The Snoring Child
Evaluation and Management

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Approach to Sleep History in Children

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Use of the 'BEARS' sleep screening tool in a pediatric residents' continuity clinic: a pilot study

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Abstract

Objective: To assess the effectiveness of a simple, 5-item pediatric sleep screening instrument, the BEARS (B=Bedtime Issues, E=Excessive Daytime Sleepiness, A=Night Awakenings, R=Regularity and Duration of Sleep, S=Snoring) in obtaining sleep-related information and identifying sleep problems in the primary care setting.

Setting: Pediatric residents' continuity clinic in a tertiary care children's hospital.

Methods: BEARS forms were placed in the medical records of a convenience sample of 2 to 12 year old children presenting for well child visits over the 5 month study period. Sleep-related information recorded in the BEARS visit and in the pre-BEARS visit, which was the subject's most recent previous well child check (WCC), was coded with respect to whether or not a sleep problem was indicated, and whether sleep issues were addressed.

Results: A total of 195 children had both a documented pre-BEARS and BEARS WCC visit. BEARS visits were significantly more likely than the pre-BEARS visits to have any sleep information recorded (98.5% vs. 87.7%, $p<0.001$), and to have information recorded about bedtime issues (93.3% vs. 7.7%, $p<0.001$), excessive daytime sleepiness (93.9% vs. 5.6%, $p<0.001$), snoring (92.8% vs. 7.2%, $p<0.001$), nighttime awakenings (91.3% vs. 29.2%, $p<0.001$), and regularity and duration of sleep (65.3% vs. 31.5%, $p<0.001$). Significantly more sleep problems were identified during the BEARS visits in the domains of bedtime issues (16.3% vs. 4.1%, $p<0.001$), nighttime awakenings (18.4% vs. 6.8%, $p<0.001$) and snoring (10.7% vs. 4.6%, $p=0.012$). Finally, almost twice as many BEARS charts had sleep mentioned in the Impression and Plan (13.1% vs. 7.3%), which approached significance ($p=0.07$).

Conclusions: The BEARS appears to be a user-friendly pediatric sleep screening tool which significantly increases the amount of sleep information recorded as well as the likelihood of identifying sleep problems in the primary care setting.

Approach to Sleep History in Children

	Preschool (2–5 years)	School-aged (6–12 years)	Adolescent (13–18 years)
*B*edtime problems	Does your child have any problems 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)
*E*xcessive daytime sleepiness	Does your child seem over tired or sleepy a lot during the day? Does 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? in school? while driving? (C)

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Approach to Sleep History in Children

	Preschool (2–5 years)	School-aged (6–12 years)	Adolescent (13–18 years)
Awakenings during the night	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 alot at night? Have trouble getting back to sleep? (C)

Approach to Sleep History in Children

	Preschool (2–5 years)	School-aged (6–12 years)	Adolescent (13–18 years)
*R*egularity and duration of sleep	Does your child have a 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/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)

Approach to Sleep History in Children

	Preschool (2–5 years)	School-aged (6–12 years)	Adolescent (13–18 years)
Sleep-disordered breathing	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)

B, bedtime problems; E, excessive daytime sleepiness; A, awakenings during the night; R, regularity and duration of sleep; S, sleep-disordered breathing; P, Parent C, Child.

Snoring

- Respiratory sound typically
  - Occurring during inspiration (or expiration)
  - Generated from vibration of the upper airway walls during sleep
  - Due to partial upper airway obstruction
- Reported prevalence ranges from 5% to 20% in children
- A symptom of a continuum of upper airway obstruction during sleep

Increasing degree of airway obstruction

Paediatric Obstructive Sleep Apnoea (OSA)

- Disorder of breathing during sleep, characterised by
  - Prolonged partial upper airway obstruction – obstructive hypoventilation
    and/or
  - Intermittent complete or partial obstruction – obstructive apnoea or hypopnoea
- Disrupts
  - Normal ventilation – hypoxia, hypercarbia
  - Normal sleep patterns – sleep fragmentation

American Thoracic Society. Standards and indications for cardiopulmonary sleep studies in children Am J Respir Crit Care Med 1996

Global Prevalence of OSA

- Overall incidence of OSA in children about 0.7% to 3%

Ali NJ, Pitson D, Stradling JR. Arch Dis Child 1993
Gislason T, Benediktsdottir B. Chest 1995
Chay OM, Goh A, Abisheganaden J et al. Pediatr Pulmonol 2000

- Incidence in obese children much higher, ranging from 13% to 66%

Chay OM, Goh A, Abisheganaden J et al. Pediatr Pulmonol 2000
Mallory BG Jr, Fisher DH, Jackson R. J Pediatr 1989
Silvestri JM, Weese-Mayer DE, Bass MT et al. Pediatr Pulmonol 1993
Marcus CL, Curtis S, Koerner CB et al. Pediatr Pulmonol 1996
Wing YK, Hui SH, Pak WM et al. Arch Dis Child 2003

Definitions

- **Primary snoring**

  Snoring during sleep ***without***
  - Apnoea
  - Hypoventilation
  - Hypoxaemia
  - Hypercarbia
  - Sleep disturbance
  - Daytime symptoms

- **Upper airway resistance syndrome**

  Partial upper airway obstruction sufficient to cause
  - Sleep disruption
  - Daytime symptoms
  - ***NO*** gas exchange abnormalities

October 14, 2009

Primary Snoring Is Not Necessarily Benign in Children

F. Bruder Stapleton, MD reviewing Li AM et al. J Pediatr 2009 Sep.

Primary snoring was associated with elevated blood pressure.

Habitual snoring (>3 nights/week) affects about 10% of children, and the potential health implications in this population are uncertain. Investigators examined a cross-sectional community-based sample of 190 nonobese, prepubertal children (age range, 6–13 years) who were involved in an epidemiological study of obstructive sleep apnea (OSA) in China. All children at high risk for OSA and a randomly selected sample of low-risk children were invited for an overnight sleep study and ambulatory blood pressure (BP) monitoring: 56 nonsnoring controls were compared with 46 primary snorers (snoring >3 nights/week with normal polysomnography), 62 children with apnea-hypopnea index (AHI) 1–3, and 26 children with AHI >3.

Daytime and nighttime systolic BP, diastolic BP, and mean arterial BP increased across the severity spectrum of sleep-disordered breathing. BP measurements were not statistically different among primary snorers, children with AHI 1–3, and those with AHI >3. Nighttime BP dipping decreased as severity of OSA increased, with significantly less dipping among children with AHI >3 compared with controls.

COMMENT

Primary snoring is not necessarily benign. Even habitual snorers who have normal polysomnography might have elevated BP. Pediatric healthcare providers should be aware of the risk for hypertension in children with a history of sleep-disordered breathing.

Pediatrics. 2004 Jul;114(1):44-9.

Neurobehavioral implications of habitual snoring in children.

O'Brien LM[1], Mervis CB, Holbrook CR, Bruner JL, Klaus CJ, Rutherford J, Raffield TJ, Gozal D.

Author information

Abstract

OBJECTIVE: Current guidelines for the treatment of children with obstructive sleep apnea (OSA) suggest that primary snoring (PS) in children is benign. However, PS has not been well evaluated, and it is unknown whether PS is associated with serious morbidity. This study investigated whether PS is associated with neurobehavioral deficits in children.

METHODS: Parents of 5- to 7-year-old snoring children in public schools were surveyed about their child's sleeping habits. Children with a history of snoring and nonsnoring children were invited for overnight polysomnographic assessment and a battery of neurobehavioral tests. Only children who did not have a history of attention-deficit/hyperactivity disorder and were not considered hyperactive by parental report were tested.

RESULTS: Children with a history of snoring, an obstructive apnea index of <1/hour of total sleep time (hrTST), an apnea/hypopnea index <5/hrTST, and no gas exchange abnormalities were classified as PS (n = 87). Control subjects were defined as children without a history of snoring, an obstructive apnea index <1/hrTST, an apnea/hypopnea index <5/hrTST, and no gas exchange abnormalities (n = 31). Although means for both groups were in the normal range, the PS children were found to perform worse on measures related to attention, social problems, and anxious/depressive symptoms. In addition, although within the normal range, both overall cognitive abilities and certain language and visuospatial functions were significantly lower for the PS group than for the control subjects.

CONCLUSIONS: PS seems to be associated with significant neurobehavioral deficits in a subset of children, possibly related to increased susceptibility to sleep fragmentation. Larger studies are urgently required because current guidelines for treatment of snoring in children may require reevaluation.

Causes, Risk Factors & Associated Conditions

- Most commonly
  - Tonsillar and/or adenoidal enlargement
    - Associated with atopic diseases eg. allergic rhinitis
  - Obesity

- Others
  - Conditions causing anomaly of upper airway
    - Isolated
    - Syndromes
  - Neuromuscular diseases
  - Family history of OSA
  - Prematurity
  - Race
    - African-Americans more susceptible than Caucasians

Causes, Risk Factors and Associated Conditions

- Chronic nasal obstruction
  - ✓ Choanal stenosis, severe septal deviation
  - ✓ Allergic rhinitis
  - ✓ Nasal polyps and rare nasal and/or pharyngeal tumours
- Laryngomalacia, glottic/subglottic anomalies
- Cleft palate, isolated or as part of a syndrome
- Orthodontic conditions e.g. malocclusion, maxillary contraction, mandibular retrognathism
- Craniofacial conditions
  - ✓ Pierre Robin sequence
  - ✓ Craniosynostosis (Crouzon syndrome, Apert syndrome, Pfeiffer syndrome)
  - ✓ Treacher Collins syndrome
  - ✓ Goldenhar syndrome
- Down syndrome
- Prader Willi syndrome
- Beckwith-Wiedemann syndrome
- Achondroplasia
- Klippel-Feil syndrome
- Marfan syndrome
- Mucopolysaccharidoses
- Neuromuscular diseases
  - ✓ Duchenne muscular dystrophy
  - ✓ Spinal muscular atrophy
  - ✓ Guillain Barré syndrome
  - ✓ Myotonic dystrophy
  - ✓ Myotubular myopathy
  - ✓ Myasthenia gravis
- Spina bifida/Chiari malformation
- Cerebral palsy
- Hypothyroidism
- Sickle cell anaemia

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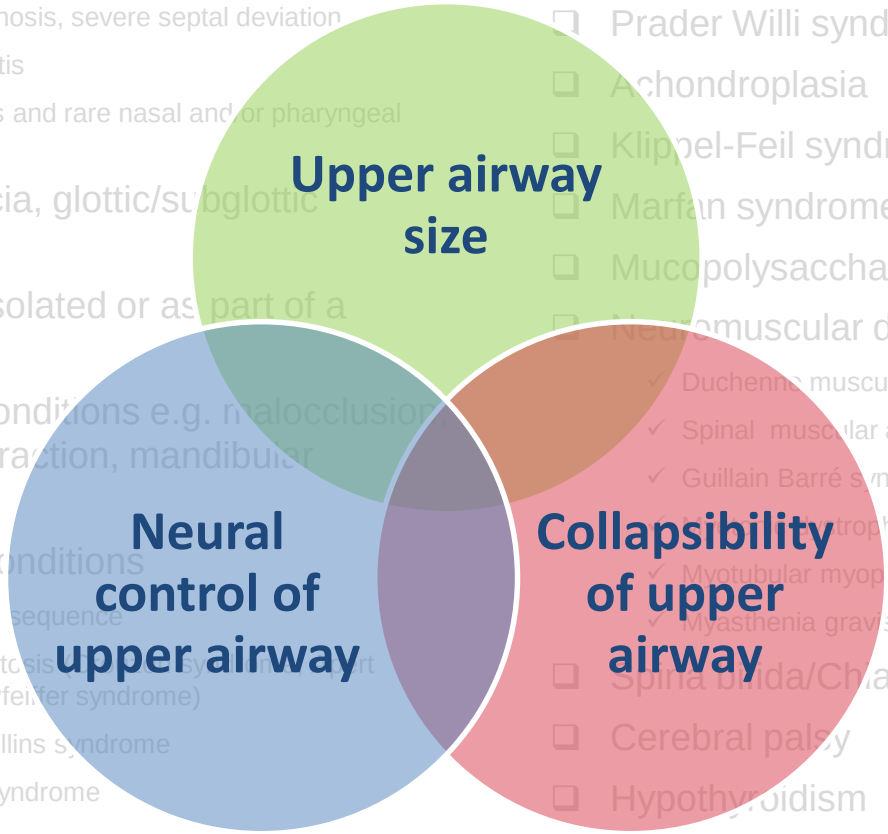

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Clinical Features

- Snoring
  - 6 to 12% of children have habitual snoring

Chng SY, Goh DYT, Wang XS et al. Pediatr Pulmonology 2004
Ng DK, Kwok KL, Cheung JM et al. Chest 2005
Ali NJ, Pitson DJ, Stradling JR. Arch Dis Child 1993

- Symptoms/signs suggestive of OSA in snoring children
  - Observed cyanosis or apnoea during sleep, snorting, gasping
  - Laboured/paradoxical breathing during sleep
  - Unusual sleeping position, hyperextended neck
  - Restlessness and frequent awakening
  - Diaphoresis
  - Frequent daytime mouth breathing
  - Difficulty getting up in the morning
  - Unrefreshed after an overnight sleep
  - Morning headaches

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Clinical Features

- Excessive daytime sleepiness
  - Not as common in children compared to adults
    - 11% to 22% by self report and MSLT
  - More common in
    - Obese children
    - Severe OSAHS

Gozal D, Wang M, Pope DW Jr. Pediatrics 2001

Tang JPL, Chay OM, Goh A et al. APSS 17th Annual Meeting; June 2003

- Nocturnal enuresis

Clinical Features

- Behavioural and learning problems
  - Hyperactivity, aggressive behaviour, restlessness
  - Poor school performance
  - Poor performance in measures of attention, vigilance and executive functioning
    - Improve with treatment for OSAHS
    - At least partially reversible, possible residual learning deficit

Gozal D. Pediatrics 1998

Gozal D, Pope DE Jr. Pediatrics 2001

Tang JPL, Chay OM, Goh A et al. 45th Annual Meeting JRS; April 2005

Yeo F, Tang JPL, Yap J et al. KKH ASM; July 2006

- Failure to thrive
  - Accelerated growth after adenotonsillectory

Williams EF III, Woo P, Miller R, et al. Otolaryngol Head Neck Surg 1991

Nieminen P, Lopponen T, Tolonen U et al. Pediatrics 2002

Marcus CL, Carroll JL, Koerner CB et al. J Pediatr 1994

Physical Examination

Region/System	Findings
Face and neck	Adenoid facies Midface hypoplasia, flat nasal bridge, facial asymmetry Microngathia, retrongathia Short thick neck, neck masses
Nose	Turbinate hypertrophy, deviated nasal septum, nasal mass
Mouth	Size of oropharynx, Mallampati score Adenotonsillar hypertrophy Large tongue High arch palate, redundant soft palate Dentition, malocclusion
Breathing	Mouth breathing, stridor
Voice	Hyponasal speech, hoarse/weak voice
Chest	Pectus excavatum, scoliosis, barrel shaped chest
Growth	Failure to thrive, obesity
Cardiopulmonary	Hypertension, pulmonary hypertension, cardiac failure

Complications if Untreated

- Systemic hypertension, pulmonary hypertension, cor pulmonale
- Gastroesophageal reflux (GERD)
- Insulin resistance and metabolic syndrome
  - Conflicting results in children compared to adults

    Kaditis AG, Alexopoulos EL, Damani E et al. Pediatr Pulmonol 2005

    De La Eva RC, Baur LA, Donaghue KC, Waters KA. J Pediatr 2002

  - Respiratory disturbance index independent predictor of insulin resistance after correction for IBW

    Tang JPL, Chay OM, Goh A et al. 15tht ASM of the Australasian Sleep Association; 2002 Oct

Complications if Untreated

- Obesity hypoventilation (Pickwickian syndrome)
  - Abnormal response both hypercarbic and hypoxemic stimuli to breathe
  - Daytime hypoventilation and hypercarbia
- Death

Diagnostic Criteria for Paediatric OSA

Both clinical and polysomnographic criteria should be present for a child to be definitively diagnosed with OSA

Clinical criteria – The presence of 1 or more of the following clinical symptoms

- Snoring
- Laboured, paradoxical, or obstructed breathing during child's sleep
- Sleepiness, hyperactivity, behavioural problems, or learning problems

Polysomnographic criteria – The PSG demonstrates 1 or both of the following

- One or more obstructive apneas, mixed apneas, or hypopnoeas, per hour of sleep
- A pattern of obstructive hypoventilation, defined as at least 25 percent of total sleep time with hypercapnia ($PaCO_2 > 50$ mmHg) in association with 1 or more of the following
  - Snoring
  - Flattening of the nasal pressure waveform
  - Paradoxical thoracoabdominal motion

American Academy of Sleep Medicine. International Classification of Sleep Disorders, 3rd ed. American Academy of Sleep Medicine 2014

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Diagnostic Criteria for Paediatric OSA

Table 1: Diagnostic criteria of childhood OSAS (1- to 18-year-old)

Criteria A and B must be met
Criteria A: 1 or more of the followings
Habitual snoring, i.e., ≥3 nights per week
Labored breathing (snorting), or observed obstructive apnea during the child's sleep
Daytime sleepiness, hyperactivity, attention deficit, behavioral problems, learning problems, academic deterioration
Hypertension or nocturnal hypertension
Nocturnal enuresis (primary or secondary)
Excessive sweating during sleep
Chronic NREM parasomnias
Criteria B: PSG demonstrates one or both of the following
One or more obstructive apneas, mixed apneas, or hypopneas, per hour of sleep, i.e., AHI ≥1[#] or
A pattern of obstructive hypoventilation, defined as at least 25% of total sleep time with hypercapnia, i.e., $PaCO_2$ (or validated surrogate marker like $TcCO_2$*) >50 mmHg together with signs of partial obstruction like paradoxical breathing and/or out of phase between chest and abdominal recordings and/or flow limitation

[#]For children older than 12 years, AHI >5 might be used as the cutoff at the discretion of the attending pediatric respirologist, *$TcCO_2$ should be done with a validated transcutaneous CO_2 monitor with *in vivo* calibration by arterial CO_2 or arterialized capillary CO_2. PSG: Polysomnography, NREM: Non rapid eye movement

Ng et al. The Asian Paediatric Pulmonology Society (APPS) position statement on childhood obstructive sleep apnea syndrome. Pediatr Respirol Crit Care Med 2017

Diagnostic Approach

- Children of all ages should be screened for snoring and symptoms of OSA during routine health checks
- If snoring or OSA symptoms are present, diagnostic evaluation for OSA consists of the following
  - Focused sleep history
  - Physical examination, including oropharynx
  - PSG and/or referral to a specialist in sleep medicine or ENT for further evaluation and treatment
- The PSG is needed to make a definitive diagnosis of OSA and can assist with treatment decisions
- Specialty referral and PSG depend on individual patient characteristics and severity of symptoms

Marcus et al. Diagnosis and management of childhood obstructive sleep apnea syndrome. Pediatrics 2012
Ng et al. The APPS position statement on childhood obstructive sleep apnea syndrome. Pediatr Respirol Crit Care Med 2017

Diagnostic Approach – Ideal World

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Marcus et al. Diagnosis and management of childhood obstructive sleep apnea syndrome. Pediatrics 2012
Ng et al. The APPS position statement on childhood obstructive sleep apnea syndrome. Pediatr Respirol Crit Care Med 2017

Diagnostic Approach – Real World

- Reality
  - Local resources – PSG availability, waiting time for PSG, other diagnostic modalities available
  - Local expertise – Availability of paediatric pulmonologist, sleep specialist, ENT surgeon, orthodontist
  - Local practice patterns – Awareness and experience of primary care doctors, healthcare model and funding
  - Patient/parental preference – Cost, tolerance of PSG and other diagnostic modalities, perception of need for evaluation and treatment
  - Disease severity – Urgency of diagnosis and treatment, complications of disease
  - Patient complexity – Presence of high risk factors, co-morbidities, risk of surgery and other interventions, combination of interventions
- Existing literature does not indicate which type of specialty referral or diagnostic modality serves different areas and population best
- Selection, sequence and timing of specialty referral, diagnostic modality and treatment/intervention depends on above factors

Types of Sleep Study

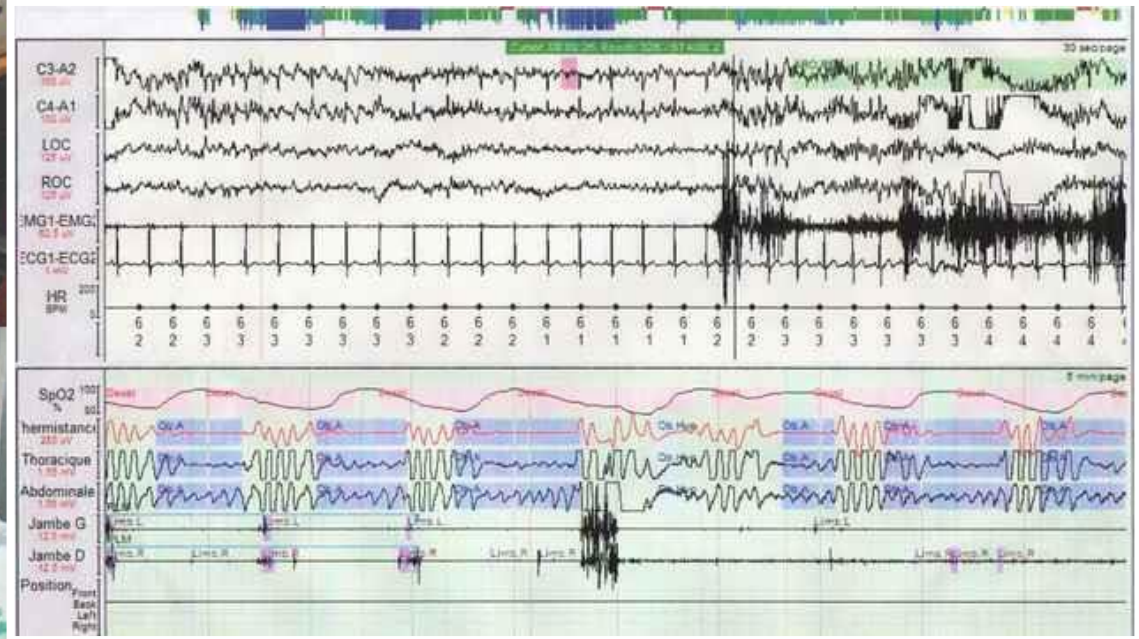
- 4 classes of sleep studies based upon how channels are recorded and whether a sleep technologist is present throughout the recording to provide oversight ("attended" or "unattended")
  - **Level 1 PSG** – Performed in a sleep laboratory with a sleep technologist present, recording a minimum of 7 channels including EEG, EOG, chin EMG, ECG/heart rate, and SpO_2
  - **Level 2 PSG** – A Level 1 PSG which is recorded unattended, in or out of the sleep laboratory
  - **Level 3 study** – Records a minimum of 4 channels, including ventilation, oximetry, ECG, or heart rate, and is done at home or outside of the sleep laboratory, unattended
  - **Level 4 study** – Records 2 to 3 cardiorespiratory signals (most often airflow, SpO_2, and heart rate) and is typically done at home, unattended

Portable Monitoring Task Force of the American Academy of Sleep Medicine. Clinical guidelines for the use of unattended portable monitors in the diagnosis of obstructive sleep apnea in adult patients. J Clin Sleep Med 2007

Sleep Study Modalities

- Comprehensive in-laboratory overnight PSG (Level 1)
- Home sleep apnoea testing (Level 2/3)
- Daytime nap PSG (Level 1)
- Overnight continuous pulse oximetry (Level 4)
- Nocturnal home audio or video recordings

Polysomnography



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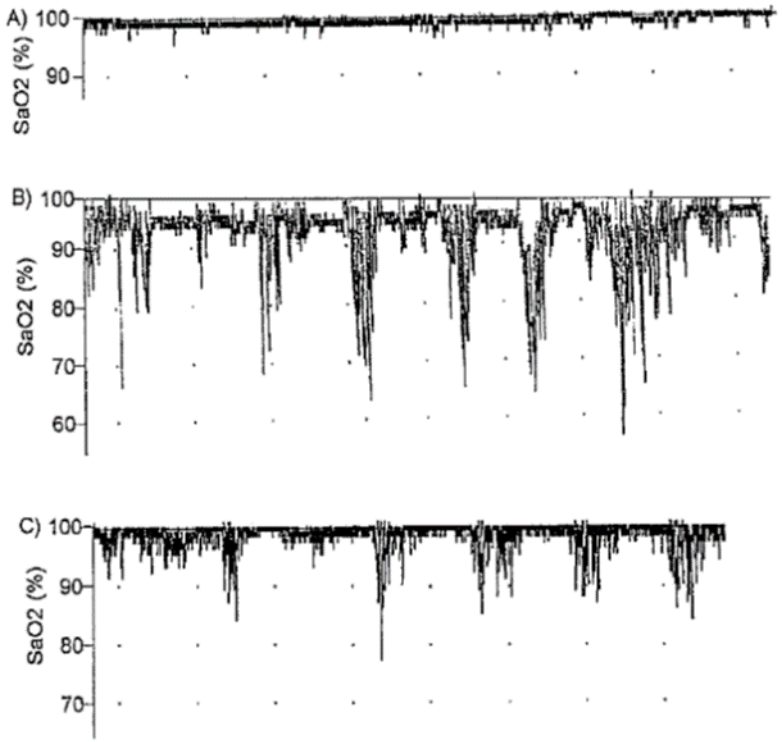
Overnight Pulse Oximetry

- Monitors pulse rate, pulse amplitude and SpO2 saturation
- Can identify OSA in some children by detecting clusters of desaturation events
  - Positive predictive value 97%
  - Negative predictive value 53%

Brouillette et al. Nocturnal pulse oximetry as an abbreviated testing modality for pediatric obstructive sleep apnoea

Overnight Pulse Oximetry



Brouillette et al. Nocturnal pulse oximetry as an abbreviated testing modality for pediatric obstructive sleep apnoea

Overnight Pulse Oximetry

Table 4: The McGill Oximetry Scoring

Score	Comment	Criteria			
		Number of drops in SaO_2 <90%	Number of drops in SaO_2 <85%	Number of drops in SaO_2 <80%	Others
1	Inconclusive for OSA	<3	0	0	Baseline: Stable (<3 clusters of desaturations) and >95%
2	Mild OSA	≥3	≤3	0	3 or more clusters of desaturation events
3	Moderate OSA	≥3	>3	≤3	3 or more clusters of desaturation events
4	Severe OSA	≥3	>3	>3	3 or more clusters of desaturation events

Desaturation: ≥ 4% fall in saturation
Cluster: ≥ 5 desaturations within a 30 minute period

Brouillette et al. Nocturnal pulse oximetry as an abbreviated testing modality for pediatric obstructive sleep apnoea

Audiotapes & Videotapes

- Audiotapes identify OSA with a
  - Positive predictive value of 50% to 75%
  - Negative predictive value of 73% to 83%

- Videotapes identify OSA with a
  - Positive predictive value of 83%
  - Negative predictive value of 88%

Lamm C, Mandell J, Kattan M. Pediatr Pulmonol 1999
Goldstein NA, Sculerati N, Walsleben JA et al. Otolaryngol Head Neck Surg 1994
Sivan Y, Kornecki A, Schonfeld T. Eur Respir J 1996

Treatment

Medical Treatment

- May be helpful in primary snoring, mild OSA at diagnosis or residual OSA after surgical intervention
  - Topical nasal corticosteroids
  - Leukotriene antagonists

- Meta-analysis of studies in children show reduction in apnoea hypopnoea index (AHI) with medical treatment
  - Nasal corticosteroids by 1.1
  - Leukotriene antagonists by 2.7
  - Nasal corticosteroids with leukotriene antagonists by 3.3

Liu et al. Am J Rhinol Allergy 2016

Ng et al. Pediatr Respirol Crit Care Med 2017

Surgical Treatment

- Tonsillectomy and/or adenoidectomy (T&A)
  - First line treatment in paediatric OSA with adenotonsillar hypertrophy

- Often, but does not always result in cure
  - Prevalence of residual OSA after T&A ranged from 34% to 87%, depending the population characteristics and AHI definition used for residual OSA

Lee et al. Clin Otolaryngol 2016

- Meta-analysis of studies in children
  - Postoperative AHI < 5 in 80% of all children and 55% of obese children
  - Postoperative AHI < 1 in 55% of all children and 30% of obese children

Ng et al. Pediatr Respirol Crit Care Med 2017

Surgical Treatment

- The Childhood Adenotonsillectomy Trial (CHAT)
  - 464 mild to moderate OSA above 5 years old
  - Randomised to early adenotonsillectomy (eAT) or watchful waiting with supportive care (WWSC)
  - AHI, oxygen desaturation index, hypercapnia and arousal index improved in both groups but significantly more so in eAT group
  - Normalization of PSG findings in 79% of eAT versus 46% of WWSC on assessment after 7 months
  - Significantly greater reported reduction in symptoms and improvement in behaviour and quality of life in the eAT than WWSC group
  - eAT compared to WWSC did not significantly improve attention or executive function as measured by neuropsychological testing
- Normalization rate of 46% in the WWSC group, who nevertheless had worse behavioural performance, warrants further study

Marcus et al. N Engl J Med 2013

Surgical Treatment

- Children at increased risk of post-operative complications
  - Below 3 years old
  - Severely obese
  - Severe OSAHS
  - OSAHS complicated by cor pulmonale or failure to thrive
  - Underlying abnormalities
    - Neuromuscular disorders
    - Cerebral palsy
    - Trisomy 21
    - Craniofacial disorders
    - Achondroplasia
    - Upper/lower airway abnormalities
    - Asthma

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    - Craniofacial disorders
    - Achondroplasia
    - Upper/lower airway abnormalities
    - Asthma

Also at risk of residual OSA post T&A

Surgical Treatment

- Epiglottoplasty
  - Significant laryngomalacia
- Mandibular distraction osteogenesis
  - Syndromes with mandibular hypoplasia
- Craniofacial surgery
  - Craniosynotosis syndromes
- Tracheostomy
  - Life-threatening obstructive apnoea not amenable to other therapies
- Uvulopharyngopalatoplasty
  - Higher risk of velopharyngeal insufficiency in children
  - May eliminate snoring but does not always cure OSAHS
- Tongue wedge resection
  - Only in carefully selected conditions eg Beckwith-Wiedermann syndrome

Positive Airway Pressure (PAP)

- Overcomes dynamic upper airway obstruction by stenting the airway open by pneumatic pressure
- In paediatric OSA
  - Effective in improving PSG parameters
  - Improvement in subjective parental assessment of sleepiness, snoring and difficulty in breathing during sleep
  - Significant improvement in neurobehavioral function in children after 3 months of PAP therapy demonstrated, even in developmentally delayed children

Marcus et al. J Clin Sleep Med 2012

Marcus et al. Am J Respir Crit Care Med 2012

Positive Airway Pressure

- CPAP/Bilevel PAP
  - Pre-operative stabilisation of severe OSAHS prior to T&A
  - Transient OSAHS in the perioperative period after T&A
  - Long term management of OSAHS in children without adenotonsillar hypertrophy or other surgically treatable conditions
  - Residual OSAHS after T&A or other surgical intervention
  - OSAHS associated with morbid obesity
- Adherence in children is difficult
- Comfortable and well fitting interface critical
- Pressure requirements change with growth/weight changes, need to titrate on regular basis
- Long term effects on maxillofacial structure development in children

Supplemental Oxygen

- Not advised as primary treatment for OSAHS
- Improved arterial oxygen saturation but
  - Does not address other pathophysiological problems of OSAHS
    - Sleep fragmentation
    - Sleep deprivation
    - Associated autonomic stimulation during the obstructive episodes
    - Associated GERD
  - May blunt hypoxic drive

Weight Management (Loss)

- Recommended and clearly desirable for all obese patients
  - Exercise appropriate for fitness level
  - Dietary changes and good eating habits
  - Behavioural modifications
  - Motivation from family, peers and healthcare professionals
- Difficult to achieve in many cases
  - Intergrated weight management programs may be helpful

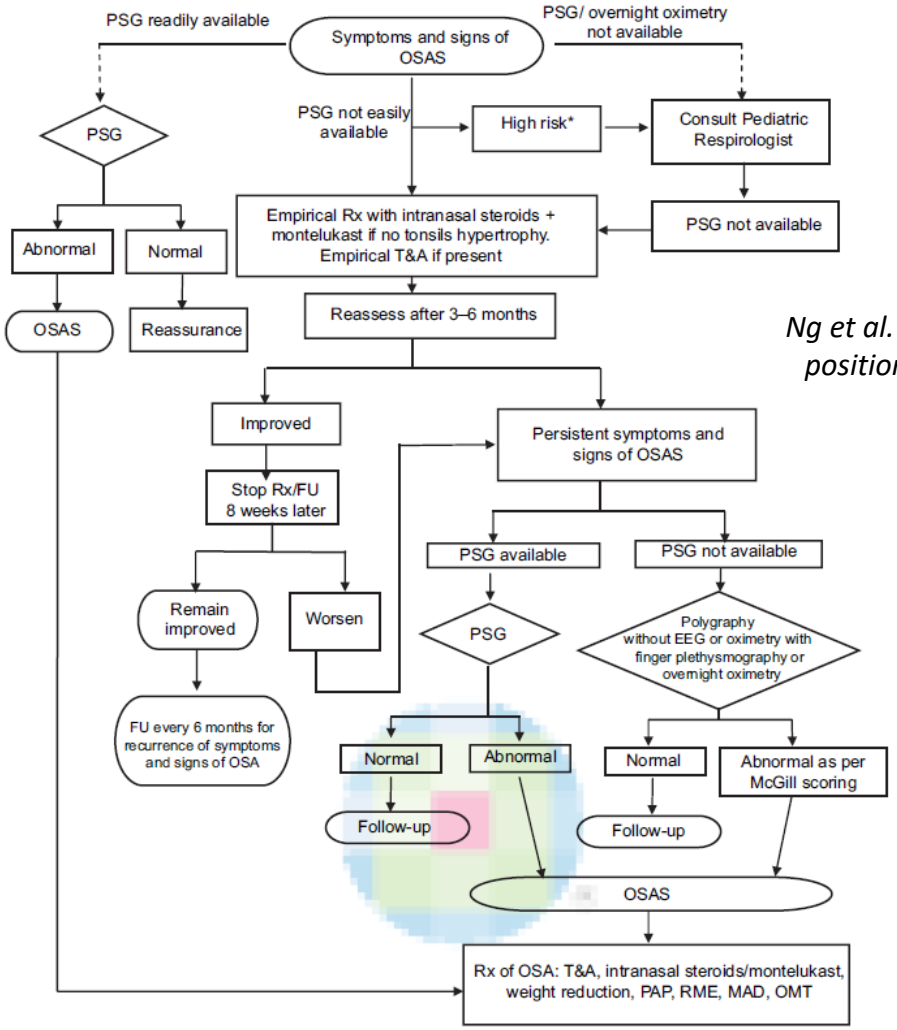
Appliances

- Increasing evidence in selected paediatric OSAHS
  - Orthodontic treatment
    - Rapid maxillary expansion
    - Mandibular advancement devices
  - Nasal expiratory positive airway pressure device

Huynh NT, Desplats E, Almeida FR. Orthodontics treatments for managing obstructive sleep apnea syndrome in children: A systematic review and meta-analysis. Sleep Med Rev 2015

Kureshi et al. Pilot study of nasal expiratory positive airway pressure devices for the treatment of childhood obstructive sleep apnea syndrome. J Clin Sleep Med 2014

APPS Management Algorithm



Ng et al. The Asian Paediatric Pulmonology Society (APPS) position statement on childhood obstructive sleep apnea syndrome. Pediatr Respirol Crit Care Med 2017

Figure 1: Management algorithm of children with suspected obstructive sleep apnea syndrome. *High-risk group: age <3 years, obesity, chronic mouth breathing, syndromic or nonsyndromic craniofacial growth disorders, chronic gastroesophageal reflux, chronic upper airway allergies, trisomy 21, cerebral palsy, neuromuscular disorders, chronic lung disease, sickle cell disease, genetic/metabolic diseases. Abbreviations: T and A: Tonsillectomy and adenoidectomy; PAP: Positive airway pressure; RME: Rapid maxillary expansion; MAD: Mandibular advancement device; OMT: Orofacial myofunctional therapy.

THANK YOU

Pathophysiology in Presence of Obesity

- Reduced pharyngeal lumen and increased pharyngeal collapsibility due to
  - Fat deposition in the pharyngeal muscles
  - Extra-pharyngeal compression from superficial subcutaneous fat
- Reduced ventilatory effort, lung volume and oxygen reserve due to
  - Reduced chest wall compliance
  - Cephalad displacement of the diaphragm by abdominal fat when supine
- Reduced lung volume causes reflexive decrease in the size of the pharyngeal airway exacerbating respiratory compromise

Horner RL, Mohiaddin RH, Lowell DG et al. Eur Respir J 1989;2:613-22
Shelton KE, Woodson H, Gay S, Surratt PM. Am Rev Respir Dis 1993;148:462-6
Hoffstein V, Zamel N, Phillipson EA. Am Rev Respir Dis 1984;130:175-8

- Potential role of leptin, a respiratory stimulant and central chemoreceptor modulator as a link between obesity, OSAHS and metabolic dysfunction

Saaresranta T, Polo O. Ann Med 2004:36:172-83

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Kids are not little adults…

	Adult	Children
Habitual snoring	9 – 25%	3 – 12%
Snoring because of sleep disordered breathing	Peak 40 – 65 years Male 3 – 8% Female 2 %	Bimodal Distribution 4 – 7 years Adolescence 1 – 3 %
Gender	Male > Female 2 – 4:1	Male = Female 1:1