

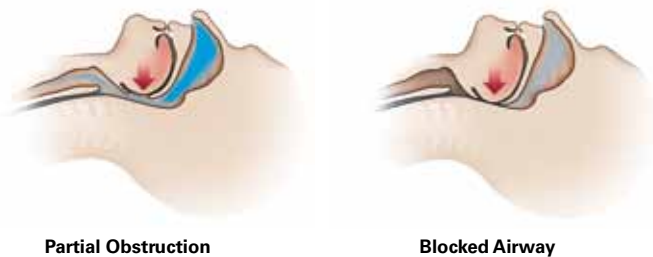
WHAT IS SLEEP-DISORDERED BREATHING (SDB)?

SDB describes a number of nocturnal breathing disorders

- Obstructive sleep apnea (OSA)
- Central sleep apnea (CSA)
- Nocturnal hypoventilation
- Cheyne–Stokes respiration (CSR)

WHAT IS OBSTRUCTIVE SLEEP APNEA (OSA)?

- Most common form of SDB
- A partial or complete collapse of the upper airway that causes muscles controlling the soft palate and tongue to relax
- Person experiences apneas, hypopneas and flow limitation
 - Apnea: a cessation of airflow for ≥ 10 seconds
 - Hypopnea: a decrease in airflow lasting ≥ 10 seconds with a 30% oxygen reduction in airflow and with at least a 4% oxygen desaturation from baseline
 - Flow limitation: narrowing of the upper airway and an indication of an impeding upper airway closure



Signs and Symptoms of Sleep Apnea

- LACK OF ENERGY**
- MORNING HEADACHES**
- HYPERTENSION**
- FREQUENT NOCTURNAL URINATION**
- DEPRESSION**
- OBESITY**
- LARGE NECK SIZE**
- EXCESSIVE DAYTIME SLEEPINESS (EDS)**
- NIGHTTIME GASPING, CHOKING OR COUGHING**
- GASTROESOPHAGEAL REFLUX (GE REFLUX)**
- IRREGULAR BREATHING DURING SLEEP (IE, SNORING)**

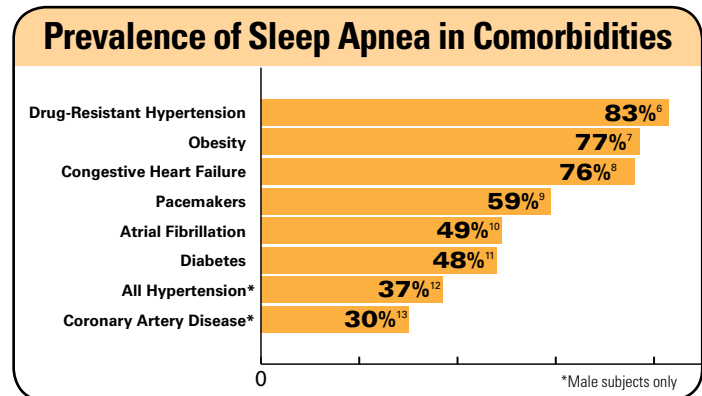
CLASSIFICATION OF SLEEP APNEA

AHI (Apnea–Hypopnea Index)

- Number of apneas and/or hypopneas per hour of sleep (or study time)
- Reflects the “severity” of sleep apnea
 - AHI = 0-4** Normal range
 - AHI = 5-14** Mild sleep apnea
 - AHI = 15-30** Moderate sleep apnea
 - AHI > 30** Severe sleep apnea

PREVALENCE OF SLEEP APNEA

- Approximately 42 million American adults have SDB¹
- 1 in 5 adults has mild OSA²
 - 1 in 15 has moderate to severe OSA²
- 9% of middle-aged women and 25% of middle-aged men suffer from OSA³
- Prevalence similar to asthma (20 million) and diabetes (23.6 million of US population)⁴
- 75% of severe SDB cases remain undiagnosed⁵



INCREASED RISK FACTORS FOR SLEEP APNEA

- Male gender
- Obesity (BMI >30)
- Diagnosis of hypertension
- Excessive use of alcohol or sedatives
- Upper airway or facial abnormalities
- Smoking
- Family history of OSA
- Large neck circumference (>17” men; >16” women)
- Endocrine and metabolic disorders

CARDIOVASCULAR LINKS

- 5.7 million people in the US have heart failure (American Heart Association)
- Approximately 76% of congestive heart failure patients have SDB⁶
- Heart failure is the most expensive disorder to treat¹⁴
- OSA noted in 49% of atrial fibrillation patients¹⁰ and 30% of cardiovascular patients¹³
- OSA presents in 70% of heart attack patients with AHI ≥ 5 and 52% of heart attack patients with AHI ≥ 10 ¹⁵

HYPERTENSION LINKS

- Studies have shown that sleep apnea is an independent risk factor for hypertension
- 30–83% of patients with hypertension have sleep apnea^{6,12}
- 43% of patients with mild OSA and 69% of patients with severe OSA have hypertension⁵
- AHA guidelines on drug-resistant hypertension have shown treatment of sleep apnea with CPAP likely improves blood pressure control



TYPE 2 DIABETES LINKS

- 48% of type 2 diabetes sufferers have sleep apnea¹¹
- OSA may have a causal role in the development of type 2 diabetes¹⁶
- OSA is associated with insulin resistance (independent of obesity)¹⁷
- 30% of patients presented to a sleep clinic have impaired glucose intolerance¹⁸
- Mild forms of SDB may be important in predicting risk of pre-diabetes¹⁹
- 86% of obese type 2 diabetic patients suffer from sleep apnea²⁰

STROKE RISK

- 65% of stroke patients have SDB²¹
- Up to 70% of patients in rehabilitation therapy following stroke have significant SDB (AHI >10)²²

MORTALITY LINKS

- SDB is associated with a 3-fold increase in mortality risk⁵
- There is an independent association of moderate to severe OSA with increased mortality risk³
- Severe sleep apnea raises death risk by 46%²³

HEALTH CARE COSTS

(Economic consequences of untreated SDB)

- Undiagnosed patients used \$200,000 more in the two-year period prior to diagnosis than matched controls²⁴
- Prior to sleep apnea diagnosis, patients utilized 23–50% more medical resources²⁵
- Total economic cost of sleepiness = approximately \$43–56 billion²⁶
- Undiagnosed moderate to severe sleep apnea in middle-aged adults may cause \$3.4 billion in additional medical costs in the US²⁷

TRAFFIC ACCIDENTS

- People with moderate to severe sleep apnea have an up to 15-fold increase of being involved in a traffic accident²⁸
- People with sleep apnea are at twice the risk of having a traffic accident²⁹
- Treating all US drivers suffering from sleep apnea would save \$11.1 billion in collision costs and save 980 lives annually³⁰

Treatment of OSA with CPAP

- Treatment of OSA resulted in a 10 mmHg reduction in blood pressure which would reduce stroke risk by 56% and coronary heart disease risk by 37%³¹
- CPAP treatment reduces the need for acute hospital admission due to cardiovascular disease in patients with sleep apnea³²
- One month of CPAP improves daytime blood pressure, heart rate and left ventricular function³³
- CPAP reduces blood glucose levels³⁴
- Two nights of CPAP improves insulin sensitivity, sustained at the 3-month interval³⁵
- For every dollar spent on CPAP, \$3.49 would be saved in reduced collision costs³⁰
- CPAP improved the prognosis of heart failure patients with OSA³⁶

1. Young et al. *New Engl J Med* 1993 2. Young et al. *J Am Med Assoc* 2004 3. Marshall et al. *Sleep* 2008 4. US Department of Health and Human Services, Centers for Disease Control and Prevention 2008 5. Young et al. *Sleep* 2008 6. Logan et al. *J Hypertens* 2001 7. O’Keeffe & Patterson. *Obes Surg* 2004 8. Oldenburg et al. *Eur J Heart Fail* 2007 9. Garrigue et al. *Circulation* 2007 10. Gami et al. *Circulation* 2004 11. Einhorn et al. *Endocr Pract* 2007 12. Sjostrom et al. *Thorax* 2002 13. Schafer et al. *Cardiology* 1999 14. Medicare - \$20.4 billion p.a. 15. Kuniyoshi et al. *J Am Coll Cardiol* 2008 16. Reichmuth et al. *Am J Respir Crit Care Med* 2005 17. Punjabi et al. *Am J Respir Crit Care Med* 2002 18. Meslier et al. *Eur Respir J* 2003 19. Stamatakis et al. *Sleep* 2008 20. Foster et al. *Diabetes Care* 2009 21. Dyken et al. *Stroke* 1996 22. Good et al. *Stroke* 1996 23. Punjabi et al. *PLoS Medicine* 2009 24. Kryger et al. *Sleep* 1996 25. Smith et al. *Chest* 2002 26. Leger et al. *Sleep* 1994 27. Kapur et al. *Sleep* 1999 28. Horstmann et al. *Sleep* 2000 29. Teran-Santos et al. *New Engl J Med* 1999 30. Sassani et al. *Sleep* 2004 31. Becker et al. *Circulation* 2003 32. Peker et al. *Am J Respir Crit Care Med* 1997 33. Kaneko et al. *New Engl J Med* 2003 34. Babu et al. *Arch Intern Med* 2005 35. Harsch et al. *Am J Respir Crit Care Med* 2004 36. Kasai et al. *Chest* 2008