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 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 improving 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 27th June, 2017 to 25th 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/adenoidecctomy 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, emesis 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 grade1 IOTN and this was statistically significant ($\chi^2 = 15.245; p < 0.001$) (Table 2). The Spearman’s test gave a

<p>| Table 1: Distribution of the study population- Age wise |
|-----------------|-----------|--------|-----|-----|--------|-------|</p>
<table>
<thead>
<tr>
<th><strong>AGE</strong></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 years</td>
<td>6</td>
<td>9</td>
<td></td>
<td>7.86</td>
<td>.944</td>
</tr>
</tbody>
</table>

**Figure 1: Distribution of the study population (gender wise)**

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

<table>
<thead>
<tr>
<th>IOTN GRADE (%)</th>
<th>Chi square value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>SDB Absent</td>
<td>84.62</td>
<td>80</td>
</tr>
<tr>
<td>SDB Present</td>
<td>15.38</td>
<td>20</td>
</tr>
</tbody>
</table>
...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.

**References**


