

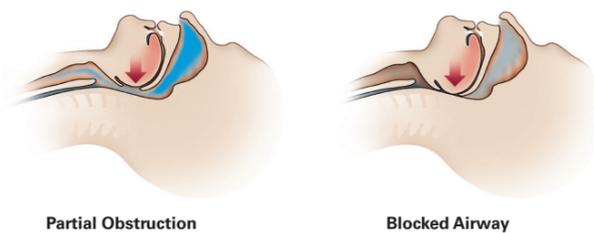
## WHAT IS SLEEP-DISORDERED BREATHING (SDB)?

**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  $\geq 10$  seconds
  - Hypopnea: a decrease in airflow lasting  $\geq 10$  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 impending 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

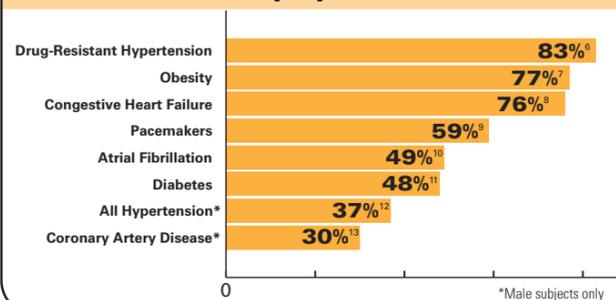
**AHI** (Apnea–Hypopnea Index)

- 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 SDB<sup>1</sup>
- 1 in 5 adults has mild OSA<sup>2</sup>
  - 1 in 15 has moderate to severe OSA<sup>2</sup>
- 9% of middle-aged women and 25% of middle-aged men suffer from OSA<sup>3</sup>
- Prevalence similar to asthma (20 million) and diabetes (23.6 million) of US population<sup>4</sup>
- 75% of severe SDB cases remain undiagnosed<sup>5</sup>

## Prevalence of Sleep Apnea in Comorbidities



## INCREASED RISK FACTORS FOR SLEEP APNEA

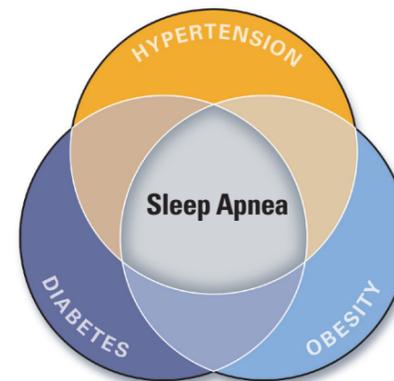
- Male gender
- Obesity (BMI >30)
- Diagnosis of hypertension
- Excessive use of alcohol or sedatives
- Upper airway or facial abnormalities
- Smoking
- Family history of OSA
- Large neck circumference (>17” men; >16” women)
- Endocrine and metabolic disorders

## CARDIOVASCULAR LINKS

- 5.7 million people in the US have heart failure<sup>14</sup>
- Approximately 76% of congestive heart failure patients have SDB<sup>8</sup>
- Heart failure is the most expensive disorder to treat<sup>15</sup>
- OSA noted in 49% of atrial fibrillation patients<sup>10</sup> and 30% of cardiovascular patients<sup>13</sup>
- OSA presents in 70% of heart attack patients with AHI  $\geq 5$  and 52% of heart attack patients with AHI  $\geq 10$ <sup>16</sup>

## HYPERTENSION LINKS

- Studies have shown that sleep apnea is an independent risk factor for hypertension
- 30–83% of patients with hypertension have sleep apnea<sup>6,12</sup>
- 43% of patients with mild OSA and 69% of patients with severe OSA have hypertension<sup>5</sup>
- 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 apnea<sup>11</sup>
- OSA may have a causal role in the development of type 2 diabetes<sup>17</sup>
- OSA is associated with insulin resistance (independent of obesity)<sup>18</sup>
- 30% of patients presented to a sleep clinic have impaired glucose intolerance<sup>19</sup>
- Mild forms of SDB may be important in predicting risk of pre-diabetes<sup>20</sup>
- 86% of obese type 2 diabetic patients suffer from sleep apnea<sup>21</sup>

## STROKE RISK

- 65% of stroke patients have SDB<sup>22</sup>
- Moderate to severe sleep apnea triples stroke risk in men<sup>23</sup>

## MORTALITY LINKS

- SDB is associated with a threefold increase in mortality risk<sup>5</sup>
- There is an independent association of moderate to severe OSA with increased mortality risk<sup>3</sup>
- Severe sleep apnea raises death risk by 46%<sup>24</sup>

## HEALTH CARE COSTS

(Economic consequences of untreated SDB)

- Undiagnosed patients used \$200,000 more in the two-year period prior to diagnosis than matched controls<sup>25</sup>
- Prior to sleep apnea diagnosis, patients utilized 23–50% more medical resources<sup>26</sup>
- Total economic cost of sleepiness = approximately \$43–56 billion<sup>27</sup>
- Undiagnosed moderate to severe sleep apnea in middle-aged adults may cause \$3.4 billion in additional medical costs in the US<sup>28</sup>

## TRAFFIC ACCIDENTS

- People with moderate to severe sleep apnea have up to 15 times higher risk of being involved in a traffic accident<sup>29</sup>
- Treating all US drivers suffering from sleep apnea would save \$11.1 billion in collision costs and save 980 lives annually<sup>30</sup>

## 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%<sup>31</sup>
- CPAP treatment reduces the need for acute hospital admission due to cardiovascular disease in patients with sleep apnea<sup>32</sup>
- One month of CPAP improves daytime blood pressure, heart rate and left ventricular function<sup>33</sup>
- CPAP reduces blood glucose levels<sup>34</sup>
- Two nights of CPAP improves insulin sensitivity, sustained at the three-month interval<sup>35</sup>
- For every dollar spent on CPAP, \$3.49 would be saved in reduced collision costs<sup>30</sup>
- CPAP improved the prognosis of heart failure patients with OSA<sup>36</sup>

<sup>1</sup> Young et al. *New Engl J Med* 1993 <sup>2</sup> Young et al. *J Am Med Assoc* 2004 <sup>3</sup> Marshall et al. *Sleep* 2008 <sup>4</sup> US Department of Health and Human Services, Centers for Disease Control and Prevention 2008 <sup>5</sup> Young et al. *Sleep* 2008 <sup>6</sup> Logan et al. *J Hypertens* 2001 <sup>7</sup> O’Keefe & Patterson. *Obes Surg* 2004 <sup>8</sup> Oldenburg et al. *Eur J Heart Fail* 2007 <sup>9</sup> Garrigue et al. *Circulation* 2007 <sup>10</sup> Gami et al. *Circulation* 2004 <sup>11</sup> Einhorn et al. *Endocr Pract* 2007 <sup>12</sup> Sjoström et al. *Thorax* 2002 <sup>13</sup> Schafer et al. *Cardiology* 1999 <sup>14</sup> American Heart Association <sup>15</sup> Medicare - \$20.4 billion p.a. <sup>16</sup> Kuniyoshi et al. *J Am Coll Cardiol* 2008 <sup>17</sup> Reichmuth et al. *Am J Respir Crit Care Med* 2005 <sup>18</sup> Punjabi et al. *Am J Respir Crit Care Med* 2002 <sup>19</sup> Meslier et al. *Eur Respir J* 2003 <sup>20</sup> Stamatakis et al. *Sleep* 2008 <sup>21</sup> Foster et al. *Diabetes Care* 2009 <sup>22</sup> Dyken et al. *Stroke* 1996 <sup>23</sup> Redline et al. *Am J Respir Crit Care Med* 2010 <sup>24</sup> Punjabi et al. *PLoS Medicine* 2009 <sup>25</sup> Kryger et al. *Sleep* 1996 <sup>26</sup> Smith et al. *Chest* 2002 <sup>27</sup> Leger et al. *Sleep* 1994 <sup>28</sup> Kapur et al. *Sleep* 1999 <sup>29</sup> Horstmann et al. *Sleep* 2000 <sup>30</sup> Sassani et al. *Sleep* 2004 <sup>31</sup> Becker et al. *Circulation* 2003 <sup>32</sup> Peker et al. *Am J Respir Crit Care Med* 1997 <sup>33</sup> Kaneko et al. *New Engl J Med* 2003 <sup>34</sup> Babu et al. *Arch Intern Med* 2005 <sup>35</sup> Harsch et al. *Am J Respir Crit Care Med* 2004 <sup>36</sup> Kasai et al. *Chest* 2008