Sex Differences in the Evaluation and Diagnosis of Obstructive Sleep Apnea in Adults: A Systematic Review

LOMA LINDA UNIVERSITY HEALTH

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Introduction

Obstructive sleep apnea (OSA) is characterized by repeated episodes of partial or complete upper airway obstruction during sleep, leading to intermittent hypoxemia and increased sympathetic activation. Clinical guidelines for the diagnosis of OSA have been primarily based on studies conducted in male patients. The prevalence of OSA is estimated to be approximately 14% in males and 5% in females, with a male-to-female ratio of approximately 3:1.[1] However, recent research suggests that this disparity may be influenced by underdiagnosis in females, who often present with atypical or less recognized symptoms compared to males.

The gold standard for diagnosing OSA is polysomnography (PSG), and determining which patients should undergo PSG relies on clinical evaluation. Risk factors for OSA include elevated body mass index, neck and waist circumference, and Epworth Sleepiness Scale (ESS) scores. Emerging research suggests that these risk factors may manifest differently between sexes, contributing to diagnostic disparities.[2,3]

Sex-based differences in OSA pathophysiology have been attributed to variations in body fat distribution, airway mechanics, hormonal influences, and lifestyle-related risks.[4] PSG findings further reveal women with OSA typically have lower AHI values, shorter apneic episodes, fewer oxygen desaturations, and a lower prevalence of supine dependent OSA. Despite these 'milder' PSG findings, women often report symptom burdens, including fatigue, insomnia, and mood disturbances.[3] These findings highlight a disconnect between measured severity and reported symptoms in women with OSA, reinforcing the need for sex-specific diagnostic criteria and screening tools.

This systematic review aims to explore and synthesize the anatomical, physiological, and clinical differences between males and females with OSA to inform more equitable sex-specific approaches to OSA screening, diagnosis, and management.

Methods and Materials

A systematic review was conducted according to PRISMA guidelines. PubMed, Embase, and Web of Science were searched from inception to January 2024 using terms related to "sleep apnea," "diagnosis," and "sex differences." Duplicates were removed in EndNote, and studies were screened in Rayyan. Eligible studies compared diagnostic variables between male and female OSA patients, including anthropometrics, questionnaire scores, and PSG results. Study quality was assessed using the QUADAS tool.

Data were independently extracted by two reviewers for study characteristics and sex-specific measures (age, BMI, neck/waist circumference, ESS, AHI, SpO_2 nadir). Random-effects models compared sex differences, with heterogeneity and outlier influence assessed, and publication bias evaluated. Analyses were performed in R (v4.3.0) using metafor and meta, with p<.05 considered significant.

Results

Twenty-five studies were included, 16,576 males and 8,741 females

- Females exhibited significantly higher age (mean difference –2.37 years, 95% CI –3.61 to –1.14; p<.001) and BMI (–1.28 kg/m², 95% CI –2.18 to –0.38; p<.01) compared to males.
- Males had higher neck circumference (5.19 cm, 95% CI 4.86–5.52; p<.0001) and AHI (8.88 events/hour, 95% CI 6.31–11.45; p<.0001). **(Figure 1)**.
- No significant sex differences were found for waist circumference (p=.22), ESS scores (p=.06), or SpO_2 nadir (p=.31) **(Table 1)**.
- Heterogeneity was high across most analyses.
- Leave-one-out analysis and Baujat plots indicated no influential studies altered results, and funnel plots and Egger's tests suggested no publication bias.

Results

Variable	Mean Difference (M – F)	95% CI	p-value	Heterogeneity (I²)
Age (years)	-2.37	[-3.61, -1.14]	< 0.001	98%
BMI (kg/m²)	-1.28	[-2.18, -0.38]	< 0.01	96%
Neck Circumference (cm)	5.19	[4.86, 5.52]	< 0.0001	0%
Waist Circumference (cm)	4.57	[-2.68, 11.81]	0.22	98%
AHI	8.88	[6.31, 11.45]	< 0.0001	97%
SpO_2 Nadir (%)	-1.13	[-3.29, 1.04]	0.31	99%
Epworth Sleepiness Scale	-1.02	[-2.08, 0.04]	0.06	96%

Table 1. Summary of mean differences between males and females

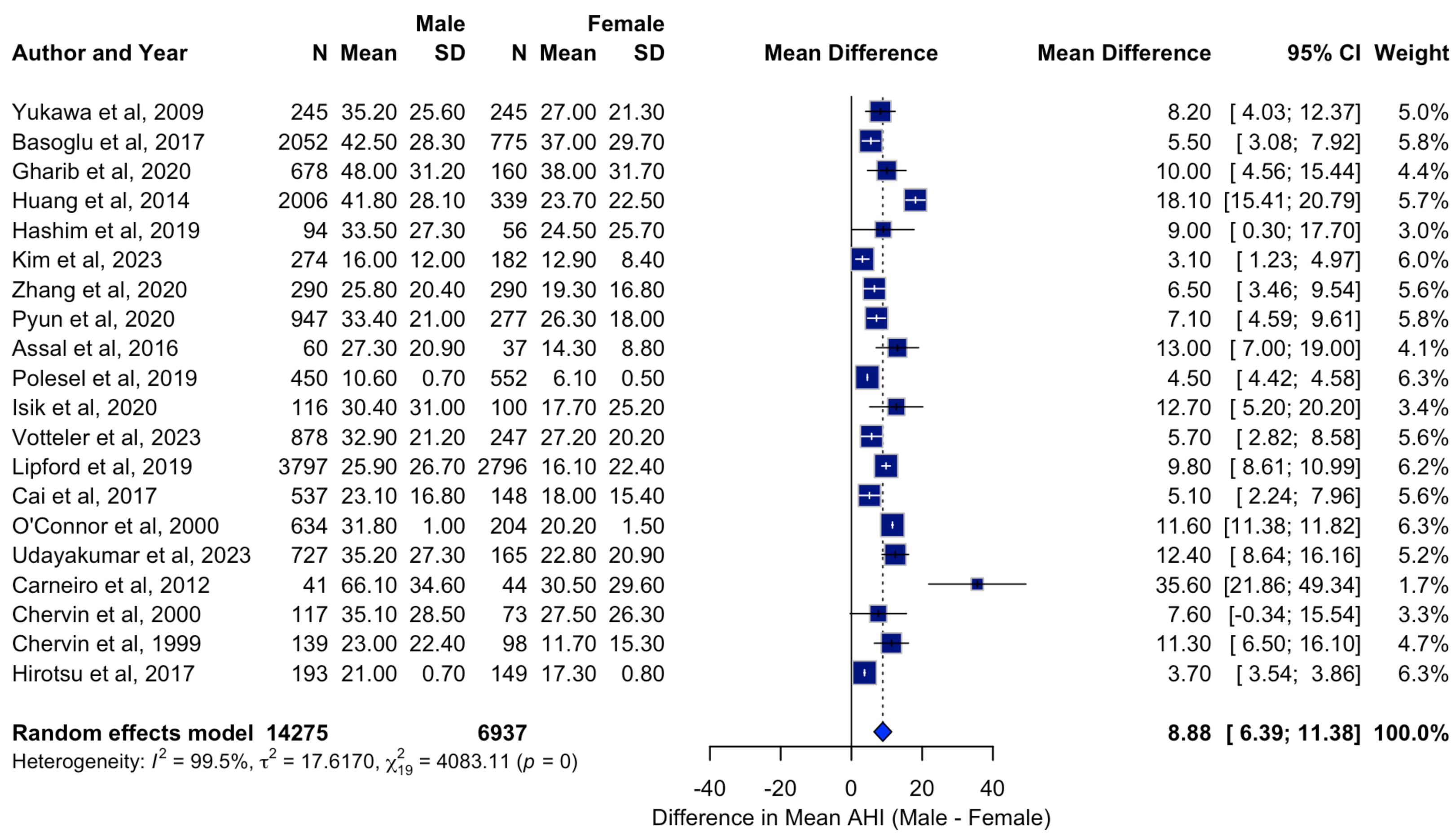

Figure 1. Forrest plots comparing AHI between males and females with OSA.

Discussion

This study highlights important sex-based differences in OSA, with implications for screening, diagnosis, and management. Females with OSA were significantly older and had higher BMI, while males had greater neck circumference and higher AHI. Waist circumference and ESS scores did not differ significantly, suggesting standard anthropometric and symptom-based measures may not fully capture risk in women.

Male-predominant features, such longer pharyngeal airway, larger soft palate, and a more caudally positioned hyoid bone, also contribute to increased airway collapsibility.[5,6] This difference in structural traits may explain why men often exhibit more classic OSA phenotypes, especially with supine positioning and in non-REM sleep.

Despite lower AHI, females may experience substantial nocturnal hypoxemia and greater symptom burden, presenting with fatigue, insomnia, or mood disturbances rather than classic sleepiness. These atypical presentations can contribute to underdiagnosis and delayed recognition, potentially increasing risk for cardiovascular and metabolic comorbidities.

Limitations include high heterogeneity across studies, selective reporting of variables, and inclusion of only confirmed OSA cases, which may underrepresent undiagnosed disease in women. Future research should refine diagnostic criteria to account for sex-specific physiology, airway anatomy, and symptom profiles, and explore complementary PSG metrics such as REM-AHI and RERA indices.

Conclusion

This systematic review highlights key sex-based differences in OSA, particularly age, airway anatomy, and fat distribution. Females may have higher BMI but lower AHI and atypical symptoms, while males often have larger neck circumference and higher AHI. These differences underscore the need for tailored, sex-specific screening and diagnostic tools to improve accuracy and support personalized management.

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