailed examination sans the presence of the patient.

In our study, almost half the children showed presence of SDB

and a majority of these had an IOTN grade of 4, which is in agreement with Löfstrand-Tideström et al [13]. who reported that children with sleep related breathing disturbances had a narrower maxilla, deeper palatal height, and a shorter lower dental arch when compared with healthy children. In SDB, both nasal and oral airflow is prevented by blockage of the upper airway during sleep resulting in a collapsed airway that may lead to a change in the posture of head or body while sleeping, or the position of the tongue and/or the mandible in order to breathe. These changes in the muscle posture and tone at rest and/or in function, may lead to malocclusion. Carvalho (2014) observed that crossbite and open bite malocclusions were associated with SDB, and may be indicative of SDB in Brazilian children [7].

In our study, most of the children with SDB reported of inattention and hyperactivity. Children with SDB have been known to display daytime behaviour disorders such as inattention, hyperactivity, aggressiveness, and social withdrawal [14].

Oomen (2017) observed that Indian adults with SDB have a dental arch abnormality with 60% of the test subjects having an Angle's Class II malocclusion [15]. However, in our study we did not assess the type of malocclusion most commonly seen in SDB.

### Limitations

The present study is a cross-sectional study, hence the association between SDB and developing malocclusion was evident, however a causality could not be established. A convenient sample was chosen for the investigation from those patients who reported to our institute seeking dental care, hence it may not truly represent the population. Assessment of sleep through a questionnaire involves a risk of recall bias. However, this limitation is intrinsic to any type of questionnaire. Thus, this study is generalizable to the population with similar study settings and a similar population.

### Conclusion

48.57% of children suffered from SDB and amongst them, 84.62% presented with grade 4 IOTN. SDB has a moderately positive correlation with developing malocclusion.

### Recommendations

A larger sample size, multicentric settings and more representative sample to further establish the claims made by us.

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Nil.

### Conflict of interest

The authors declare that there is no conflict of interest.

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