Asthma and COPD for Healthcare Professional 2025

OSA in asthma and COPD patients

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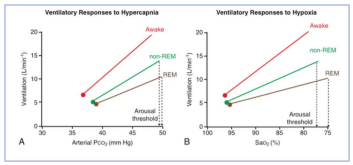
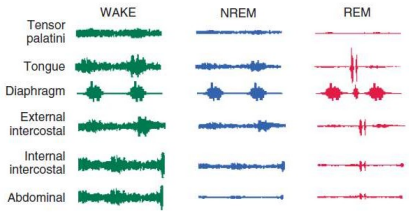
Outline

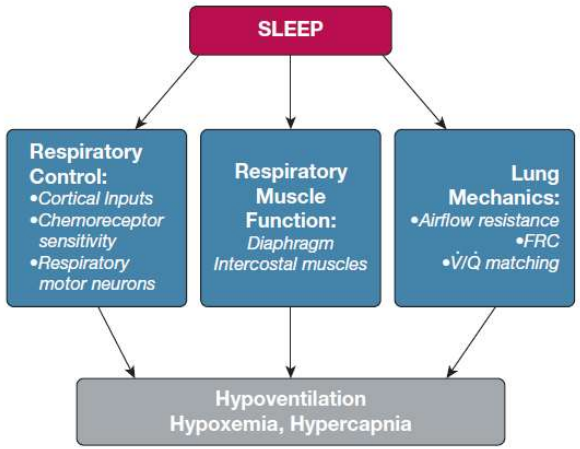
- Physiological effects of sleep on respiration
- Obstructive sleep apnea (OSA)
  - OSA and asthma
  - OSA and COPD
- Summary

Breathe 2023; 19: 230046

Physiological effects of sleep on respiration

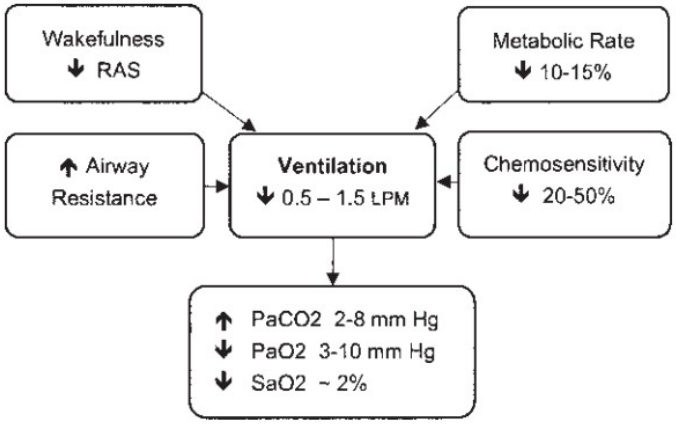






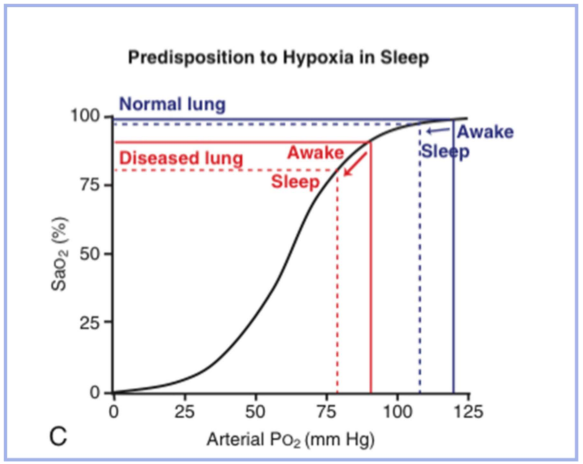
CHEST 2017; 152(6):1318-1326

Changes in the respiratory system and blood gases during normal sleep



Semin Respir Crit Care Med . 2005 Feb;26(1):109-16.

Predisposition to hypoxia in sleep



Murray & Nadel's Textbook of Respiratory Medicine, 6th edition
Adv Physiol Educ. 2001;25:101–116.

OSA

Characterized by repetitive narrowing (hypopnea) and closure (apnea) of the upper airway during sleep, transient hypoxia and hypercapnia, more marked intra-thoracic pressure swings and frequent cortical arousals that fragment sleep

OSA ICSD-3

A The presence of one or more of the following:

1. **The patient complains of sleepiness, fatigue, insomnia, or other symptoms leading to impaired sleep-related quality of life.**
2. The patient wakes with breathing holding, gasping, or choking.
3. The bed partners or other observer reports habitual snoring, breathing interruptions, or both during the patient's sleep.
4. ~~The patient has been diagnosed with hypertension, a mood disorder, cognitive dysfunction, coronary artery disease, stroke, congestive heart failure, atrial fibrillation, or type 2 diabetes mellitus.~~

(A and B) or C satisfy the criteria

ICSD-3-TR

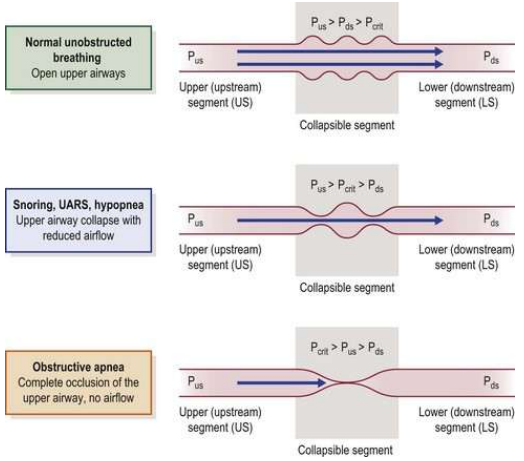
B Polysomnography (PSG) or OCST demonstrates

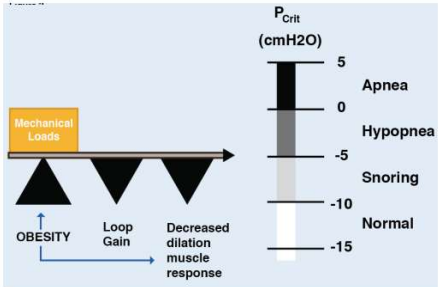
- Five of more predominantly obstructive respiratory events (obstructive and mixed apneas, hypopneas, or respiratory effort related arousals (RERA)) per hour of sleep during a PSG or per hour of monitoring (OCST).

C Polysomnography (PSG) or OCST demonstrates

- Fifteen or more predominantly obstructive respiratory events (apneas, hypopneas, or RERAs) per hour of sleep during a PSG or per hour of monitoring (OCST).

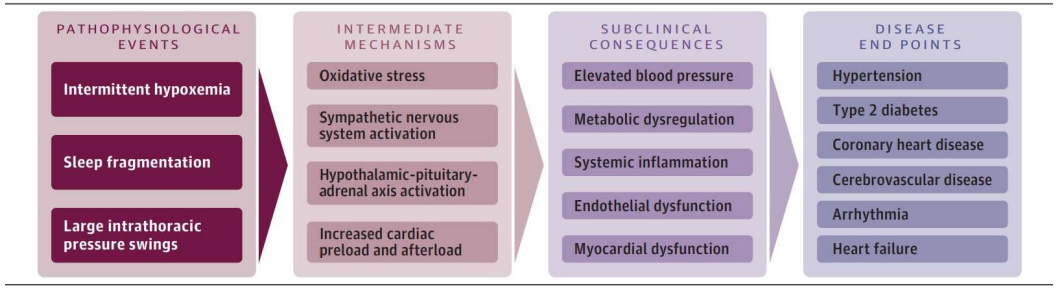
Upper airways collapsibility during sleep





JAMA. 2020;323(14):1389-1400.

Putative Causal Mechanisms of Obstructive Sleep Apnea–Related Cardiovascular and Metabolic Disease



JAMA. 2020;323(14):1389-1400

Clinical symptoms of OSA

Nocturnal symptoms

- Snoring
- Witnessed apnoeas, interrupting snoring and ending with a snoring
- Gasping and choking sensations that may wake the patient from sleep
- Restless sleep, with frequent arousals
- Nocturia
- Insomnia
- Nocturnal sweating
- PLMS
- Parasomnia (e.g. pseudo REM sleep bahavior disorder)

Daytime symptoms

- EDS during quiet activities; as severity worsens, patients are sleepy during activities requiring alertness (e.g. work, driving)
- Nonrestorative sleep
- Daytime fatigue/tiredness
- Morning headache
- Dry or sore throat
- Cognitive deficit: memory impairment,
  - loss of concentration
- Decreased vigilance
- Personality and mood changes (depression and anxiety)
- Sexual dysfunction (decreased libido, impotence)
- Gastro-oesophageal reflux

Risk factors at clinical examination

- Obesity, high BMI
- Neck circumference of >17 inches men and >16 inches in women
- Male sex
- Age >50 years
- Postmenopausal state
- Pregnancy/pregnancy-induced hypertension
- Ethnicity (African-Americans, Asian populations)
- Smoking and alcohol consumption
- Nasal obstruction
- Craniofacial anatomical structure (retrognathia, macroglossia, increased or modified Mallampati score, Friedman tongue position, high-arched palate)
- Neuropathy or myopathy of the upper airway (i.e. the genioglossus muscle)

Conditions associated with OSA

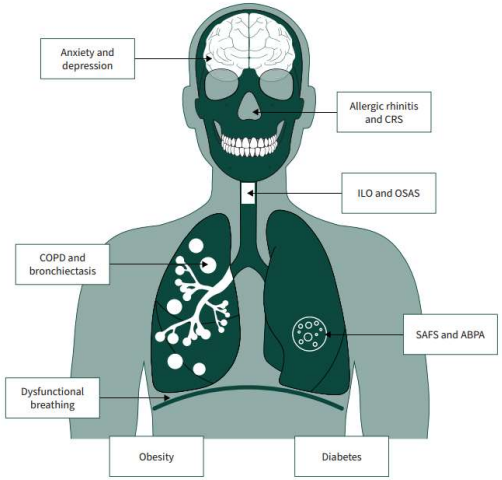
- Hypertension (particularly resistant), 'non-dipping' pattern
- AF
- Stroke and transient ischaemic attacks
- CHF
- PH
- OHS
- Metabolic syndrome
- Type 2 diabetes mellitus
- Polycystic ovary syndrome
- Acromegaly
- Hypothyroidism
- Chronic lung disease (asthma, COPD, IPF)
- End-stage kidney disease
- Parkinson disease
- Down syndrome, Pierre Robin syndrome

ERS Handbook: Respiratory Sleep Medicine

Asthma

OBSTRUCTIVE SLEEP APNEA

Common comorbidities encountered in difficult and severe asthma



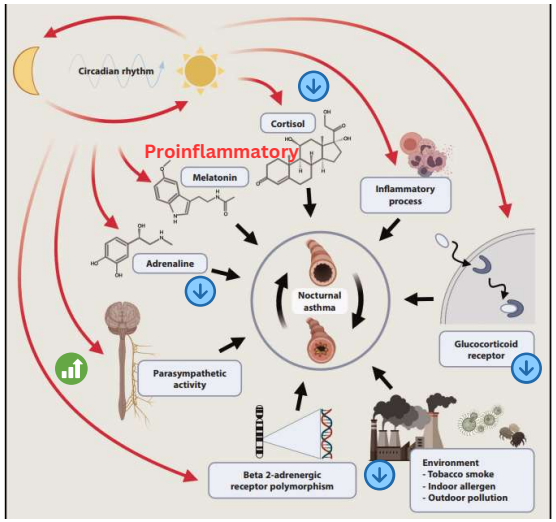
Breathe 2023; 19: 230046

OSA and asthma

- Sleep and asthma
- Prevalence, pathophysiology and burden on asthma
- Diagnosis
- Management and outcomes

Breathe 2023; 19: 230046

Sleep and asthma

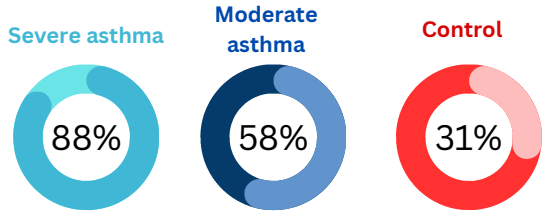


Lowest FEV1

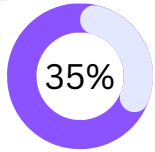
Asian Pac J Allergy Immunol 2021;39:78-88 DOI 10.12932/AP-231020-0986

Epidemiology of asthma and OSA

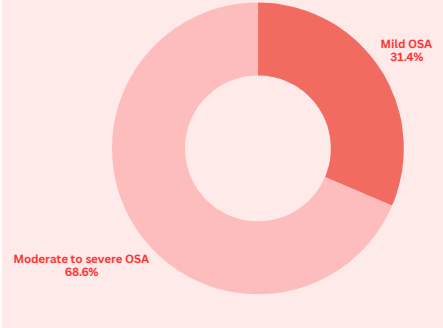
Prevalence of OSA (defined as AHI ⩾15/hour)



Prevalence of asthma in OSA patients



74.5%: difficult to treat asthma patients (N =35)



J Allergy Clin Immunol.2009;124(2):371-6
Asian Pac J Allergy Immunol. 2014;32(2):153-9

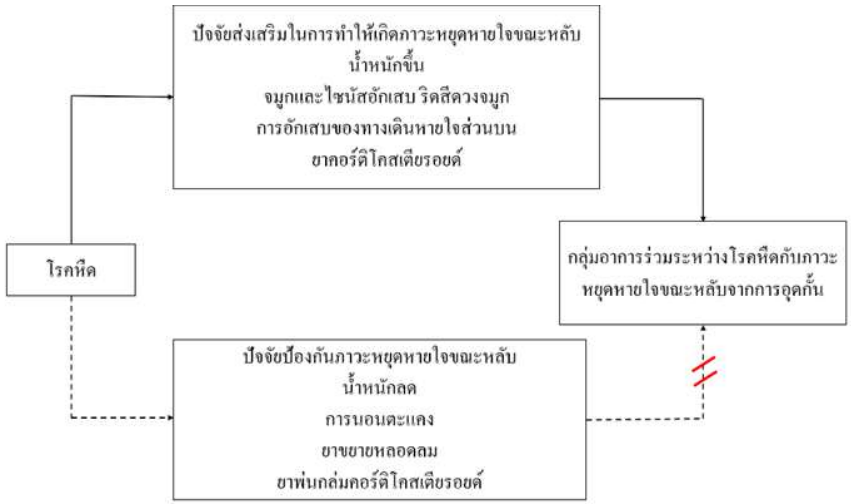
Nocturnal asthma

- In patients with nocturnal asthma whose quality of sleep does not improve with proper antiasthma treatment, the coexistence of OSA (i.e., asthma/OSA overlap syndrome) should be excluded.

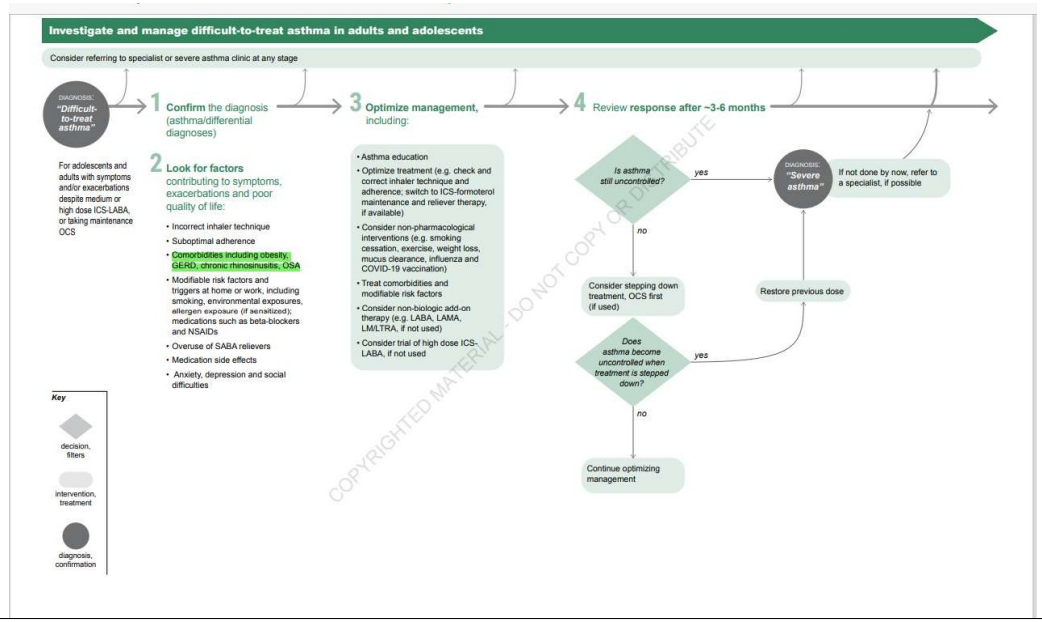
Nocturnal asthma: increased risk of mortality

J Allergy Clin Immunol.2009;124(2):371-6.
Asian Pac J Allergy Immunol. 2014;32(2):153-9.

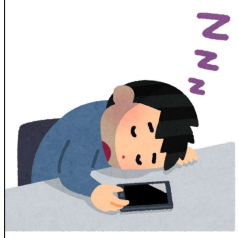
Bidirectional Relationship Asthma and OSA



Asian Pac J Allergy Immunol. 2016;34(4):265-71



Diagnosis



Gold standard is polysomnography

- Asthma for longer durations
- Severe asthma
- Difficult to control asthma
- On higher doses of ICS
- Asthma with obesity
- Others risk of OSA

- Limited sleep studies
- Validated questionnaire can be used as screening tools
- HSAT may be underestimated OSA

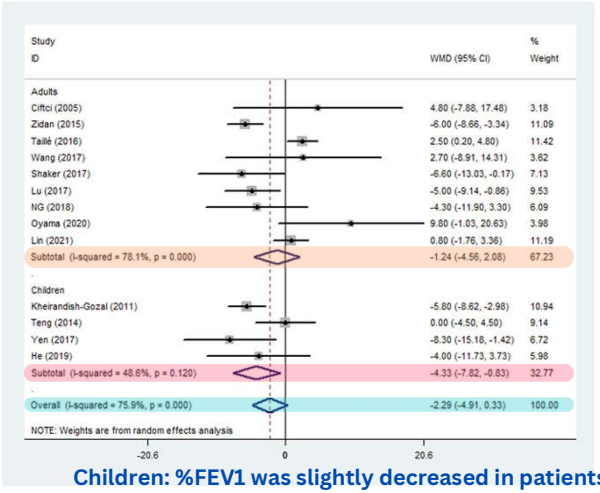
Am J Respir Crit Care Med Vol 201, Iss 11, pp 1345–1357, Jun 1, 2020

OSA and asthma

The relationship between obstructive sleep apnea and asthma severity and vice versa: a systematic review and meta-analysis

34 studies with 27,912 subjects

OSA and asthma: FEV1%



Adult

Children*

Children: %FEV1 was slightly decreased in patients with asthma complicated by OSA

Subgroup meta-analysis of main outcomes in patients with OSA in asthma group and non-asthma group

Outcomes and subgroups	No. of studies	Population	WMD	95%CI	I^2 (%)	PH	Statistical model	PZ	Between-group *P* value
AHI (events/hour)									
All	9	9540	0.47	− 1.59, 2.52	65.9	0.003	Random	0.656	–
Age									
Adult	7	9434	0.72	− 1.95, 3.38	74.2	0.001	Random	0.599	0.670
Children	2	106	− 0.08	− 2.61, 2.44	0	0.703		0.948	–
Severity of OSA									
AHI ≥ 1 or 5/h	5	3801	0.27	− 1.97, 2.50	43.0	0.135	Random	0.686	0.912
AHI ≥ 15/h	3	5739	0.63	− 5.45, 6.71	82.1	0.004		0.839	–
$LSpO_2$ (%)	4	6360	− 0.10	− 1.28, 1.09	47.2	0.128	Fixed	0.872	–
ODI (events/hour)	4	6310	− 0.56	− 1.68, 0.56	30.2	0.231	Fixed	0.326	–
ArI (events/hour)	3	3074	− 0.94	− 2.14, 0.26	4.6	0.351	Fixed	0.123	–
T90 (%)	3	3142	0.02	− 0.42, 0.47	0	0.536	Fixed	0.915	–
ESS score	4	9089	0.60	0.16, 1.04	0	0.678	Fixed	0.007	–

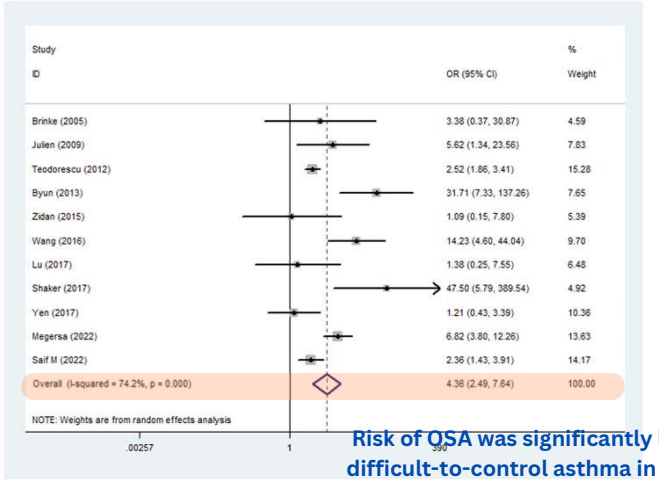
WMD; weighted mean difference, CI; confidence interval, PZ; *P* value for *Z* test, PH; P value based on Q test for between-study heterogeneity, AHI; apnea/hypopnea index, $LSpO_2$; lowest peripheral oxygen saturation, ODI; oxygen desaturation index, ArI; arousal index, T90%; percent sleeping time in which oxygen saturation was below 90%, ESS; Epworth Sleepiness Scale

AHI

ESS*

Comorbidity of asthma may exacerbate daytime sleepiness assessed by ESS

The risk of OSA in patients with different asthma severity



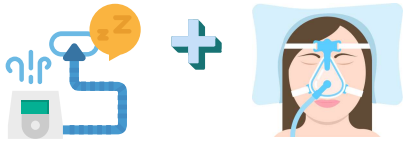
difficult-to-control asthma

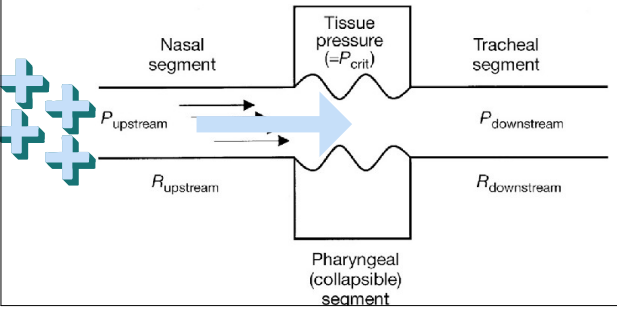
- significant risk factor for OSA (pooled OR = 4.36, 95%CI 2.49–7.64, I2 = 74.2%, P < 0.001)

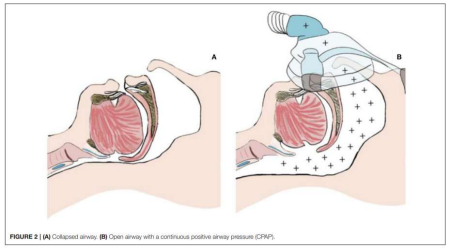
Risk of OSA was significantly higher in more severe or more difficult-to-control asthma in 7 of the 11 studies (Total N = 1869)

Continuous positive airway pressure (CPAP)

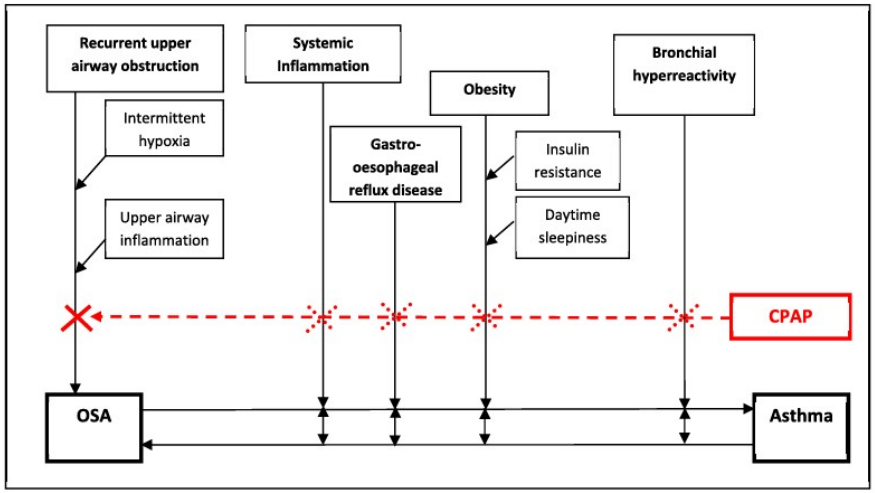
First line treatment for OSA







Mechanistic effect of CPAP improving asthma in co-existing OSA



Respiratory Medicine 143 (2018) 18-30

CPAP treatment of OSA and asthma

Does Continuous Positive Airway Pressure (CPAP) treatment of obstructive sleep apnoea (OSA) improve asthma-related clinical outcomes in patients with co-existing conditions?- A systematic review

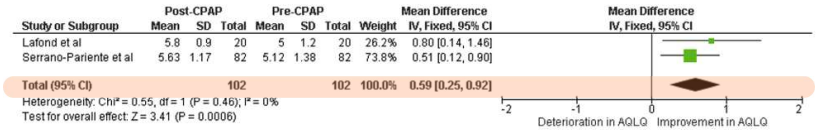
12 studies;

- **8 prospective quasi-experimental**
- **4 observational**

Respiratory Medicine 143 (2018) 18-30

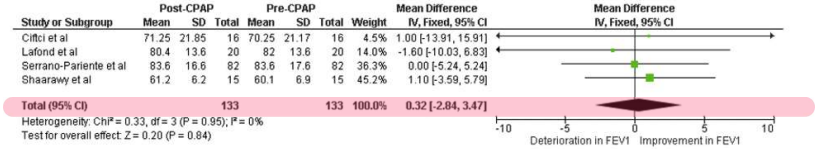
Meta-Analysis of Clinical Outcomes pre and post CPAP

a) Asthma related quality of life (AQLQ/mini-AQLQ)



QOL***

b) Lung Function (FEV1% predicted)



FEV1%

Significant improvement in mean Asthma Quality of Life Questionnaire scores

Respiratory Medicine 143 (2018) 18-30

Effects of Treatment for OSA on Asthma Outcomes

Reference	Design/Sample	Assessment	Results	Limitations
CPAP treatment				
Teodorescu *et al.*, 2012 (62)	Cross-sectional $n = 132$ with OSA, 75 on CPAP	OSA: SA-SDQ and PSG Asthma: physician diagnosis	• ↓ Daytime asthma symptoms (*OR, 0.46)	Objective CPAP adherence not available
Teodorescu *et al.*, 2013 (7)	Cross-sectional Age 18–59 yr vs. 60–75 yr $n = 140$	OSA: PSG Asthma: physician diagnosis	• ↓ Risk of severe asthma (more in older vs. younger patients, by 91% vs. 57%)	PSG-derived OSA severity or objective CPAP adherence not available
Kauppi *et al.*, 2016 (97)	Longitudinal, retrospective study $n = 152$	OSA: physician diagnosis and CPAP ⩾3 mo Asthma: on asthma medication	• ↓ Asthma severity (ACT and VAS)	Generalizability limited with high CPAP adherence (6.3 h daily)
Wang *et al.*, 2017 (63)	Longitudinal, retrospective study $n = 77$	OSA: PSG Asthma: spirometry	• ↓ The annual decline in FEV_1 in severe OSA	No control group
Lafond *et al.*, 2007 (68)	Interventional: CPAP × 6 wk $n = 20$	OSA: PSG (AHI ⩾ 15/h) and CPAP titration Asthma: ATS criteria	• No difference in methacholine challenge test • ↑ Asthma-specific quality of life	Per-protocol analysis of 13 patients with ⩾4 h daily CPAP use
Serrano-Pariente *et al.*, 2017 (69)	Interventional: CPAP × 6 mo $n = 99$	OSA: AHI ⩾20/h Asthma: physician diagnosis	• ↑ Asthma control, disease-specific quality of life • ↓ Bronchial reactivity (reduced proportion of patients with positive bronchodilator response), exhaled NO	No control group

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Clinical Outcomes and Treatment in Asthma and OSA

- **No long-term studies** that have evaluated asthma outcomes, either nocturnal or awake, among patients with comorbid untreated OSA or OSA outcomes in OSA patients with comorbid asthma.
- Improve asthma symptoms and possibly spirometric parameters

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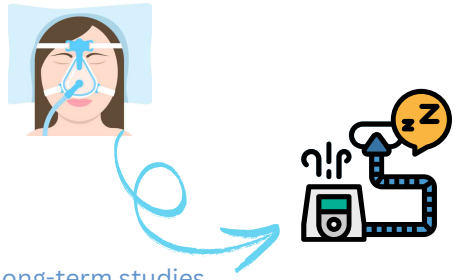
Continuous positive airway pressure (CPAP)



No long-term studies

Impact on asthma control

- Asthma attack in days
- Nocturnal asthma attacks
  Night time symptom scores
- Bronchial hyperresponsiveness within 7 days of use
- ACT score
- Mean PEFR and %FEV1, QoL

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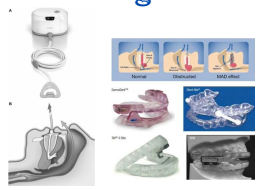
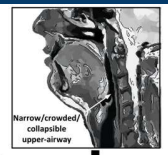
Personalized Management



Anatomical impairment

↑ ACT with oral appliance treatment

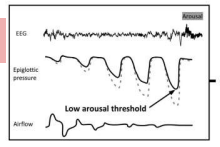
CPAP/MAD/surgery/
Weight reduction/
positional therapy/
Nasal expiratory resistance device (Provent®) (discontinued)/
Oral pressure therapy (Winx®)/Intranasal steroid



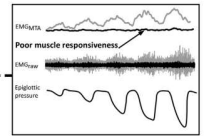
Low arousal threshold

Poor pharyngeal dilator muscles responsiveness

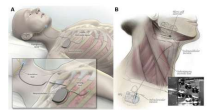
Hypnotic drug



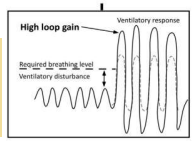
OSA



Upper airway muscle training
Hypoglossal nerve stimulation
Drugs (noradrenergic and anticholinergic targets)



Supplemental O2 (limited data/NOT recommended)
/Acetazolamide (limited recommended)

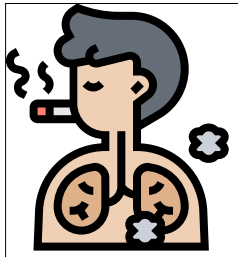


High loop gain

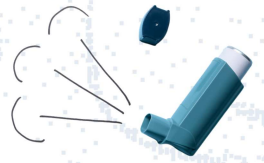
CHEST 2018; 153(3):744-755

Summary: SBD and asthma

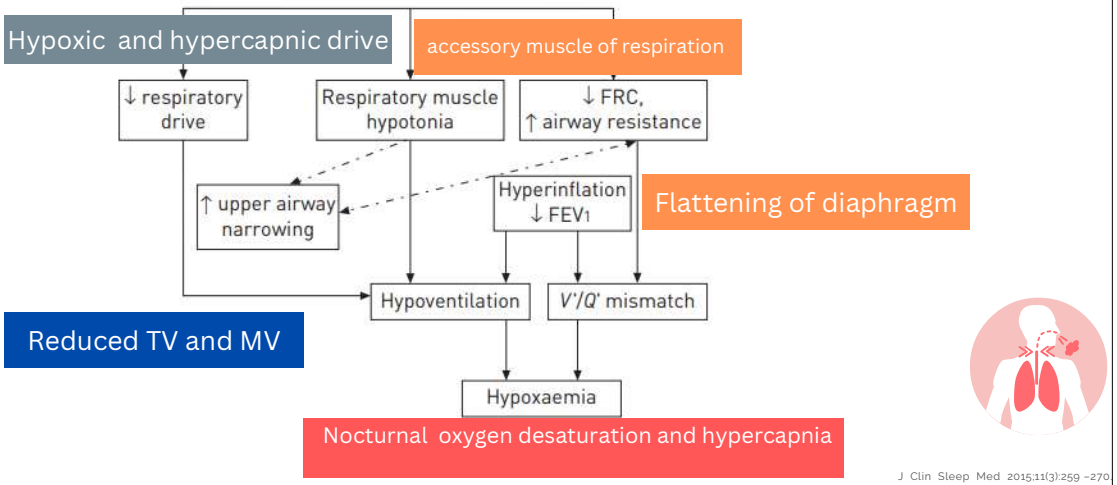
- OSA is more commonly observed in asthma patients particularly in severe and uncontrolled group.
- Should periodically screen patients with asthma for OSA
  - Esp. asthma for longer durations, uncontrolled disease, or on higher doses of ICS, obesity
- HSAT: underestimate clinically significant OSA in patients with asthma
- Treatment for OSA such as the use of CPAP in adult and adenotonsillectomy in children was proven to improve asthma symptoms and possibly spirometric parameters



OSA and
Chronic obstructive pulmonary disease (COPD)



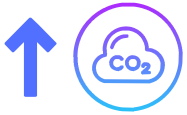
Pathophysiology of sleep-related respiratory changes in COPD



J Clin Sleep Med 2015;11(3):259 –270
Eur Respir Rev 2013; 22: 365–375

SBD and COPD

Sleep related hypoxemia



Sleep related hypoventilation

Overlap syndrome (COPD and OSA)

Eur Respir J 2002; 20: 799–805
Eur Respir Rev 2013; 22: 365–375

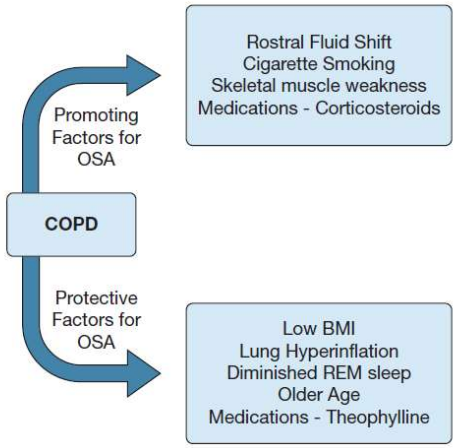
Overlap syndrome (COPD and OSA)

- Prevalence: Similar to the general population: 10-30%
  - Sleep Heart Health Study
  - MONICA-II
- Some reports indicate a higher prevalence of SDB in COPD:

  65.9%

Eur Respir J 2002; 20: 799–805
Eur Respir Rev 2013; 22: 365–375

Interactions between COPD and OSAS



Supine position during sleep
Accumulation of fluid in the neck resulting in upper airway narrowing, increased pharyngeal wall compliance, and possible reduced pharyngeal dilator muscle contraction

Airway inflammation

- Caudal traction effects on the upper airway
- Computed tomography measures of hyperinflation and gas trapping are reported to be negatively associated with the apnoea–hypopnoea index (AHI) frequency per hour

CHEST 2017; 152(6):1318-1326

Hypercapnia in Overlap Syndrome

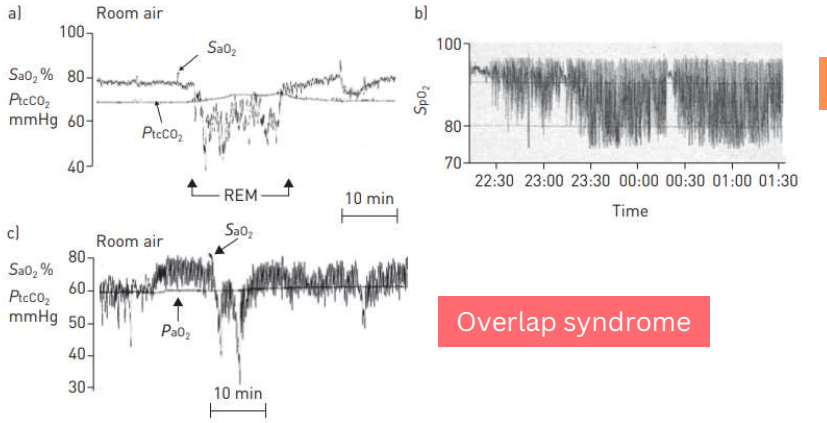
- Retrospectively evaluated data from 213 consecutive patients
- OLS significantly higher PaCO2 in the presence of a similar AHI
- OLS vs COPD patients
  - OLS significantly **higher PaCO2 value**, significantly **less severe obstructive impairment**

	COPD Group (n = 32)	OLS Group (n = 29)	OSA-Only Group (n = 152)
Age (years)	60.1 (10.4)	57.2 (9.5)	48.9 (12.9)
Weight (kilograms [kg])	87.6 (17.5)	**102.2** (20.6)	106.8 (28.8)
BMI (kg/m²)	31 (7)	36 (6)	39 (10)
FVC (% predicted)	60 (19)	72 (17)	87 (20)
FEV_1 (% predicted)	47 (16)	63 (16)	89 (20)
FEV_1/FVC (%)	59 (9)	67 (5)	87 (9)
PaO_2 (mm Hg)	69 (10.4)	70 (11)	79 (12)
PCO_2 (mm Hg)	40 (5)	45 (5)	39 (4)
AHI (events/h)	6 (5)	40 (20)	42 (23)
%Time SpO_2 < 90%	16 (28)	48 (28)	30 (28)

Sleep Breath 2002; 06(1): 011-018

Different patterns of oxygen desaturation during sleep in patients

COPD



OSA

Overlap syndrome

Eur Respir Rev 2019; 28: 190064

Indications for performing a sleep diagnostic test in COPD patients

Symptoms or findings indicative for sleep disordered breathing in patients with COPD

Sleep-related symptoms such as snoring, gasping and choking, as well as nocturia or morning headache
Increased daytime sleepiness
Signs of obesity including BMI >30 kg·m^{-2} in men and >35 kg·m^{-2} in women, neck circumference >43 cm in men and >41 cm in women
Reduced daytime pulse oxygen saturation (<93%) at rest or during exercise
Daytime hypercapnia
Signs of pulmonary hypertension or right heart failure, such as peripheral oedema
Polycythaemia
Patients who use opioids and/or hypnotic medications
Comorbidities such as atrial fibrillation, end-stage renal disease, type 2 diabetes, heart failure, difficult to treat hypertension and stroke

In-laboratory PSG is the gold standard method

CO2 monitoring

Eur Respir Rev 2019; 28: 190064

Ventilatory Support in COPD and OSA

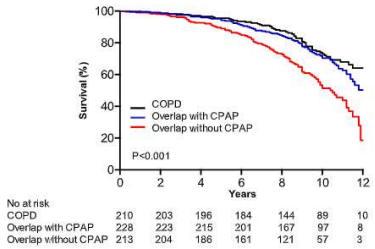
Global Initiative for Chronic Obstructive Lung Disease 2025 REPORT

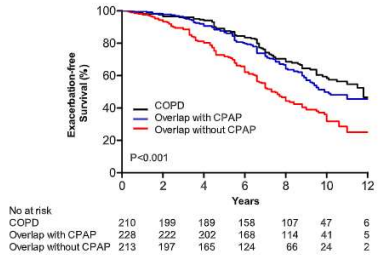
Stable patient

No CO2 retension

In patients with both COPD and obstructive sleep apnea there are clear benefits associated with the use of continuous positive airway pressure (CPAP) to improve both survival and the risk of hospital admissions.[780,781]

- The use of positive pressure ventilation in patients with COPD and OSA has been reported to reduce all- cause hospitalizations, emergency room visits, moderate and severe exacerbations and associated healthcare costs.[98,99]





Clear benefits: CPAP use in COPD-OSA overlap syndrome

Improve both survival and risk of hospital admission

Am J Respir Crit Care Med Vol 182. pp 325–331. 2010

Summary: OSA and COPD

Clinical

Poor sleep quality: symptoms of COPD, comorbid sleep disorders

In-laboratory PSG

- The gold standard method +/-CO2 monitoring; preferred for evaluation
  - HSAT: limited data

COPD and OSA without hypoventilation

- CPAP: reduces the number of COPD-related severe exacerbations and hospital admissions.
- Oxygen alone is not an effective treatment.

THANK YOU

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