Sleep Disorders in Women: Pregnancy and Beyond

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Objectives- Pregnancy

• Understand normal pulmonary anatomic and physiologic changes associated with pregnancy
• Understand normal sleep patterns and associated changes due to pregnancy
• Review obstructive sleep apnea and pregnancy complications related to it
• Discuss current and future research directions related to this complication in pregnancy
Objectives- Other

• Not to put you to sleep during this presentation!
Background - Pregnancy Anatomy

- Upper Airway
  - Oropharynx Diameter narrows
  - Nasal Mucosa
    - Hyperemia, edema
    - Congestion
  - Epistaxis
    - Increase estrogen/progesterone
Background- Anatomy

• Thorax/Diaphragm
  – Subcostal angle
    • $68^\circ$
  – Chest diameter
    • Increase 2cm
    • “Barrel chested”
Background- Pregnancy Anatomy

- **Thorax/Diaphragm**
  - Subcostal angle
    - 68° to 103°
  - Diaphragm
    - Raises 4cm
  - Chest diameter
    - Increase 2cm
    - “Barrel chested”
**Background - Physiology**

<table>
<thead>
<tr>
<th>IRV</th>
<th>VC</th>
<th>VT</th>
<th>ERV</th>
<th>RV</th>
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<tbody>
<tr>
<td>FRC</td>
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<td>Functional Residual Capacity (FRC)</td>
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Background - Pregnancy Physiology

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**Increase**

- **Tidal volume** 500 --> 700ml
- **Minute Ventilation** 7.5 --> 10.5 l/min
  (no change in respiratory rate)
Decrease

Functional Residual Capacity (18%)

Residual volume (20% 1200 --> 1000ml)
Background- Pregnancy Physiology

Decrease

Functional Residual Capacity (18%)
Residual volume (20% 1200 -->1000ml)
Summary

• Unchanged
  – Respiratory rate

• Increase
  – Tidal volume 500 -->700ml
  – Minute Ventilation 7.5-->10.5 l/min

• Decrease
  – Functional Residual Capacity (18%)
  – Residual volume (20%)
What about Sleep?

• Normal Sleep Stages
  – 2 Categories
    • REM
    • Non-REM
      – N1-N3
REM Sleep

• 20-25% total sleep time
• Recurs every 90-120 minutes
• Parasympathetic NS

• 3 Features
  – EEG active and awake
    • ‘paradoxical sleep’
  – Rapid Eye Movement
  – Inactivity of all other voluntary muscles*
Non-REM Sleep

• Divided into 3 Stages:
  • N1
    – 2-5% total sleep time
    – Transition wakefulness to sleep
    – ? True physiologic stage
  • N2
    – 40-50% total sleep time
    – Intermediate sleep
    – EEG- sleep spindles, K-complexes
  • N3
    – 20% total sleep time
    – ‘Slow wave’ sleep
Normal Sleep Architecture
Sleep Architecture- Pregnancy

• Hormones

• Progesterone
  – Decreased wakefulness
  – Shorten latency to non-REM sleep
  – Shorten duration of REM sleep

• Estrogen
  – Conflicting
    • Decreased REM sleep in animals
    • Increased REM sleep in perimenopausal women taking HRT
Sleep Architecture - Pregnancy

• 1\textsuperscript{st} Trimester
  – Increased sleepiness
  – Increased sleep duration (0.7hrs) (PIEN)
  – Decreased N3 (slow wave) sleep duration

• 2\textsuperscript{nd} Trimester
  – Decreased total sleep time
  – Increased N3 (slow wave) sleep duration

• 3\textsuperscript{rd} Trimester
  – Decreased N2 and REM sleep
‘Normal’ sleep in pregnancy

• Generalized discomfort (back pain, leg pain)
• Urinary frequency
• Spontaneous awakening
• Fetal movements
• Heartburn

• 1.9% fail to experience awakenings in 3\textsuperscript{rd} trimester (PIEN 26)
‘Abnormal’ Sleep

• Sleep-related breathing disorders (SBD)
  – Abnormal respiratory pattern OR
    • (apneas, hypopneas, or respiratory effort related arousals)
  – Abnormal reduction in gas exchange
    • (hypoventilation)

  – Repetitively alter sleep duration and architecture
  – Results in daytime symptoms, signs, or organ system dysfunction
Sleep-Related Disordered Breathing

• Syndromes
  – Obstructive sleep apnea
  – Central sleep apnea syndrome
  – Hypoventilation syndromes
Sleep-Related Disordered Breathing

• Syndromes
  – Obstructive sleep apnea
  – Central sleep apnea syndrome
  – Hypoventilation syndromes
OSA

• Cardinal features:
  – Polysomnographic obstructive apneas, hypopneas, or respiratory effort related arousals (RERA)
  – Daytime symptoms (sleepiness, fatigue, or poor concentration attributable to poor sleep)
  – Signs of disturbed sleeps (snoring, restlessness, or resuscitative snorts)
OSA

• Cardinal features:
  – Polysomnographic obstructive apneas, hypopneas, or respiratory effort related arousals (RERA)
  – Daytime symptoms (sleepiness, fatigue, or poor concentration attributable to poor sleep)
  – Signs of disturbed sleeps (SNORING, restlessness, or resuscitative snorts)
Snoring

• “Laugh and the world laughs with you, snore and you sleep alone.”
  – Anthony Burgess

• “Snoring keeps the monsters away.”
  – Judy Blume
Snoring

• "Snoring should be regarded as a fine art and respected accordingly. If this be admitted, I might suggest further that our civilization does not so regard it, as it should, and gives the practice no encouragement, but rather the contrary."

— Albert Jay Nock, Snoring as a Fine Art, and Twelve Other Essays
Snoring

- 10-50% of adults
- Males > Females
- Increased susceptibility with age
- Treatment
  - Lifestyle modification
  - CPAP
  - Dental appliances
  - Surgery
  - Pharmacologic
OSA and Pregnancy

• Definition
• Prevalence
• Risk factors
• Associated adverse outcomes
• Future directions
OSA and Pregnancy

• Diagnosis same in pregnant and non-pregnant women

• Limited by the scarcity of studies that address OSA in pregnant women
  – case studies, case series, small cohort studies, and small longitudinal studies.
  – No population based epidemiological studies have been performed
OSA and Pregnancy

• The set up:
• Anatomic changes
  – Upper airway hyperemia and edema
• Physiologic changes
  – Increased minute ventilation affecting ventilatory drive
• Hormonal
  – Estrogen/Progesterone effects
OSA and Pregnancy- Prevalence

• Exact prevalence in pregnancy unknown
• Non-pregnant reproductive age women
  – 0.7-6.5%
• Wisconsin Sleep Cohort Study, women 30-39yo
  – mild OSA (AHI ≥5 events/hr sleep) 6.5%
  – moderate to severe OSA (AHI >15 events/hr sleep) 4.4%
OSA and Pregnancy- Risk factors

• Obesity
• Obesity
• Obesity
• Craniofacial and upper airway soft tissue abnormalities
• Smoking
OSA and Pregnancy- Risk factors

• Pregnancy associated changes that increase risk of OSA:

• Gestational weight gain
  – Only normal adult physiologic process which body weight increases by 20% or more over relatively short period of time!
    • In a non-pregnant cohort 20% weight gain predicted a 70% increase in AHI

• Upper airway edema

• Decreased functional reserve capacity

• Increased sleep arousals
OSA and Pregnancy- Risk factors

• Pregnancy associated changes that DECREASE risk of OSA:
  – Increased minute ventilation
  – Lateral sleep posture preference
  – Decreased REM sleep time
OSA and Pregnancy- Adverse outcomes

• Symptoms of OSA vs. polysomnographically proven OSA in pregnancy*
  – Pregnancy induced hypertension (PIH)
  – Pre-eclampsia (PEC)
  – Gestational Diabetes Mellitus (GDM)
  – Fetal growth restriction (FGR)
  – Preterm birth (PTB)
  – Depression
OSA and Pregnancy- Adverse outcomes

• Symptoms of OSA vs. polysomnographically proven OSA in pregnancy*
  – Pregnancy induced hypertension (PIH)
  – Pre-eclampsia (PEC)
  – Gestational Diabetes Mellitus (GDM)
  – Fetal growth restriction (FGR)
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  – Depression
OSA and Pregnancy- Outcomes

• Swedish retrospective cohort (n=500)
  – Hypertension (aOR, 2.03; p<0.05)
  – Fetal growth restriction (aOR, 3.45; p<0.01)
• Argentina retrospective cohort (n=456)
  – PIH and/or PEC (aOR 1.82; p<0.01)
• US retrospective cohort (n=1000)
  – PIH and PEC (aOR 2.3, 95% CI 1.4-4.0),
  – GDM (aOR 2.1, 95% CI 1.3-3.4) and
  – Unplanned Cesarean (aOR 2.1, 95% CI 1.4-3.2)
OSA and Pregnancy- Outcomes

• Louis et al. Obstet Gynecol 2012
  – 57 PSG confirmed OSA pregnant women
  – 2:1 matched
  – OSA women
    • Preeclampsia (19.3% vs 7.0%; P = .02)
    • PTB (29.8% vs 12.3%; P = .007).
    • Cesarean delivery (aOR 8.1; 95% CI, 2.9-22.1)
OSA and Pregnancy- Outcomes

• Chen et al. AJOG 2012
• Korean database
• 791 OSA vs. 2950 without OSA
• adjusted odds ratios for:
  – LBW 1.76 (95% CI, 1.28-2.40),
  – Preterm birth 2.31 (95% CI, 1.77-3.01)
  – SGA 1.34 (95% CI, 1.09-1.66)
  – Cesarean 1.74 (95% CI, 1.48-2.04)
  – PEC 1.60 (95% CI, 2.16-11.26)
OSA and Pregnancy- Outcomes

- Facco et al, AJOG 2010
- Prospective cohort
- Sleep study survey (n=189)
- 48% Short sleep duration (SSD)
- 18.5% reported frequent snoring (FS)
- Both associated with higher incidence of GDM
  - SSD (10.2% vs 1.1%; P = .008)
  - FS (14.3% vs 3.3%; P = .009)
Summary

• Pamidi et al. AJOG 2013
• Systematic review, meta-analysis of 31 studies
• SDB was significantly associated with:
  – Gestational hypertension/Preeclampsia (aOR, 2.34; 95% confidence interval [CI], 1.60–3.09; 5 studies)
  – Gestational diabetes (aOR, 1.86; 95% CI, 1.30–2.42; 5 studies)
Conclusion

• “Large-scale, prospective cohort, and interventional studies are needed to further elucidate the relationship between maternal SDB and adverse pregnancy outcomes.”
Future Directions

• IDEAS??
Future Directions

• Should high risk pregnancies be screened for OSA?
• Does treatment for OSA improve perinatal outcomes?
• Is OSA a confounder, and are adverse outcomes due to another cause (e.g., obesity)?
• OSA and postpartum depression?
Summary

• Sleep disorders in reproductive age women exist.
• It is biologically plausible that pregnancy related changes in pulmonary anatomy and physiology can induce or exacerbate existing underlying sleep disorders.
• Symptoms of sleep disordered breathing is associated with approximately a 2-fold increased risk of PIH/PEC and impaired glucose tolerance.
• Prospective analysis of this condition and it’s relationship to pregnancy is warranted.
Questions?
Sleep Disorders in Women: Pregnancy and Beyond

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Maternal-Fetal Medicine Fellow, Women & Infants Hospital and Warren Alpert Medical School of Brown University
Providence, RI
Objectives- Pregnancy

• Review pulmonary anatomy, physiology changes and normal sleep patterns
• Review obstructive sleep apnea
• Discuss screening tools to assist in diagnosis of OSA
• Review sleep disorders in the context of menopause including treatment options
• Discuss current and future research directions related to OSA in women
Background- Physiology

![Diagram showing lung volumes and capacities](image)

- Inspiratory Reserve Volume (IRV)
- Vital Capacity (VC)
- Expiratory Reserve Volume (ERV)
- Residual Volume (RV)

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- Tidal Volume (TV)
- Functional Residual Capacity (FRC)
- Inspiratory Reserve Volume (IRV)

FRC: Functional Residual Capacity
IRV: Inspiratory Reserve Volume
RV: Residual Volume
VC: Vital Capacity
TV: Tidal Volume
VC: Vital Capacity
ERV: Expiratory Reserve Volume
What about Sleep?

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  – 2 Categories
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    - ‘Slow wave’ sleep
Normal Sleep Architecture
OSA Diagnosis

• Gold standard
  – Full-night, attended, in-laboratory polysomnogram
  – Unattended, in-home portable monitoring if high likelihood of moderate or severe OSA (Excludes pregnant women)
OSA Terminology

• Apnea
  – Pause in breathing for > 10 seconds

• Hypopnea
  – Abnormal shallow breathing event for >10 seconds

• Respiratory effort related arousals (RERA)
  – Sequence of breaths lasting > 10 seconds
  – Characterized by increasing respiratory effort followed by an arousal from sleep
  – Does not meet the criteria for an apnea or hypopnea
  – Often accompanied by a terminal snort

• Apnea Hypopnea Index (AHI)
OSA Diagnosis

• Asymptomatic Patient
  >15 apneas, hypopneas, or RERAs per hour of sleep

• Symptomatic Patient (sleepiness, fatigue, inattention or signs of disturbed sleep)
  >5 apneas, hypopneas, or RERAs per hour of sleep
  • >75 percent of the apneas or hypopneas must have an obstructive pattern
OSA Severity

- Mild
- Moderate
- Severe
OSA Severity

• **Mild** —
  – AHI events between 5 and 15 per hour sleep
  – Asymptomatic
  – Daytime sleepiness only noticeable unstimulated
  – Does not impair daily life
  – May be recognized by family members
  – Sleep stages and slow wave sleep preserved
  – Systemic hypertension, cor pulmonale, and polycythemia absent
  – 30% tolerate and respond to treatment
  – Positive airway pressure therapy reduces daytime sleepiness and blood pressure
• **Moderate** —
  - AHI events 15 and 30 events per hour of sleep
  - Symptoms of daytime sleepiness. Take steps to avoid falling asleep at inappropriate times (e.g., taking a nap or avoiding driving long distances).
  - Continue their daily activities, but at reduced levels
  - Systemic hypertension may co-exist
  - Sleep is fragmented, but the progression of sleep stages is conserved
  - Responds to CPAP (improvement in daytime sleepiness, quality of life, and blood pressure)
• **Severe** —
  – AHI events >30 per hour of sleep and/or
  – O2 saturation below 90% for >20% of total sleep time
  – Daytime sleepiness interferes with normal daily activities
  – Fall asleep often during the day (and in a sitting posture)
  – Cardiopulmonary failure, nocturnal angina, polycythemia, or cor pulmonale may result from hypoxemia.
  – Benefit from prompt therapeutic intervention
  – Treatment may improve daytime sleepiness, hypertension, other hypoxemia-related abnormalities
OSA screening

• STOP/ STOP-BANG
• Epworth sleepiness scale (ESS)
• Berlin questionnaire
OSA Screening- STOP-Bang

• Chung et al. Anesthesiology 2008
• Questionnaire given to 2467 preoperative patients
• 27% identified as high risk for OSA
• 211 underwent polysomnography
Quickly..

- Sensitivity
- Specificity
- Positive predictive value
- Negative predictive value
• Sensitivity: Percentage correctly identified as having the condition
  – High sensitivity = Few False negatives

• Specificity: Percentage correctly identified as not having the condition
  – High specificity = Few False positives
Table 6. Predictive Parameters for STOP Questionnaire (n = 177)

<table>
<thead>
<tr>
<th>AHI &gt;5</th>
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<tbody>
<tr>
<td></td>
<td>Sensitivity, %</td>
<td>65.6 (56.4–73.9)</td>
</tr>
<tr>
<td></td>
<td>Specificity, %</td>
<td>60.0 (45.9–73.0)</td>
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<tr>
<td></td>
<td>PPV, %</td>
<td>78.4 (69.2–86.0)</td>
</tr>
<tr>
<td></td>
<td>NPV, %</td>
<td>44.0 (32.6–56.0)</td>
</tr>
<tr>
<td></td>
<td>Likelihood ratio</td>
<td>1.639 (1.172–2.385)</td>
</tr>
<tr>
<td></td>
<td>Odds ratio</td>
<td>2.857 (1.482–5.507)</td>
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<tr>
<td></td>
<td>Area under ROC curve</td>
<td>0.703</td>
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</tbody>
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<th>AHI &gt;15</th>
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<tr>
<td></td>
<td>Sensitivity, %</td>
<td>74.3 (62.4–84.0)</td>
</tr>
<tr>
<td></td>
<td>Specificity, %</td>
<td>53.3 (43.4–63.0)</td>
</tr>
<tr>
<td></td>
<td>PPV, %</td>
<td>51.0 (41.3–60.7)</td>
</tr>
<tr>
<td></td>
<td>NPV, %</td>
<td>76.0 (64.8–85.1)</td>
</tr>
<tr>
<td></td>
<td>Likelihood ratio</td>
<td>1.590 (1.280–2.057)</td>
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<tr>
<td></td>
<td>Odds ratio</td>
<td>3.293 (1.707–6.352)</td>
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<tr>
<td></td>
<td>Area under ROC curve</td>
<td>0.722</td>
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<tr>
<td></td>
<td>Sensitivity, %</td>
<td>79.5 (63.5–90.7)</td>
</tr>
<tr>
<td></td>
<td>Specificity, %</td>
<td>48.6 (40.0–63.0)</td>
</tr>
<tr>
<td></td>
<td>PPV, %</td>
<td>30.4 (21.7–40.3)</td>
</tr>
<tr>
<td></td>
<td>NPV, %</td>
<td>89.3 (80.1–95.3)</td>
</tr>
<tr>
<td></td>
<td>Likelihood ratio</td>
<td>1.545 (1.261–2.010)</td>
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<tr>
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<td>Odds ratio</td>
<td>3.656 (1.636–9.054)</td>
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<tr>
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<td>Area under ROC curve</td>
<td>0.769</td>
</tr>
</tbody>
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Data are presented as average (95% confidence interval).
AHI = apnea–hypopnea index; NPV = negative predictive value; PPV = positive predictive value; ROC = receiver operating characteristic.
Chung et al
OSA screening- Berlin Questionnaire

• Netzer et al, Ann Int Med, 1999
• Survey of 744 adults in primary care setting
• 100 underwent portable sleep monitoring
• Stratified by high- and low- risk
  – Category 1: persistent snoring symptoms >3x per week
  – Category 2: persistent waketime sleepiness >3x per week
  – Category 3: high blood pressure, BMI >30
face by volunteers. They estimated from symptom distributions that 20% of a primary care patient population might have sleep-disordered breathing. We used a patient-centered approach and risk grouping and found a somewhat greater prevalence. Possible explanations are that our patients responded to self-reporting in a more positive manner or that symptom severity was inflated in these urban practices. The prevalence of patients at high risk in our study is higher than estimates from community-based surveys and is similar to the estimates found in industry studies (23). The prevalence of patients at high risk in our study is higher than estimates from industry studies (23). Risk factors for sleep apnea include age, obesity, and smoking. Sleep apnea is associated with increased cardiovascular risk and hospitalization (23, 24). Risk factors for sleep apnea include age, obesity, and smoking. Sleep apnea is associated with increased cardiovascular risk and hospitalization (23, 24).
OSA-Screening ESS

- Johns, Sleep 1991
- Questionnaire given to 180 adults
- 30 healthy controls, 150 with sleep disorders
- 138 overnight polysomnography
OSA-Screening ESS

*JOHNS*

*al subjects, their ages and ESS scores*

<table>
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<th>Age in years (mean ± SD)</th>
<th>ESS scores (mean ± SD)</th>
<th>Range</th>
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<tr>
<td>36.4 ± 9.9</td>
<td>5.9 ± 2.2</td>
<td>2–10</td>
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OSA-Screening ESS

...somnial diagnoses were made on the basis of each patient’s history, using the criteria set out in the International Classification of Sleep Disorders (1). Other insomniacs, with mood disorders or drug effects, were excluded.

Twenty-seven patients had MSLTs after overnight polysomnography. They had four naps, at 1000, 1200, 1400 and 1600 hours. Sleep latency was measured from the time lights were switched off until the onset of stage 1 sleep of at least 1 minute duration, or the onset of either stage 2 or rapid eye movement (REM) sleep.

...per hour of sleep, was 43.6 ± 30.4 (SD). Patients who had both PLMD and OSAS were excluded from this study. However, 9 of the 18 subjects with PLMD snored during polysomnography without having OSAS.

Statistical methods

The ESS scores of male and female control subjects were compared by a Student’s t test. Differences in ESS scores between the diagnostic groups were tested by...
OSA Screening- Summary

• Screening tests such as STOP-Bang, Berlin Questionnaire, and Epworth Sleepiness scale is effective in identifying those who are high risk for moderate to severe OSA
OSA- Treatment

• Behavior modification
• Positional therapy
• Oral Appliances
• Surgery
• Breathing masks
OSA- Behavior Modification

• Weight Loss
• 70% of patients with OSA are overweight or obese
• Weight gain is associated with worsening OSA
• Weight loss improves overall health, improves quality of life
• What is the best method?
Treatment- Weight Loss

• Intensive weight loss therapy vs Conventional Therapy
• Surgical vs. Conventional Therapy?
• Tuomilehto et al, Am J Respir Crit Care Med 2009
• Prospective RCT!!
• 72 overweight patients with mild OSA
• Intervention: very low cal diet and supervised lifestyle modification
• Control: routine lifestyle modification
<table>
<thead>
<tr>
<th>Patients with follow-up data, n</th>
<th>37</th>
<th>35</th>
<th>0.011</th>
<th>0.017</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI (total)</td>
<td>0.3 (8.0)</td>
<td>-4.0 (5.6)</td>
<td>0.033</td>
<td>0.019</td>
</tr>
<tr>
<td>Number of cured patients, n (%)</td>
<td>13 (35)</td>
<td>22 (63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apnea indices separately per hour</td>
<td>1.3 (5.1)</td>
<td>-0.9 (2.4)</td>
<td>0.029</td>
<td>0.005</td>
</tr>
<tr>
<td>Hypopnea indices separately per hour</td>
<td>-0.9 (4.3)</td>
<td>-3.5 (4.1)</td>
<td>0.013</td>
<td>0.053</td>
</tr>
<tr>
<td>AHI (supine)</td>
<td>-5.9 (23.9)</td>
<td>-6.5 (13.0)</td>
<td>0.90</td>
<td>0.29</td>
</tr>
<tr>
<td>AHI (positions other than supine)</td>
<td>1.4 (9.3)</td>
<td>-1.8 (8.5)</td>
<td>0.24</td>
<td>0.015</td>
</tr>
<tr>
<td>Percentage of supine recording</td>
<td>-1.4 (28.9)</td>
<td>-0.4 (21.2)</td>
<td>0.89</td>
<td>0.85</td>
</tr>
<tr>
<td>Mean $\text{Sa}_\text{O}_2$</td>
<td>-0.3 (1.3)</td>
<td>0.8 (1.2)</td>
<td>&lt;0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>Time with mean $\text{Sa}_\text{O}_2$ below 90%, s</td>
<td>2.5 (21.0)</td>
<td>-4.8 (12.8)</td>
<td>0.126</td>
<td>0.068</td>
</tr>
<tr>
<td>Percentage of time with $\text{Sa}_\text{O}_2$ below 90%</td>
<td>1.8 (6.3)</td>
<td>-1.7 (4.1)</td>
<td>0.016</td>
<td>0.042</td>
</tr>
<tr>
<td>Heart rate, beats/min</td>
<td>1.1 (5.0)</td>
<td>-2.8 (5.8)</td>
<td>0.081</td>
<td>0.075</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>-2.4 (5.6)</td>
<td>-10.7 (6.5)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>-0.8 (2.0)</td>
<td>-3.5 (2.1)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Waist circumference, cm</td>
<td>-3.0 (6.0)</td>
<td>-11.6 (6.6)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Plasma glucose, fasting, mmol/L</td>
<td>-0.4 (1.4)</td>
<td>-0.6 (2.3)</td>
<td>0.52</td>
<td>0.30</td>
</tr>
<tr>
<td>Plasma insulin, mU/L</td>
<td>-1.2 (3.4)</td>
<td>-5.9 (7.0)</td>
<td>&lt;0.001</td>
<td>0.004</td>
</tr>
<tr>
<td>Serum HDL cholesterol, mmol/L</td>
<td>0.05 (0.22)</td>
<td>0.14 (0.22)</td>
<td>0.085</td>
<td>0.103</td>
</tr>
<tr>
<td>Serum triglycerides, mmol/L</td>
<td>-0.06 (0.65)</td>
<td>-0.48 (1.13)</td>
<td>0.054</td>
<td>0.027</td>
</tr>
<tr>
<td>Systolic blood pressure, mm Hg</td>
<td>-1.1 (19.6)</td>
<td>-1.7 (14.7)</td>
<td>0.88</td>
<td>0.47</td>
</tr>
<tr>
<td>Diastolic blood pressure, mm Hg</td>
<td>-0.4 (12.6)</td>
<td>-1.9 (10.6)</td>
<td>0.62</td>
<td>0.87</td>
</tr>
<tr>
<td>SOS</td>
<td>11.8 (12.6)</td>
<td>19.0 (14.2)</td>
<td>0.025</td>
<td>0.001</td>
</tr>
<tr>
<td>ESS</td>
<td>-2.1 (2.9)</td>
<td>-3.1 (4.0)</td>
<td>0.25</td>
<td>0.31</td>
</tr>
<tr>
<td>Witnessed apneas, n (%)</td>
<td>33 (97)</td>
<td>23 (74)</td>
<td>0.011</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Data represent mean changes with standard deviation (SD).
Changes in apnea–hypopnea index (AHI) in relation to changes in body weight (left), and the proportion of patients (ex $\exists e$) with OSA (AHI $> 5$) (right) in relation to the following weight change categories: less than $-15$ kg, $-15$ to $-5$ kg, $-5$ to 0 kg.
Surgical vs. Conventional Therapy

- Dixon et al. JAMA 2012
- Prospective RCT!
- 60 obese patients, recently diagnosed OSA and AHI >20
- Conventional weight loss program (dietitian and physician) or Laparoscopic gastric banding
- 2 year follow-up
- Primary outcome change in AHI
<table>
<thead>
<tr>
<th></th>
<th>(n = 30)</th>
<th>(n = 30)</th>
<th>Difference</th>
<th>at 2 y</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight, kg</td>
<td>107 (99 to 116)</td>
<td>121 (113 to 129)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in weight, kg</td>
<td>–27.8 (–34.7 to –20.9)(a)</td>
<td>–5.1 (–9.3 to –0.8)(a)</td>
<td>–22.7 (–31.1 to –14.3)</td>
<td>2 (3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Apnea-hypopnea index, events/h</td>
<td>39.5 (28.4 to 50.5)(a)</td>
<td>43.2 (34.9 to 51.9)(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in apnea-hypopnea index, events/h</td>
<td>–25.5 (–36.7 to –14.2)</td>
<td>–14.0 (–24.6 to –3.3)</td>
<td>–11.5 (–28.3 to 5.3)</td>
<td>6 (10)</td>
<td>.18</td>
</tr>
<tr>
<td>Total sleep time, min</td>
<td>373 (348 to 399)</td>
<td>333 (297 to 370)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in total sleep time, min</td>
<td>22.0 (–5.5 to 46.5)</td>
<td>10.5 (–25.5 to 46.4)</td>
<td>11.5 (–39.0 to 62.1)</td>
<td>6 (10)</td>
<td>.65</td>
</tr>
<tr>
<td>Sleep latency, min</td>
<td>18.6 (11.3 to 26)</td>
<td>24.5 (15.0 to 34.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in sleep latency, min</td>
<td>–6.3 (–13.7 to 1.0)</td>
<td>4.2 (–4.4 to 12.8)</td>
<td>–10.6 (–24.4 to 2.3)</td>
<td>6 (10)</td>
<td>.11</td>
</tr>
<tr>
<td>Sleep efficiency, %</td>
<td>79.8 (75.8 to 83.8)</td>
<td>72.4 (65.3 to 79.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in sleep efficiency, %</td>
<td>1.6 (–3.4 to 6.6)</td>
<td>–3.04 (–9.70 to 3.70)</td>
<td>4.7 (–4.6 to 13.9)</td>
<td>6 (10)</td>
<td>.32</td>
</tr>
<tr>
<td>Supine sleep, %</td>
<td>47.1 (35.5 to 58.6)</td>
<td>37.0 (25.1 to 48.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in supine sleep, %</td>
<td>2.9 (–7.6 to 13.4)</td>
<td>–1.7 (11.5 to 8.0)</td>
<td>4.6 (–11.3 to 20.5)</td>
<td>6 (10)</td>
<td>.57</td>
</tr>
<tr>
<td>Slow wave sleep, %</td>
<td>15.3 (10.5 to 20.1)</td>
<td>21.1 (13.1 to 29.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in slow wave sleep, %</td>
<td>0.7 (–2.7 to 4.1)</td>
<td>2.6 (–3.5 to 8.7)</td>
<td>–1.9 (–10.0 to 6.3)</td>
<td>7 (12)</td>
<td>.65</td>
</tr>
<tr>
<td>Rapid eye movement sleep, %</td>
<td>15.5 (12.8 to 18.2)</td>
<td>11.3 (8.4 to 14.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in rapid eye movement sleep, %</td>
<td>2.6 (–1.1 to 6.3)</td>
<td>–1.6 (–4.7 to 1.5)</td>
<td>4.2 (–1.1 to 9.5)</td>
<td>7 (12)</td>
<td>.12</td>
</tr>
<tr>
<td>Apnea-hypopnea index rapid eye movement sleep, events/h</td>
<td>34.0 (21.8 to 46.2)</td>
<td>54.5 (43.6 to 65.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in apnea-hypopnea index rapid eye movement sleep, events/h</td>
<td>–32.2 (–49.7 to –14.7)(a)</td>
<td>–13.5 (–26.7 to –0.3)(a)</td>
<td>–18.7 (–44.8 to 7.5)</td>
<td>10 (18)</td>
<td>.16</td>
</tr>
<tr>
<td>Arousal index, events/h</td>
<td>29.9 (23.2 to 36.7)</td>
<td>33.6 (27.8 to 39.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in arousal index, events/h</td>
<td>–14.9 (–28.0 to –1.8)</td>
<td>–24.9 (–62.5 to 12.7)</td>
<td>10.0 (–32.0 to 52.5)</td>
<td>15 (27)</td>
<td>.64</td>
</tr>
<tr>
<td>Available hemoglobin saturated with oxygen During sleep, %</td>
<td>95.5 (94.9 to 96.1)</td>
<td>95.2 (94.9 to 95.9)(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change during sleep, %</td>
<td>1.2 (0.3 to 2.0)(a)</td>
<td>0.2 (–1.1 to 1.4)</td>
<td>1.0 (–0.6 to 2.6)</td>
<td>9 (17)</td>
<td>.22</td>
</tr>
</tbody>
</table>

\(a\) Out of range.
Conclusion

• Among a group of obese patients with OSA, the use of bariatric surgery compared with conventional weight loss therapy did not result in a statistically greater reduction in AHI despite major differences in weight loss.
OSA Treatment

• Exercise
  – May reduce AHI events by 20%, even in absence of weight loss

• Sleep Position
  – Mild improvement of AHI events, no improvement in daytime symptoms

• Alcohol
  – Avoidance may improve symptoms

• Medication
  – Many may suppress CNS function, induce weight gain
OSA Treatment

• Oral appliances
  – Either protrude mandible forward OR
  – Hold tongue anteriorly
  – Effective treatment for moderate to severe OSA
  – Comparable to CPAP in some studies
OSA Treatment

• Surgery
  – Most effective if OSA due to obstructive process
    • UPPP
    • RFA
    • MMA
  – Few studies demonstrating effectiveness over CPAP
OSA Treatment

• CPAP
• First line therapy
• High quality evidence that CPAP decreases respiratory events, improves daytime sleepiness and improves quality of life
• No studies have demonstrated improved mortality
• So...what is the catch??
• CPAP adherence
• Favorable outcomes directly related to adherence
• 30-80% NON-adherence
• Part-time use does not improve outcomes
  – Both <4hrs or skipping nights
• Close follow up and adjustments may improve adherence
Summary

• OSA affects approximately 2-5% of women
• The incidence increases with age and menopause may contribute to worsening symptoms in women
• First line therapy for OSA is CPAP
• Poor adherence limits improvement in symptoms and sleep parameters
Questions?
Survey Results!