Sleep disordered breathing in children seeking orthodontic care

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Introduction: Our objective was to evaluate the prevalence of high-risk factors for sleep disordered breathing (SDB) in an orthodontic population of children. SDB is a spectrum of breathing disorders ranging from primary snoring to obstructive sleep apnea. **Methods:** The sample included 303 healthy children between the ages of 9 and 17. High risk of SDB was assessed using the Pediatric Sleep Questionnaire, a validated instrument that consists of 22 questions, and high risk is defined as positive answers to 33% or more of the questions answered. Sixteen randomly selected patients repeated the questionnaire 1 month after the initial survey for reliability. **Results:** In this sample, high-risk status on the Pediatric Sleep Questionnaire was not associated with sex, age, or race. The percentage of patients who were screened as high risk was 7.3% (95% confidence interval, 4.7%-10.6%). **Conclusions:** The results of this study suggest that approximately 7% of adolescent orthodontic patients may be at a significant risk for some form of SDB. (Am J Orthod Dentofacial Orthop 2018;154:65-71)

Sleep is a tightly regulated and well-organized biologic process that affects our daily functioning and our physical and mental health. According to the American Sleep Association, there are different stages of sleep, primarily separated into rapid eye movement sleep and nonrapid eye movement, which is additionally divided into 3 stages.[1] Humans spend almost 50% of total sleep in the second stage of nonrapid eye movement and about 20% in rapid eye movement sleep. Deep and restorative sleep occurs in the third stage, whereas rapid eye movement sleep provides energy to the brain and supports daytime performance.[1,2]

According to the *Journal of Clinical Sleep Medicine*, children aged 6 to 12 years should sleep 9 to 12 hours, and teenagers aged 13 to 18 years should sleep 8 to 10 hours per night, for the body to fully recover and properly function. On average, nearly half of childhood is dedicated to sleep.[3] However, for high school students in the United States, only 25% have reported sleeping 8 hours or more per night.[4] The health effects of chronic sleep deficiency are immune suppression, cardiovascular disease, neurologic imbalances, compromised quality of life, and ultimately a shortened lifespan.[1,5,6]

Several factors can interfere with sound sleep, including sleep disordered breathing (SDB). SDB describes a group of disorders characterized by abnormal respiratory patterns such as apneas or hypopneas or insufficient ventilation during sleep. This complex group of disorders occurs during sleep and is described by extended periods of upper airway resistance (snoring) at 1 end of the spectrum and partial or complete airway obstruction at the other.[7]

Craniofacial morphology seems to be often correlated to SDB, particularly obstructive sleep apnea, which is related to neurogenic and anatomic factors. In the sagittal dimension, the most common findings in adults are an increased hyoid to mandibular plane angle and an increased length of the soft palate. A narrower posterior pharyngeal space has been found in adolescents who snore compared with those who do not.[8,9] Anatomically, the floor of the nose is the roof of the mouth. Transverse skeletal discrepancies as a result of maxillary constriction are associated with narrower lateral nasal walls, decreased nasal volume, and increased nasal airway resistance.[10] To compensate for the increased upper airway resistance, mouth breathing becomes the primary means of respiration.[11] Angle in

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1907 called mouth breathing the "most potent cause of malocclusion," and the literature has reports from as early as 1800 identifying airway obstructions as etiologies of malocclusions in both dental and medical fields.[12-14] It has also been reported that changes in the transverse dimension by using maxillary expanders can increase the airway volume in the nasal area.[15]

It is not often recognized that the clinical presentation of SDBs differs between children and adults. Adults become lethargic when sleepy, whereas hyperactivity is exacerbated in children when they do not have sufficient sleep. Thus, children with SDB may at times be misdiagnosed as having attention deficit disorder and subsequently medicated for the wrong condition.[16,17] Snoring, often thought to be a common symptom, is not generally reported to pediatricians; the literature shows that snoring during childhood is not normal.[16] Due to these variations in the signs and symptoms of SDB between adults and children, pediatric SDB may be underrecognized and underreported in clinical settings.

Definitive diagnosis of SDB, particularly the most severe form that is obstructive sleep apnea, is made by both clinical examination and polysomnography. However, due to limited accessibility, required training time, and high expense, polysomnography has barriers that limit its use.[18] Accordingly, several questionnaires have been developed to assess patients at high risk of SDB who require further evaluation. Of the questionnaires used in various studies, there is a widely reported range of validity and reliability. Furthermore, question selections based on individual studies have limited the universal application of most questionnaires.[19]

Chervin et al[20] sought to evaluate SDB and the related symptoms in children. A validated prospective Pediatric Sleep Questionnaire (PSQ) was developed for patients 2 to 18 years old to assess patient-reported or parent-reported snoring, apneas, sleepiness, and behavior disorders. This 22-item questionnaire evaluates 3 categories. Questions in the first category inquire about snoring, the second about sleepiness, and the third about behavior (particularly inattention and hyperactivity). Scoring on the PSQ ranges from 0 to 22 points. The last 6 questions on inattention and hyperactivity were adapted from the American Psychiatric Association's questionnaire for attention deficit hyperactivity disorder and linked with a response category well recognized in other population-based epidemiologic studies.[21]

It was estimated that about 80% of people with SDB remain undiagnosed and are unaware that they have the condition.[22] Dental specialists such as orthodontists generally see adolescent patients more often than do their medical colleagues.[23] This could contribute to not only educating the public, but also assessing the risk of SDB, alerting those with high risk to follow it up with a sleep physician for proper diagnosis and course of action. The prevalence of SDB in the United States in populations seeking orthodontic care has not been reported in the literature to our knowledge. The aim of this study was to evaluate the prevalence of positive or potential SDB in children in the orthodontic population. See Supplemental Materials for a short video presentation about this study.

MATERIAL AND METHODS

The Institutional Review Board at Case Western Reserve University in Cleveland, Ohio, approved this study. As part of the initial screening, in addition to a medical and dental history form, the PSQ was given when the patient was under 18 years old (Fig 1). The records of 303 children between the ages of 9 and 17 years who came to the orthodontic clinic between January 2014 and March 2016 were examined. This study was performed at 1 site only, and all data were evaluated and interpreted by 1 orthodontist and 1 statistician with a PhD degree in epidemiology.

Inclusion criteria consisted of no previous orthodontic treatment, good general health, ability to read and write in English, and having completed the PSQ and health history forms. Patients with craniofacial anomalies, such as cleft lip and palate and syndromes, were excluded from this sample.

Patient age, sex, and ethnicity were collected on the PSQ. Racial and ethnic categories were defined according to the guidelines of the National Institutes of Health.[24] An additional category of "other" was listed as the seventh option choice for race. To evaluate the reliability of the PSQ in this study sample, 16 parents or legal guardians of the participants repeated the PSQ approximately 1 month after the initial completion.

On the PSQ, the response categories for all questions are "yes" or "no" or "don't know," indicated by "?". The cutoff value to identify patients at high risk for SDB is 0.33, meaning that 33% of the responses were "yes." A proportion of "yes" responses greater than or equal to 0.33 indicated a high risk of SDB; a lower percentage indicated a low risk. Missing and "don't know" responses were excluded from the denominator when estimating the percentage for risk status. When compared with polysomnographic data, the PSQ has previously demonstrated sensitivity of 0.85 and specificity of 0.87.[20]

Statistical analysis

All data were analyzed with the Statistical Package for the Social Sciences software (version 22.0; IBM, Armonk, NY). Descriptive statistics are presented (means