

# Correlation between obstructive sleep apnea syndrome and cardiovascular risk factors: a primary care strategy for early identification

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## Abstract

Obstructive sleep apnea syndrome (OSAS) is the most common form of sleep-disordered breathing and is increasingly recognized as an independent and modifiable cardiovascular risk (CVR) factor. Evidence indicates a strong association between OSAS and hypertension, central obesity, metabolic syndrome (MS), and cerebrovascular disease. However, polysomnography, the diagnostic gold standard, is limited by cost, technical complexity, and long waiting lists, resulting in substantial underdiagnosis. The aim of this cross-sectional observational study was to evaluate the relationship between OSAS risk and components of MS in a primary care population and to assess the usefulness of simple, low-cost screening questionnaires for early identification of high-risk individuals. We enrolled 174 consecutive patients presenting at least one MS criterion according to ATP III guidelines (80 males, 94 females; mean age 58.8±7.7 years). OSAS risk was assessed using the Epworth Sleepiness Scale and the Sleep Apnea Scale. High OSAS risk was identified in 37% of participants. Significant associations were observed between elevated OSAS risk and arterial hypertension [odds ratio (OR) 2.84; 95% confidence interval (CI) 1.55-5.20;  $p<0.001$ ] as well as increased waist circumference (OR 3.12; 95% CI 1.71-5.67;  $p<0.001$ ). These associations remained significant after adjustment for age and sex (hypertension: adjusted OR 2.41; 95% CI 1.28-4.54;  $p=0.006$ ; waist circumference: adjusted OR 2.76; 95% CI 1.48-5.15;  $p=0.001$ ). Conversely, no statistically significant associations were found with impaired fasting glucose (OR 1.29; 95% CI 0.71-2.35;  $p=0.39$ ) or dyslipidemia (OR 1.18; 95% CI 0.65-2.13;  $p=0.59$ ). Correlation analysis showed moderate positive relationships between OSAS risk scores and waist circumference ( $r=0.42$ ;  $p<0.001$ ) and systolic blood pressure ( $r=0.36$ ;  $p<0.001$ ), while correlations with glycemic and lipid parameters were weak and not significant. These findings confirm that OSAS risk in primary care patients with cardiometabolic abnormalities is strongly linked to central obesity and hypertension. Routine use of validated questionnaires represents a practical and cost-effective strategy for early identification of OSAS, enabling a more comprehensive CVR stratification and facilitating timely referral for diagnostic confirmation and treatment.

**Key words:** obstructive sleep apnea, cardiovascular risk, metabolic syndrome, hypertension.

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## Introduction

Obstructive sleep apnea syndrome (OSAS) is characterized by the recurrent collapse of the upper airways during sleep, resulting in intermittent hypoxia, sleep fragmentation, and systemic sympathetic activation. Growing clinical evidence identifies OSAS as a significant and independent risk factor for cardiovascular disease (CVD), including systemic hypertension, coronary artery disease, stroke, and heart failure.<sup>1</sup> OSAS shares several complex pathophysiological pathways with metabolic syndrome (MS), such as oxidative stress, systemic inflammation, insulin resistance, and endothelial dysfunction, with central obesity acting as a primary driver for both conditions.<sup>2</sup>

Despite its high clinical relevance and impact on long-term morbidity, OSAS remains profoundly underdiagnosed in the general population. Polysomnography (PSG), while remaining the diagnostic gold standard, is frequently limited by high costs, technical complexity, and prolonged waiting lists, which create significant

barriers to timely intervention. Therefore, there is an urgent clinical need for simple, reliable, and cost-effective screening tools applicable within the primary care setting.

The primary endpoint of this study was to evaluate the prevalence of OSAS risk within a primary care population presenting with cardiometabolic abnormalities. The secondary endpoint was to assess the strength of the association between high OSAS risk and individual components of the MS, specifically focusing on hemodynamic and anthropometric markers. By clarifying these relationships, we aim to demonstrate the utility of validated questionnaires as a pragmatic strategy for early identification and comprehensive cardiovascular risk (CVR) stratification.

## Materials and Methods

### Study design and population

This cross-sectional observational study included 174 consecutive patients evaluated in a primary care and internal medicine

setting. Inclusion criteria required the presence of at least one MS component according to the NCEP-ATP III guidelines.<sup>3</sup> While a full diagnosis of MS requires three or more criteria, this threshold was chosen to evaluate OSAS risk across the broader spectrum of metabolic impairment. This approach is supported by evidence suggesting that even individual components of MS, such as central obesity or hypertension, significantly increase cardiovascular vulnerability and may serve as early markers for sleep-disordered breathing.<sup>4,5</sup> By including patients with a single criterion, we aimed to capture individuals in the early stages of cardiometabolic risk, where preventive intervention is most effective.<sup>6</sup> The final study population consisted of 80 males (46%) and 94 females (54%), with a mean age of years.

### Clinical and laboratory assessment

All participants underwent a standardized clinical evaluation to ensure data reproducibility. Anthropometric measurements included body mass index and waist circumference; the latter was used as a specific marker for central obesity. Blood pressure (BP) was measured in accordance with current international guidelines, utilizing the average of three consecutive readings taken in a seated position after a 5-minute rest period.

Laboratory assessments were performed on venous blood samples collected after an overnight fast (minimum 8 hours). The biochemical profile specifically included: i) fasting plasma glucose to identify impaired fasting glucose or overt diabetes; ii) lipid profile, comprising total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglycerides, to define the presence of dyslipidemia.

### Obstructive sleep apnea syndrome risk assessment

To overcome the limited accessibility of PSG in a primary care environment, OSAS risk was stratified using two validated screening instruments: i) Epworth Sleepiness Scale (ESS) – a self-administered questionnaire used to assess the subject’s general level of daytime sleepiness;<sup>7</sup> ii) Sleep Apnea Scale (SAS) – a clinical tool focused on nocturnal symptoms and respiratory patterns.<sup>8</sup>

High OSAS risk was defined based on established clinical cutoff values for each scale. These tools were selected due to their non-invasive nature and high feasibility for routine use during standard medical consultations.

### Statistical analysis

Continuous variables are presented as mean and standard deviation, while categorical variables are expressed as percentages. Normality of data distribution was assessed to ensure the appropriateness of subsequent tests. Statistical analyses included: i) Pearson

or Spearman correlation coefficients to evaluate the relationship between OSAS risk scores and metabolic components; ii) chi-square tests for categorical comparisons and independent t-tests for continuous variables; iii) univariate and multivariate logistic regression (adjusting for age and sex) to calculate odds ratios (OR) and 95% confidence intervals (CI). A p-value of was considered statistically significant.

OSAS is characterized by recurrent upper airway collapse during sleep, leading to intermittent hypoxia, sleep fragmentation, and sympathetic activation. Accumulating evidence supports its role as an independent risk factor for CVD, including systemic hypertension, coronary artery disease, stroke, and heart failure.<sup>1</sup>

OSAS shares several pathophysiological pathways with MS, such as oxidative stress, systemic inflammation, insulin resistance, and endothelial dysfunction. Central obesity plays a crucial role in both conditions.<sup>2</sup>

Despite its clinical relevance, OSAS remains markedly underdiagnosed. PSG, although the diagnostic gold standard, is limited by high cost and restricted availability. Therefore, simple and reliable screening tools applicable in primary care are urgently needed.<sup>3</sup>

This study investigates the relationship between OSAS risk and MS components and evaluates the role of validated questionnaires as practical tools for early identification.

## Results

The study population consisted of 174 patients, with a slight female predominance (54%) and a mean age of 58.8±7.7 years. Regarding the metabolic profile, hypertension was the most prevalent component (61%), followed by increased waist circumference (68%), dyslipidemia (42%), and impaired fasting glucose (39%) (Table 1).

Based on the screening questionnaires, a high risk for OSAS was identified in 37% of the participants. The analysis of the association between OSAS risk and MS components revealed significant findings for hemodynamic and anthropometric parameters. Specifically, patients at high risk for OSAS showed a nearly three-fold increase in the likelihood of having hypertension (OR 2.84; 95% CI 1.55-5.20; p<0.001) and over a three-fold increase in the likelihood of presenting with central obesity (OR 3.12; 95% CI 1.71-5.67; p<0.001) (Table 2). These robust associations were confirmed even after adjusting for potential confounders such as age and sex, with adjusted ORs of 2.41 for hypertension (p=0.006) and 2.76 for waist circumference (p=0.001). In contrast, metabolic laboratory variables did not reach statistical significance. The association with impaired fasting glucose (OR 1.29; p=0.39) and dyslipidemia (OR 1.18;

**Table 1.** General characteristics of the study population stratified by obstructive sleep apnea syndrome risk.

Characteristic	Total population (n=174)	Low OSAS risk (n=110)	High OSAS risk (n=64)	p
Age (years), mean±SD	58.8±7.7	58.5±7.2	59.3±8.1	0.450
Gender (male), n (%)	80 (46)	48 (44)	32 (50)	0.410
Arterial hypertension, n (%)	106 (61)	55 (50)	51 (80)	<0.001
Increased waist circumference, n (%)	118 (68)	63 (57)	55 (86)	<0.001
Impaired fasting glucose, n (%)	68 (39)	41 (37)	27 (42)	0.390
Dyslipidemia, n (%)	73 (42)	45 (41)	28 (44)	0.590

SD, standard deviation; OSAS, obstructive sleep apnea syndrome.

**Table 2.** Association between obstructive sleep apnea syndrome risk and cardiometabolic components.

Variable	Prevalence in study population (%)	OR (95% CI)	p	Adjusted OR (95% CI)	p (adj)
Arterial hypertension	61	2.84 (1.55-5.20)	<0.001	2.41 (1.28-4.54)	0.006
Increased waist circumference	68	3.12 (1.71-5.67)	<0.001	2.76 (1.48-5.15)	0.001
Impaired fasting glucose	39	1.29 (0.71-2.35)	0.39	-	-
Dyslipidemia	42	1.18 (0.65-2.13)	0.59	-	-

OR, odds ratio; CI, confidence interval; adj, adjusted.

$p=0.59$ ) appeared weak. This trend was further corroborated by correlation analysis, which showed a moderate positive relationship between OSAS risk scores and both waist circumference ( $r=0.42$ ;  $p<0.001$ ) and systolic BP ( $r=0.36$ ;  $p<0.001$ ), while correlations with glycemic and lipid levels remained negligible.

## Discussion

The findings of this study confirm a robust and independent association between a high risk of OSAS and two of the most significant determinants of CVR: systemic hypertension and central obesity. Our results, showing an adjusted OR of 2.41 for hypertension and 2.76 for increased waist circumference, align with the established literature that identifies OSAS not merely as a respiratory disorder, but as a complex systemic condition with profound hemodynamic consequences. The pathophysiological link between OSAS and CVD is multifaceted.<sup>4,9</sup> The recurrent collapse of the upper airways leads to intermittent hypoxia and hypercapnia, which in turn trigger a cascade of detrimental effects, including oxidative stress, systemic inflammation, and a marked activation of the sympathetic nervous system. This sympathetic overactivity, which persists even during wakefulness, is a primary driver of sustained BP elevation. Our observation of a moderate positive correlation between OSAS risk scores and systolic BP ( $r=0.36$ ) further supports the hypothesis that screening for sleep-disordered breathing is crucial for a comprehensive evaluation of the hypertensive patient. Central obesity emerges from our data as the most significant correlate of OSAS risk (OR 3.12). This relationship is likely bidirectional and synergistic: while excess visceral fat promotes airway collapse through mechanical compression and reduced lung volume, OSAS itself may exacerbate metabolic dysfunction. Interestingly, in our cohort, we did not find statistically significant associations with impaired fasting glucose or dyslipidemia.<sup>10</sup> This discrepancy with some larger trials might be attributed to the specific characteristics of our primary care population or the moderate sample size. However, it suggests that in the early stages of cardiometabolic impairment, the impact of OSAS may be more readily detectable through anthropometric and hemodynamic markers rather than biochemical alterations. A key strength of this study is its focus on the primary care setting. Despite being the “gold standard” for diagnosis, PSG remains severely underutilized due to high costs, technical complexity, and prolonged waiting lists. This leads to a massive underdiagnosis of OSAS, leaving many high-risk patients without adequate protection. Our results demonstrate that the routine implementation of validated, low-cost screening questionnaires like ESS and SAS is a feasible strategy for early identification. In conclusion, identifying the 37% of patients at high risk for OSAS in a general practice population allows for a more accurate CVR stratification. This proactive approach enables clini-

cians to prioritize patients for diagnostic confirmation and initiate timely treatments, such as continuous positive airway pressure or lifestyle modifications, which have been shown to significantly reduce cardiovascular morbidity and mortality.<sup>11</sup>

## Limitations

This study is cross-sectional, meaning we cannot establish a definitive causal link. Furthermore, OSAS risk was determined *via* validated questionnaires rather than the gold-standard PSG. The sample size, while sufficient for primary care screening analysis, may limit the power to detect weaker associations with metabolic laboratory markers.

## Conclusions

The results of this study underscore that among patients presenting with cardiometabolic risk factors, a high risk of OSAS is profoundly associated with systemic hypertension and central obesity. These findings highlight the necessity of viewing OSAS not as an isolated sleep disorder, but as a core component of CVR that requires systematic screening within the primary care setting. The strong correlation observed with increased waist circumference and elevated BP suggests that these clinical markers should serve as “red flags” for clinicians, prompting further investigation into the patient’s sleep quality.<sup>5</sup> Moving forward, the routine implementation of validated, cost-effective screening questionnaires, such as the ESS and the SAS, represents a pragmatic and necessary shift in primary care strategy. By integrating these tools into standard clinical practice, physicians can overcome the current barriers of high diagnostic costs and limited access to PSG, which currently contribute to a significant rate of underdiagnosis. Early identification of high-risk individuals facilitates a more comprehensive CVR stratification and allows for timely referral to specialist care. Ultimately, an integrated approach that addresses both nocturnal respiratory disturbances and traditional metabolic risk factors is essential to improve long-term preventive management.<sup>12</sup> Such a strategy has the potential to significantly reduce the global burden of cardiovascular morbidity and mortality, ensuring that at-risk patients receive early intervention and personalized treatment plans.

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Received: 25 February 2026; Accepted: 19 March 2026; Early view: 16 April 2026.

Contributions: the authors contributed equally.

Conflict of interest: the authors declare no potential conflict of interest.

Ethics approval and consent to participate: ethical approval was waived by the local Ethics Committee because the study was observational, involved no intervention, and used anonymized clinical data collected during routine care.

Informed consent: written informed consent was obtained from all participants prior to inclusion in the study.

Patient consent for publication: patient consent for publication was obtained. All data were anonymized to ensure confidentiality, and no identifying information is included in this manuscript.

Availability of data and materials: the data presented in this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy and ethical restrictions.

Funding: this study was supported by institutional funding from the hospital.

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