

## Snoring in Children

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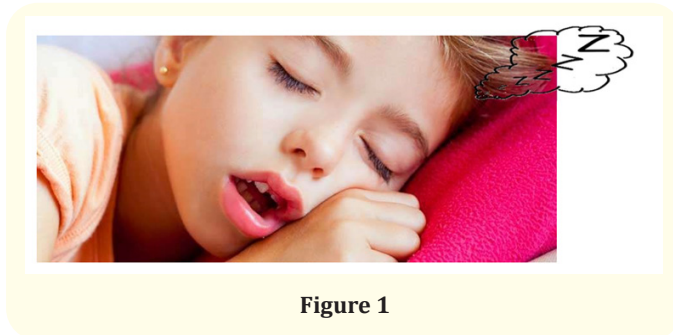
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**Figure 1**

Although snoring is most common medical disorder among adults, it occurs in children as well. Snoring is a sign that your child is not getting good quality sleep. Good Quality sleep is essential for overall development of child.

If snoring in children is minor and short-lived with no measurable effect on the person's sleep or overall health, it is of little concern. But if a child is snoring for three or more nights in a week and sleep is interrupted could be a matter of concern. It may signal a problem of disturbed breathing during sleep which may lead to sleep apnea.

Obstructive sleep apnea syndrome (OSAS) in children has become widely recognized as a relatively common disorder with potentially serious clinical implications in childhood and has emerged as a major public health problem. Obstructive Sleep Apnea Syndrome (OSAS) is characterized by repeated episodes of prolonged partial upper airway obstruction and/or intermittent complete obstruction that interrupts normal ventilation and normal sleep patterns.

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Habitual snoring, defined as snoring that occurs at least 3 nights per week, is reported in approximately 10% of preschool and school-age children, of whom only 2% to 3% demonstrate clinical Obstructive Sleep Apnea Syndrome (OSAS).

Snoring is usually the major symptom in childhood sleep-disordered breathing (SDB), a spectrum ranging from normal breathing and uncomplicated snoring to severe OSAS with increasing level of airway obstruction.

However, Parents are often more concerned about snoring in children because of the disturbed sleep, altered breathing pattern and behaviour changes that sometimes accompany it and the possibility of an underlying medical cause.

### Prevalence

The prevalence of snoring in children is estimated to be 10-12%, of whom only 1-3% is estimated to have OSA.

However, the exact statistics for snoring and sleep apnea in children is hard to determine due to lack of awareness by parents to observe their child's snoring or its frequency and severity. Also, the detailed testing for sleep apnea, may not be available, affordable, or practical in all cases.

### Why snoring occurs?

Snoring is the harsh sound produced by the vibration of the soft tissues such as pharyngeal walls, soft palate, tonsillar pillars, uvula, and tongue during sleep due to over-relaxation of the airway muscles leading to narrowing of the airways causing obstruction to the airflow.

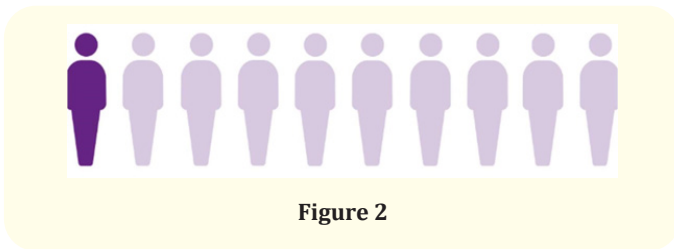


Figure 2

### Common Factors contributing to snoring in children

There are a variety of factors that can block the passages of the airway and increase the likelihood of snoring and sleep-disordered breathing in children.

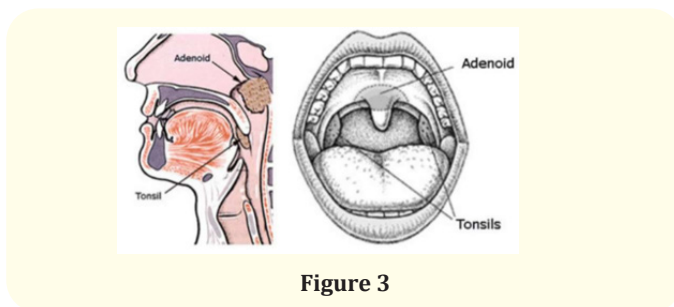


Figure 3

- **Enlarged Tonsils and Adenoids:** This is the most common reason of snoring in children. Adenoids and Tonsils are tissues found behind the nasal passages and in the throat. Enlargement of these tissues due to infection or inflammation can partially blocking the airway and leading to snoring.
- **Allergies or Nasal Congestion:** Colds, Sinus infections and Allergic reactions can cause nasal congestion and inflammation, can result in difficulty breathing through the nose, leading to increased mouth breathing, and snoring.
- **Obesity:** Excess Weight and Fat tissues around the neck can contribute to the development of snoring in children, like adults.
- **Anatomical Abnormalities:** Anatomical Abnormalities in the airways or facial structures can contribute to snoring. For Example: A Deviated Septum, narrowing of the nose from birth, high palate, small or recessed lower jaw, underdeveloped upper jaw, and misaligned teeth.
- **Medical conditions:** Certain medical conditions such as cerebral palsy, muscular dystrophy and conditions that affect the structure of the mouth or jaw, makes it harder for the body to keep the airway open during sleep.

- **Sleep Position:** Sleeping on the back can cause the tongue and soft palate to collapse to the back of the throat, leading to snoring.
- **Contaminated/Poor Air Quality:** Poor air quality or excess contaminants in air or smoke can cause increase levels of allergies and co-related with higher risk of snoring in children.

Consequences of snoring and untreated sleep disordered breathing in children

- **Sleep Disruption:** Snoring can cause sleep disruptions leading to fragmented sleep, frequent awakenings during night and overall poor quality of sleep.
- **Delayed Growth:** Chronic sleep disruptions due to snoring may interfere with the release of growth hormones during sleep, potentially leading to delayed growth and development in children. Growth hormone peaks during deep sleep stages, and disruptions in sleep can impair this process.
- **Abnormal Urine Production:** Snoring causes increased urine production during night, leading to bedwetting in children.
- **Cardiovascular Health:** Snoring in children could be a sign of underlying sleepdisordered breathing, known as obstructive sleep apnea (OSA), characterized by repeated episodes of partial or complete upper airway obstruction during sleep. If left untreated OSA can increase the risk of cardiovascular problems, such as hypertension, heart disease, and abnormal heart rhythms, which may impact physical as well as mental health.
- **Emotional Well-being:** Chronic snoring and sleep disturbances can have effect on emotional well-being and quality of life of children. Children may exhibit feelings of frustration, embarrassment, low self-esteem, and social isolation, specifically if their symptoms interfere with daily activities and functioning.
- **Impaired Cognitive Function:** Sleep disturbances can cause daytime sleepiness, irritability, difficulty in concentration, and behavioural issues, leading to impaired cognitive function, poor attention span, and memory problems which can impact academic performance and social interaction in children.

- **Behavioural Problems:** Snoring-related sleep disturbances can contribute to behavioural problems, such as hyperactivity, impulsivity, aggression, and mood swings. If snoring is untreated, these children may develop attention deficit hyperactivity disorder (ADHD) or other behavioural disorders.
- **Academic Performance:** Sleep-deprived children may exhibit difficulty in concentration, memory, and completing tasks, which can negatively impact their academic performances and educational outcomes due to cognitive deficits and behavioural problems associated with chronic sleep - disrupted snoring.

**Investigation**

The gold standard investigation for establishing the presence and severity of Obstructive Sleep Apnea (OSAS) in children is Overnight Polysomnography (PSG) or Sleep Study.



**Figure 4**

A Paediatric sleep study is preferably done in a sleep lab to evaluate child’s sleep and breathing pattern. This is a non-invasive test that measures the number of physiologic functions overnight, typically including EEG; pulse oximetry; Heart rate, arm and leg movement, oronasal airflow, abdominal and chest wall movements and partial pressure of carbon dioxide (PCO2) with the help of sensors, electrodes and monitors attached to the child’s body. The Sleep study is helpful in planning right treatment and in post-operative short and long-term management.

**Diagnosis**

Diagnosis of Obstructive sleep-disordered breathing is usually based on:

- Clinical symptoms
- Screening Tool
- Medical History
- Physical Examination of the nose, mouth, throat, palate, and neck.
- Clinical Evaluation confirmed by the polysomnography (PSG).

If a child exhibits signs and symptoms of sleep-disordered breathing, clinicians/physicians should conduct a comprehensive evaluation, including a detailed history, early screening, and confirmation through a sleep study.

**Clinical manifestations**

Daytime Symptoms	Nocturnal Symptoms
Unrefreshed sleep	Habitual Snoring (>3 times/week)
Excessive Daytime Somnolence	Mouth Breathing
Morning headaches	Witnessed Apneic Episodes
Hyperactivity	Choking or gasping during sleep
Restlessness	
Behaviour Problems	Frequent Awakenings
Deficient Attention Span	Increased efforts in breathing
Poor Academic Performance	Excessive Sweating
Cognitive Deficits	Enuresis
Poor growth and failure to thrive	Unusual Sleeping Positions (e.g. hyperextended neck)
Cor Pulmonale	Observed Cyanosis (in severe cases)
Pulmonary Hypertension	

**Table 1**

**Screening tool**

As sleep plays a crucial role in the healthy growth and development of children, it is therefore recommended that physicians, primary care providers, and paediatricians opportunistically screen for sleep problems during routine check-ups.

In a busy primary care setting, the screening can be done by using the simple ‘BEARS’ sleep screening tool. If the child shows signs like habitual snoring or excessive daytime sleepiness, a detailed history and targeted physical examination should be performed to evaluate for sleep-disordered breathing.

**BEARS sleep screening tool**

R= Regularity and Duration of Sleep S= Snoring

BEARS is divided into 5 major domains assessment.  
 B= Bedtime Issues E= Excessive Daytime Sleepiness A= Night Awakenings

Physical Examination - A focused physical examination helps to determine the probability and/or severity of the OSA.

	Toddler/Preschool (2-5 years)	School- Aged (6-12 years)	Adolescent (13-18 years)
Bedtime Problems	Does your child have any problem going to bed? Falling asleep?	Does your child have any problems at bedtime? (P) Do you have any problems going to bed? (C)	Do you have any problems falling asleep at bedtime? (C)
Excessive Daytime Sleepiness	Does your child seem overtired or sleepy a lot during the day? Does he/she still take naps?	Does your child have difficulty waking in the morning, seem sleepy during the day or take naps? (P) Do you feel tired a lot? (C)	Do you feel sleepy a lot during the day? While driving (C)
Night Awakenings	Does your child wake up a lot at night?	Does your child seem to wake up a lot at night? Any sleepwalking or nightmares? (P)  Do you wake up a lot at night? Have trouble getting back to sleep? (C)	Do you wake up a lot at night? Have trouble getting back to sleep? (C)
Regularity and Duration of Sleep	Does your child have regular bedtime and wake time? what are they?	What time does your child go to bed and get up on school days? Weekends?  Do you think he or she is getting enough sleep? (P)	What time do you usually go to bed on school nights? Weekends? How much sleep do you usually get? (C)
Snoring	Does your child snore a lot or have difficulty breathing at night?	Does your child have loud or nightly snoring or any breathing difficulties at night? (P)	Does your teenager snore loudly or nightly? (P)
(P) Parent -directed question (C) Child -directed question			
Source: A Clinical Guide to Pediatric Sleep: Diagnosis and Management of Sleep Problems' by Jodi A.Mindell and Judith A. Owens; Lippincott Williams and Wilkins			

**Table 2**



**Figure 5**

**Physical Examination can be divided into**

General Examination includes growth parameters and facial features:

- Height, Weight, and body mass index for assessment of obesity.
- Syndromic features (e.g. trisomy 21), mid-face hypoplasia or retrognathia/micrognathia, which may limit upper airway size.

- Pectus excavatum, growth failure and loud second heart sound (sign of pulmonary hypertension), which suggest long-standing, significant OSA.

**Nasal examination**

- Features of allergic rhinitis, e.g. turbinate hypertrophy
- Nasal septum deviation, presence of mouth breathing and/or hypo-nasal speech suggesting nasal obstruction and/or adenoidal hypertrophy

**Oral examination**

- Tonsillar hypertrophy, which can be graded using the Brodsky grading scale to allow an objective initial and follow-up assessment
- Large tongue, high-arched palate, malocclusion, small oropharyngeal space and high Mallampati score, which may indicate limitation of upper airway size

**Clinical evaluation confirmed by the polysomnography (PSG)**

Polysomnographic criteria for diagnosing obstructive sleep apnea (OSA) in children differ from adults. OSA in adults is typically defined by a respiratory pause lasting >10 seconds. However, clinically relevant apneas in children may not last as 10 seconds as in adults due to children’s different physiology and higher baseline respiratory rate. In children, apneas lasting 3-4 seconds with associated desaturations can be considered indicative of obstructive sleep apnea.

In children, it is considered abnormal if:  
 AHI (Apnea-Hypopnea Index) > 1 (Average: 0.1 - 0.5 events/hour)  
 Minimum Oxygen saturation < 92% (Average: 96% ± 2%)

Polysomnographic Criteria for OSA in Adults & Children		
Criteria	Adults	Children (1-12 years)
AHI* (Apnea-Hypopnea Index)	>5	>1
Oxygen Nadir (Minimum Oxygen Saturation)	<85	<92

\*The Apnea-Hypoapnea Index (AHI) is the average number of apneas and hypopneas per hour of sleep

**Figure 6**

**Treatment of snoring**

Treatment for Obstructive Sleep Apnea Syndrome (OSAS) in children are varied, complex and often requires a multidisciplinary approach. Treatment options for sleep disorders depend on the specific diagnosis of the child. Early Identification and treatment of this syndrome is essential to optimize normal airway function, resulting in alleviation of current symptoms, prevention of sequelae, improved quality of life, education of parents and decreased healthcare utilization.

The goal of the treatment is to restore optimal breathing during night and to alleviate associated symptoms such as improved daytime functioning and minimizing the negative impacts of obstructive sleep apnea.

- Pharmacological therapy (leukotriene antagonists, topical nasal steroids) is usually used for mild forms of OSAS and in children with associated allergic diseases.
- **Weight Management:** Encouraging a healthy diet and regular physical activity can be beneficial if weight is a contributing factor.
- **Sleep Hygiene:** Sleep hygiene refers to a set of practices and habits that promote healthy sleep. These practices aim to optimize the quality and duration of sleep, leading to improved overall well-being and daytime functioning in children.

Example includes:

- Setting a consistent sleep schedule.
- Make your sleeping environment comfortable and quiet.
- Sleep in a complete darkness to enhance melatonin production.
- Limit exposure to screens before bed.
- Limit caffeine and nicotine intake.
- Exercise regularly, but not too close to bedtime.
- Limit daytime naps to short durations.
- Regular sunlight exposure during the day.
- Manage stress with relaxation techniques etc.

**Positive Airway Pressure (PAP) Therapy**

Continuous positive airway pressure (CPAP) delivers a continuous stream of air, preventing airway collapse and reduce the work of breathing resulting from obstructive sleep apnea. It is consid-



**Figure 7**

ered in selected groups of children with OSA to improve both nocturnal and daytime symptoms, but poor adherence is a limiting factor. For this reason, CPAP is not recommended as first-line therapy for OSAS in children.

### Surgery

Adenotonsillectomy is the most common treatment for children with sleep apnea specially if sleep apnea is severe, but could an option for some with primary snoring. The surgical procedure involves the removal of the adenoids and tonsils to reduce the obstruction and increases the size of the upper airway. Due to which, the child can breathe normally. Some children may continue to have sleep apnea even after adenotonsillectomy.

Other surgeries performed in children if they have severe sleep apnea are:

- Tonsillectomy - the removal of Tonsils.
- Septoplasty – The surgery to reposition the deviated section of the septum if the child has deviated septum, to maximize the airflow through nasal passages.
- Distraction Osteogenesis or Jaw Distraction - The surgery to increase the size of the lower jaw (the mandible), if the child has tiny jaw.
- Tracheostomy – Tracheostomy may be considered for severe cases of sleep apnea that do not respond to other treatments, especially in children who are too young or unfit for other types of surgeries. It involves making a small hole in the trachea to facilitate airflow directly to the lungs, ensuring sufficient oxygenation during sleep.

### Alternate treatment modalities

As conventional treatments for sleep-disordered breathing may not be suitable for many children and parents due to factors such

as high cost, low effectiveness, and poor compliance with treatments like C-PAP, Alternative treatment options are gaining popularity. These alternative treatments are simple, non-invasive, and cost-effective, offering promising outcomes for managing sleep-related breathing issues.

Oropharyngeal Exercises/Myofunctional Therapy: Novel Treatment of Snoring and OSA.



**Figure 8**

Oropharyngeal exercises are relatively new and promising alternative therapeutic modality for the children with snoring and obstructive sleep apnea. These Exercises serve as an adjunct to other obstructive sleep apnea treatments.

Here are some of the oropharyngeal exercises suitable for children with obstructive sleep apnea, aiming to improve airway patency and increase the tone and strength of oropharyngeal muscles, including the tongue, soft palate, throat, jaw, and facial muscles.

Each exercise is specific and targets different muscle/muscle group to strengthen. The oropharyngeal exercises are individualized to address the unique needs of each child.

Tongue Stretch – Ask the child to stick his tongue out as far as possible and hold for few seconds.

Benefit: To strengthen and enhance the flexibility of tongue muscles.

Tongue Left and Right – Ask the child to move his tongue towards left and right as fast as he can.



Figure 9

Benefit: To enhance the mobility, coordination, and strength of tongue muscles, improving both tongue control and positioning.



Figure 10

Nose/ Chin lick - Ask the child to stick their tongue out, then point it up towards nose and then down towards chin and hold each position for few seconds.

Benefit: To improve tongue mobility and coordination and to promote proper tongue positioning.



Figure 11

Pout your lips – Encourage the child to pucker their lips together as if giving a small kiss or blowing out candles on a cake.

Benefit: To strengthen lips muscles and improve oral motor control.

Lips vibration - Press your lips together lightly and blow out forcefully through their lips to create a vibrating or buzzing sound for several times.



Figure 12

Benefit: To strengthen mouth and throat muscles.

Saying Ah – Ask the child to open your mouth wide and say “Ah” aloud, holding the sound for a few seconds.

Benefit: To strength throat and soft palate muscles.

Blowing a balloon – Instruct the child to blow up a balloon or blow using controlled breaths.

Benefit: To strengthen mouth and throat muscles, respiratory muscles, and enhances lung capacity, improving overall breathing efficiency.



Figure 13

Straw breathing – Instruct the child to breathe in through the nose and then blow gently through the straw placed in a glass of water to make bubbles.

Benefit: To strengthen respiratory muscles, promoting better airflow and lung function.



Figure 14

**Straw Sucking:** Encourage the child to suck liquid through a straw, focusing on maintaining a steady, controlled airflow.

**Benefit:** To strengthen oral muscles and improve swallowing coordination.

**Jaw Open and Close:** Ask the child to open and close his jaw several times.

**Benefit:** To strengthen jaw muscles and promoting better oral motor coordination.



Figure 15

**Single nostril breathing:** Ask the child to close off one nostril with their finger. Then, breathe in and out gently through the open nostril and repeat with the other nostril.

**Benefit:** To improve nasal function, promote balance between the two nostrils and improving respiratory health.

**Cheek puffs:** Encourage the child to puff their cheeks with air and then breathe in through their nose.

**Benefit:** To strengthen the muscles in the cheeks and promote nasal breathing. Potentially improving respiratory function and promoting relaxation.



Figure 16

**Gargling:** Instruct the child to gargle with water for a few seconds, ensuring the liquid reaches the back of the throat.

**Benefit:** To strengthen throat muscles and improve oral motor coordination.

**Show your teeth:** Encourage the child to show their teeth, by opening their mouth wide.

**Benefit:** To strengthen jaw muscles and improve oral motor coordination.



Figure 17

These exercises can be integrated into playful games or activities, incorporated into daily routines, making them enjoyable for children while effectively strengthening their muscles. They are customized to suit the child's age, individual abilities, and interests.

Lifestyle modifications

- **Sleep Positioning:** Encouraging children to sleep on their side instead of their back may help reduce snoring.
- **Avoiding Allergens:** Minimize exposure to potential allergens that could contribute to nasal congestion.
- **Regular Physical Activity:** Encourage your child to engage in age-appropriate physical activities and limit sedentary behaviours. Exercise can help improve overall health and may reduce the severity of snoring and sleep apnea symptoms.
- **Healthy Eating Habits:** Encourage your child to eat a balanced diet rich in fruits, vegetables, whole grains, and lean proteins. Limit sugary snacks and beverages, especially before bedtime, as they interfere with sleep quality.
- **Enough Hydration:** Ensure enough hydration by drinking plenty of water throughout the day. However, limit fluid intake one to two hours before bedtime to reduce the frequency of night-time bathroom trips that can disrupt sleep.



- **Limit Screen Time Before Bed:** Establish a screen-free zone in the bedroom and limit your child's exposure to electronic devices such as smartphones, tablets, and computers before bedtime. Blue light from screen can interfere with the body's natural sleep-wake cycle. Monitoring, Follow-up, and Referral.

Regular monitoring of symptoms/signs of Obstructive Sleep Apnea Syndrome (OSAS) at each visit can help prevent the further progression of the disease. If there are indications of severe OSAS, referral to a paediatric sleep specialist is recommended [1-16].

The Role of this article in clinical practices are:

- To raise awareness among medical health professionals about the importance of early recognition of OSAS to prevent delays in diagnosis and serious sequelae of the condition.
- Regular screening of children with similar symptoms followed by detailed history and comprehensive physical examination, constitutes a foundational practice in paediatric healthcare.
- To evaluate diagnostic technique of OSA.
- To discuss various treatment options tailored to each child's condition, including alternative therapies and lifestyle modifications in children of OSAS.
- To provide guidelines for follow-up and referrals.

### Take Home Messages

- Intermittent snoring is common in children whereas habitual snoring, affecting about 3%–12% of children, is of concern and needs further evaluation.
- It is important to identify obstructive sleep apnea (OSA) in children as untreated OSA can result in physical, developmental, and cognitive consequences in children.
- Obstructive Sleep Apnea is a prevalent but often under-diagnosed disorder. Early diagnosis and intervention are crucial to prevent the sequelae of OSAS.
- The 'BEARS' sleep screening tool is an effective tool in primary care setting to identify various sleep problems, including obstructive sleep apnea (OSA), in children.
- Primary care providers need to be alert about the three predominant risk factors for OSA in children (obesity, tonsillar and/or adenoidal hypertrophy, and allergic rhinitis/chronic nasal obstruction) and screen for snoring and symptoms/signs of OSA when these factors are evident.

- Oropharyngeal Exercises, a novel treatment for children with snoring and sleep apnea, aimed to increase tone and strength of throat, tongue and jaw muscles.
- Let us all unite to create awareness to fight with this serious disorder.

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