Assessment and Treatment of Obstructive Sleep-Disordered Breathing

Kaitlyn Anne Bodenner¹, Supriya K. Jambhekar, MD², Gulnur Com, MD², and Wendy L. Ward, PhD²,³

Abstract
Obstructive sleep-disordered breathing (OSDB) is a condition that affects 1% to 3% of the pediatric population. These disorders are difficult to diagnosis and left untreated may be serious, including not only medical comorbidities but also cognitive, academic, behavioral, and emotional sequelae. This article is designed to bring awareness of the severity and prevalence to family physicians and pediatricians. It reviews detailed information concerning OSDB, including the predisposing factors, assessment of presenting features, and treatment.

Keywords
obstructive sleep apnea, sleep-disordered breathing, pediatric sleep disorder

Introduction
Obstructive sleep-disordered breathing (OSDB) is defined as obstruction of the upper airway during sleep that negatively affects sleep quality.¹ This may involve either complete upper airway obstruction (apnea), repeated episodes of partial upper airway obstruction (hypopnea), or prolonged increased upper airway resistance syndrome (UARS).²³ OSDB is thought to be caused by “either anatomic narrowing of the upper airway, or increased collapsibility of UAW muscles, or abnormal neural control; usually a combination of all three events.”¹³ OSDB in children has been linked to impaired cardiac function and structure,¹² and other cardiovascular complications including impaired right ventricular function and cor pulmonale.¹³,¹⁴ Furthermore, OSDB has been associated with blood pressure dysregulation in some but not all studies.¹⁵ Circulating inflammatory mediators and increased insulin resistance have been posited as one of the potential process mechanisms, especially in obese children.¹⁶,¹⁷ OSDB may also be associated with extraesophageal reflux,¹⁸ lower exhaled

¹University of Central Arkansas, Conway, AR, USA
²University of Arkansas for Medical Sciences, Little Rock, AR, USA
³Arkansas Children’s Hospital, Little Rock, AR, USA

Corresponding Author:
Wendy L. Ward, Arkansas Children’s Hospital, 1 Children’s Way, Slot 512-21, Little Rock, AR 72202, USA.
nitric oxide/less eosinophilic and more neutrophilic type of asthma, and acutely decompensated heart failure. A causal relationship between nighttime sleep fragmentation and daytime neurobehavioral dysfunction has been suggested by multiple studies. Neurobehavioral dysfunctions associated with OSDB include poor school performance, cognitive dysfunction, inattentiveness, impaired memory, IQ deficit, executive function abnormalities, and so on. Behavioral outcomes are common as well—hyperactivity, conduct disorder, aggressive behavior, and so forth. Emotional outcomes are also present, for instance, quality-of-life impairment and depressive symptoms. Recent studies have also linked the neurobehavioral consequences of OSDB in children to inflammatory markers. However, these relationships are complex, as some circulating factors are associated with poor outcomes and others are protective.

Predisposing Factors

Enlarged tonsils and adenoids are the most common cause of OSDB in children. Obesity is another risk factor for OSDB. The reported prevalence of OSDB in obese youth ranges from 37% to 66%. Other conditions increasing the likelihood of OSDB are genetic syndromes, including Down syndrome and Prader–Willi syndrome; craniofacial anomalies, including syndromes such as Apert syndrome or Crouzon syndrome, achondroplasia, Arnold–Chiari malformation; neuromuscular syndromes, including muscular dystrophy; and cerebral palsy due to muscle tone abnormalities.

Assessment and Presenting Features

Patients present a wide variety of nonspecific symptoms that make identification of the disorder challenging. The American Academy of Pediatrics has presented guidelines on assessment of obstructive sleep apnea syndrome, a condition involving OSDB and impaired daytime functioning. This document suggests that pediatric patients may present with daytime manifestations of OSDB, including the cognitive, school, emotional, and behavioral comorbidities noted above. The symptoms include snoring, whistling noises, uneven/jagged breathing while sleeping, occasional choking, and/or unusual sleep positions (often with the neck hyperextended). In addition, patients present with a myriad of sleep concerns—startling awake, restless sleep, profuse sweating. In the morning, they may have difficulty awakening or irritability on waking, morning headaches, vomiting, and lack of appetite for breakfast due to hypoventilation.

Diagnosing OSDB first requires taking a detailed medical history, including daytime symptoms, nighttime symptoms, and adverse outcomes as described above (see Table 1) followed by physical examination. Radiological evaluation, including neck X-ray to look for enlarged adenoids, may help with diagnosis. Magnetic resonance imaging of the brain may be ordered in some patients to rule out foramen magnum stenosis or Arnold–Chiari malformation. X-ray cephalometry, computed tomography scanning and magnetic resonance imaging, dynamic scanning protocols (ultrafast computed tomography or cine magnetic resonance imaging), upper airway endoscopy during sleep, pressure measurements for the critical closing pressure are some other methods that may be used in selected patients.

Further referral to a pediatric sleep center may be necessary for comprehensive assessment. Diagnosis is greatly supported by overnight polysomnography (PSG). PSGs assess “airflow at nose and mouth, thoracic and abdominal wall movements to detect obstructive respiratory events, oximetry for oxygenation, and end tidal CO2

---

Table 1. Questions Physicians Should Ask Patients or Caregivers for Assessment of Obstructive Sleep-Disordered Breathing.

<table>
<thead>
<tr>
<th>Questions About Nighttime Manifestations</th>
<th>Questions About Daytime Manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does he or she snore?</td>
<td>Do they wake with morning headaches or vomiting?</td>
</tr>
<tr>
<td>Does he or she have uneven breathing?</td>
<td>Is he or she doing well in school?</td>
</tr>
<tr>
<td>Does he or she have trouble breathing while sleeping?</td>
<td>If not, has there been a recent onset of school complaints?</td>
</tr>
<tr>
<td>Have you ever witnessed them choke or make loud gasping sounds during the night?</td>
<td>Does he or she have attention problems or difficulty focusing?</td>
</tr>
<tr>
<td>Is it difficult to awake your child?</td>
<td>Has your child exhibited a depressed mood?</td>
</tr>
<tr>
<td>Does your child often wet the bed?</td>
<td>Does the child have low appetite on waking?</td>
</tr>
<tr>
<td>How would you describe their sleeping position? (strange sleeping position)</td>
<td>Does he or she have memory problems?</td>
</tr>
<tr>
<td>Does he or she sweat profusely while they are asleep?</td>
<td>Have you noticed hyperactivity, irritable mood, or any other behavioral problems?</td>
</tr>
<tr>
<td>Is their sleep restless or do they startle awake?</td>
<td>Does he or she seem excessively tired during the daytime?</td>
</tr>
</tbody>
</table>

*This table was adapted from one published in 2010.*
to assess ventilation.\textsuperscript{1(6)} Electroencephalography and electro-oculogram channels monitor stages of sleep throughout the study. Other conditions like periodic limb movements during sleep, nocturnal seizures, and parasomnias can also be detected on PSG. However, the PSG alone cannot be the sole assessment tool for several reasons. First, there are no proven norms for children and the exact significance of abnormal numbers in terms of predictive value for adverse outcome or need for treatment is not clearly defined. Second, significant neurobehavioral outcomes have been linked to clinical symptoms of OSDB without classical findings on PSG.\textsuperscript{46} Hence, diagnosis of OSDB and decision to treat are made based on a combination of all approaches.

**Treatment of Obstructive Sleep-Disordered Breathing**

Once the diagnosis of OSDB is made and a decision to treat is taken, nasal steroids or leukotriene antagonists are helpful especially with upper airway congestion and mild adenoidal growth.\textsuperscript{47,48} It should be noted that while melatonin, antidepressants, and nonbenzodiazepine sleep-inducing medications may be used to help the patient sleep, they cannot be used as a sleep aid until the PAP use is poor adherence.\textsuperscript{1(68)} Adherence studies in adults have shown that 30% to 46% patients with OSDB and effective.\textsuperscript{65} Referral to a pediatric sleep center may be necessary for comprehensive management in some children.

Oral appliances that attempt to increase upper airway size are used successfully in adults\textsuperscript{44,66}; however, there is very little experience in children.\textsuperscript{67} The last option is tracheostomy, which is often effective but is considered highly invasive. In addition, tracheostomy is associated with increased morbidity and mortality.\textsuperscript{68}

**Conclusion**

In summary, OSDB is a common and often undetected condition that has a wide-ranging impact on patient functioning, including not only medical comorbidities but also cognitive, academic, behavioral, and emotional sequelae. Family physicians and pediatricians need training and education on sleep disorders, crucial in identification and treatment of pediatric patients with OSDB, to prevent these myriad health effects.

**Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

**References**

25. Beebe DW, Ris MD, Kramer ME, Long E, Amin R. The association between sleep disordered breathing, academic grades, and cognitive and behavioral functioning among overweight subjects during middle to late childhood. Sleep. 2010;33:1447-1456.
42. Maurer JT, Stuck BA. Update on upper airway evaluation in obstructive sleep apnea [in German]. HNO. 2008;56:1089-1097.