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The Metabolic - Sleep Nexus: Anthropometric and Polysomnographic Profiles of PCOS Women with and without Syndrome Z

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KEYWORDS:

Metabolic syndrome, sleep apnoes, poly cystic ocarian disease, obesity

ABSTRACT:

Background

Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder associated with metabolic dysfunction and sleep disturbances. Obstructive Sleep Apnea (OSA) frequently coexists with metabolic syndrome, forming a high-risk entity known as Syndrome Z, which significantly increases cardiometabolic risk

Aim:

To evaluate and compare anthropometric and polysomnographic characteristics in women with PCOS with and without Syndrome Z

Methodology:

A cross-sectional observational study was conducted among 77 women diagnosed with PCOS. All participants underwent anthropometric assessment, metabolic evaluation, and overnight polysomnography. Statistical analysis was performed using independent t-test and Chi-square test

Results:

OSA prevalence was 49.4%. Syndrome Z was present in 27.3% of participants. Women with Syndrome Z had significantly higher BMI, central obesity indices, insulin resistance, and adverse lipid profiles. Polysomnography showed significantly higher AHI, ODI, and arousal index, with reduced sleep efficiency ($p < 0.001$)

Conclusion:

Syndrome Z is highly prevalent in PCOS and is associated with severe metabolic and sleep disturbances. Early identification and integrated management are essential

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INTRODUCTION:

Polycystic Ovary Syndrome (PCOS) is one of the most common hormonal disorders affecting women of reproductive age. It is characterized by irregular ovulation, high androgen levels, and changes in ovarian structure[1]. It is often associated with metabolic issues like insulin resistance, abnormal cholesterol levels, and obesity. PCOS is increasingly seen as a disorder that impacts multiple systems beyond reproductive health, with significant metabolic and cardiovascular effects[2]. Insulin resistance, common in many PCOS patients, plays a key role in the condition's development and raises the risk of obesity, cholesterol issues, and type 2 diabetes[3]

Sleep disorders, especially Obstructive Sleep Apnea (OSA), have become an important yet often overlooked issue in PCOS. The low oxygen levels and disrupted sleep linked to OSA can worsen insulin resistance, increase sympathetic nerve activity, and cause systemic inflammation, leading to poorer metabolic outcomes[4]. While OSA has traditionally been seen as more common in men, it is increasingly recognized in women, especially those with hormonal disorders like PCOS[5]. Additionally, high androgen levels in PCOS may affect breathing control and airway stability, making women with PCOS more likely to have OSA, even if they are not obese. This creates a cycle where metabolic problems lead to sleep issues and sleep issues worsen metabolic problems[6]

When OSA and metabolic syndrome occur together, it is known as Syndrome Z, a condition that increases the risk of heart and metabolic problems[7]. Both PCOS and OSA share similar underlying issues, such as central obesity, insulin resistance, chronic inflammation, and hormonal imbalances. Identifying Syndrome Z in PCOS is clinically important because it points to a group at high risk for serious health issues[8]

Despite increasing evidence, OSA remains underdiagnosed in women with PCOS. Recognizing Syndrome Z in this group is vital, as it may significantly impact their metabolic, cardiovascular and reproductive health

AIM AND OBJECTIVES:

Aim:

- To evaluate and compare anthropometric and polysomnographic characteristics in women with PCOS with and without Syndrome Z.

Objectives:

- To assess the prevalence of Syndrome Z in women with PCOS
- To compare anthropometric parameters (BMI, waist circumference, waist–hip ratio, neck circumference) between PCOS with Syndrome Z and PCOS without Syndrome Z
- To compare polysomnographic parameters such as Apnea-Hypopnea Index (AHI), Oxygen Desaturation Index (ODI), Sleep efficiency, Arousal index and REM/NREM distribution between 2 groups

METHODOLOGY:

Study design and setting: A cross-sectional observational study was conducted in a Tertiary care teaching hospital, Chennai for a period of 21 months

Sample size and study population: 77 women diagnosed with PCOS aged between 18–30 years were selected by purposive sampling method

Inclusion criteria:

- Women aged 18–30 years
- Diagnosed with Polycystic Ovary Syndrome (PCOS) based on Rotterdam criteria
- Willing to participate and provide informed consent

Exclusion criteria:

- Pregnant or lactating women
- Known cases of chronic systemic illness (cardiac, renal, hepatic disease)
- Patients on hormonal therapy / steroids
- Previously diagnosed or treated sleep disorders
- Rrefusal for sleep study

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Data collection: Anthropometry indices like BMI, waist circumference, waist–hip ratio, neck circumference were recorded. Metabolic parameters such as lipid profile, HOMA-IR, free androgen index were assessed. Sleep assessment was done by overnight polysomnography

Ethical Considerations: The present study is based on data from participants who were part of an earlier research project approved by the Department of Pulmonary Medicine at the institution. This analysis represents a secondary evaluation of pre-existing data. All methods followed the ethical principles and guidelines set by the institution. Strict measures were taken to ensure confidentiality, with all personal identifiers removed before data analysis to protect the privacy and anonymity of the participants.

Statistical analysis: Data collected was entered in MS Excel and analyzed using SPSS 26.0 version software. Descriptive statistics was done and represented in frequency and percentage for categorical variables and as mean and standard deviation for continuous variables. Independent t-test was applied for inferential analysis. $p < 0.05$ was considered statistically significant

RESULTS:

Table 1: Distribution of study population

Group	Frequency (n)	Percentage (%)
PCOS without OSA	39	50.6
PCOS with OSA	38	49.4
PCOS with Syndrome Z	21	55.3
PCOS without Syndrome Z	17	44.7

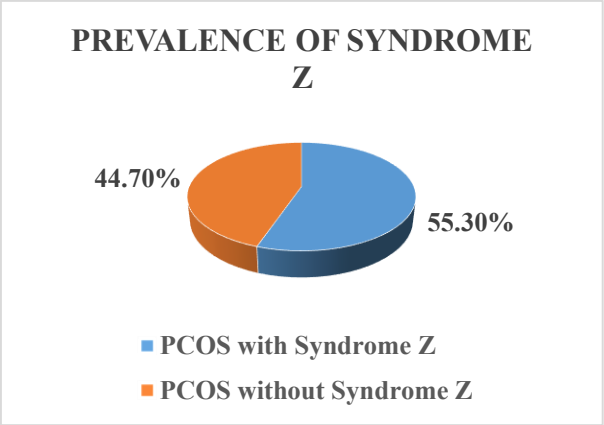

Figure 1: Prevalence of Syndrome Z

Out of 77 women with PCOS, 38 (49.4%) were diagnosed with OSA, while 39 (50.6%) did not have OSA. Among those with OSA, 21 women (55.3%) fulfilled the criteria for metabolic syndrome and were categorized as having Syndrome Z, whereas 17 (44.71%) had OSA without metabolic syndrome. This indicates a substantial coexistence of metabolic and sleep abnormalities in PCOS

Table 2: Anthropometric parameters

Parameter	PCOS without Syndrome Z (n=17)	PCOS with Syndrome Z (n=21)	p-value
BMI (kg/m²)	24.2 ± 2.1	29.8 ± 3.4	<0.001*
Waist circumference (cm)	82.3 ± 5.6	96.5 ± 6.8	<0.001*
Waist–hip ratio	0.84 ± 0.04	0.93 ± 0.05	<0.001*
Neck circumference (cm)	34.1 ± 2.2	39.2 ± 2.8	<0.001*

Anthropometric parameters were significantly higher in women with Syndrome Z compared to those without. The mean BMI was significantly elevated (29.8 ± 3.4 vs 24.2 ± 2.1 kg/m²), indicating a higher prevalence of obesity in the Syndrome Z group. Similarly, waist

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circumference, waist–hip ratio, and neck circumference were significantly increased ($p < 0.001$), reflecting central obesity and upper airway anatomical predisposition to OSA

Table 3: Polysomnographic parameters

Parameter	PCOS without Syndrome Z	PCOS with Syndrome Z	p-value
AHI	6.2 ± 2.5	22.4 ± 14.4	<0.001*
ODI	4.5 ± 2.7	21.5 ± 14.5	<0.001*
Sleep efficiency (%)	87.2 ± 2.7	81.3 ± 3.2	<0.001*
Arousal index	6.8 ± 4.1	18.5 ± 9.8	<0.001*
REM latency (min)	84.1 ± 17.3	58.8 ± 9.3	<0.001*

Polysomnographic analysis revealed marked differences between the two groups. Women with Syndrome Z had significantly higher AHI (22.4 ± 14.4 vs 6.2 ± 2.5) and ODI (21.5 ± 14.5 vs 4.5 ± 2.7), indicating more severe sleep-disordered breathing. Sleep efficiency was significantly reduced (81.3% vs 87.2%), and arousal index was markedly elevated (18.5 ± 9.8 vs 6.8 ± 4.1), reflecting poor sleep quality and fragmentation. REM latency was also significantly shortened, suggesting altered sleep architecture ($p < 0.001$)

DISCUSSION:

The present study demonstrates a high prevalence of Obstructive Sleep Apnea (OSA) (49.4%) among women with Polycystic Ovary Syndrome (PCOS), with more than half of those with OSA (55.3%) fulfilling criteria for Syndrome Z. This finding highlights a substantial overlap between metabolic dysfunction and sleep-disordered breathing in PCOS. A similar high prevalence has been reported by Jafar NK et al[9] who identified a strong association between PCOS and OSA, particularly in women with obesity and insulin resistance. Likewise, Shruthi S et al[10] reported increased clustering of metabolic syndrome components in PCOS women, supporting the elevated burden of Syndrome Z observed in our study

Anthropometric analysis revealed significantly higher BMI, waist circumference, waist–hip ratio, and neck circumference in women with Syndrome Z. These findings emphasize the role of central obesity and upper body adiposity in the pathogenesis of OSA. Increased neck circumference, in particular, is a known predictor of upper airway collapsibility. These results are consistent with Bouloukaki I et al[11], who demonstrated that central obesity is strongly associated with OSA severity and metabolic dysfunction. This suggests that adiposity-related inflammation and insulin resistance contribute to both PCOS and OSA, reinforcing the concept of shared pathophysiological pathways

Polysomnographic findings in our study showed significantly higher Apnea–Hypopnea Index (AHI), Oxygen Desaturation Index (ODI), and arousal index in women with Syndrome Z, along with reduced sleep efficiency and altered REM latency. These findings indicate severe sleep fragmentation and intermittent hypoxia, which are known to exacerbate metabolic dysfunction. Comparable results were reported by Liu P et al[12] who demonstrated a causal relationship between OSA severity and metabolic derangements in PCOS patients. The observed reduction in sleep efficiency and increased arousal index further highlight the impact of poor sleep quality on endocrine and metabolic homeostasis.

However, some studies have reported differing findings. Kahal H et al[13] reported a lower prevalence of OSA among PCOS women, which may be attributed to differences in BMI distribution and study population characteristics. Similarly, Helvaci N et al[14] observed an association between PCOS and OSA but reported less pronounced differences in polysomnographic parameters, possibly due to smaller sample size and lack of subgroup analysis based on metabolic syndrome. These discrepancies suggest that the severity of metabolic dysfunction and degree of obesity play a crucial role in determining the extent of sleep abnormalities.

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Overall, the findings of the present study support a bidirectional relationship between PCOS, OSA and metabolic syndrome, where central obesity and insulin resistance act as common mediators. The coexistence of these conditions in Syndrome Z represents a high-risk phenotype with significant implications for long-term cardiovascular and metabolic outcomes. Early screening using anthropometric markers and polysomnography is therefore essential in women with PCOS, particularly those with obesity and metabolic abnormalities

Summary:

This study aimed to evaluate the link between metabolic issues and sleep-disordered breathing in women with Polycystic Ovary Syndrome (PCOS), focusing on identifying Syndrome Z. The study included 77 women diagnosed with PCOS, who underwent extensive body measurement assessments, metabolic evaluations and overnight sleep studies. In this study, Obstructive Sleep Apnea (OSA) was found in 38 out of 77 participants, yielding a prevalence of 49.4%, while 39 women (50.6%) showed no signs of OSA. Among those with OSA, 21 women (27.3% of the total) had metabolic syndrome and were classified as having Syndrome Z, whereas 17 women (22.1%) had OSA without metabolic syndrome. These findings demonstrate a significant overlap of metabolic and sleep-related issues in women with PCOS

Anthropometric assessment showed that women with Syndrome Z had significantly higher body mass index, waist circumference, waist-hip ratio and neck circumference compared to those without Syndrome Z. The average BMI in the Syndrome Z group was 29.8 ± 3.4 kg/m² compared to 24.2 ± 2.1 kg/m² in the non-Syndrome Z group. Likewise, waist circumference (96.5 ± 6.8 cm vs 82.3 ± 5.6 cm), waist-hip ratio (0.93 ± 0.05 vs 0.84 ± 0.04), and neck circumference (39.2 ± 2.8 cm vs 34.1 ± 2.2 cm) were significantly higher, highlighting the role of central obesity in both metabolic dysfunction and OSA

Sleep study results indicated significant differences between the two groups. Women with Syndrome Z had much higher apnea-hypopnea index (22.4 ± 14.4 vs 6.2 ± 2.5) and oxygen desaturation index (21.5 ± 14.5 vs 4.5 ± 2.7), showing more severe sleep-disordered breathing. Additionally, sleep efficiency was significantly lower (81.3 ± 3.2% vs 87.2 ± 2.7%) and arousal index was significantly higher (18.5 ± 9.8 vs 6.8 ± 4.1), indicating poor sleep quality and greater sleep disruption. REM latency was also shorter in the Syndrome Z group, suggesting changes in sleep structure

This study concludes that women with PCOS and Syndrome Z form a subgroup with significantly greater cardiometabolic risk. Early identification through body measurement screening and sleep evaluation is vital for timely intervention. Integrated management strategies addressing both metabolic and sleep-related issues are crucial for reducing long-term complications

Conclusion:

The present study concludes that women with PCOS and Syndrome Z represent a subgroup with significantly increased cardiometabolic risk. Early identification through anthropometric screening and polysomnographic evaluation is essential for timely intervention. Integrated management strategies targeting both metabolic and sleep-related abnormalities are crucial to reduce long-term complications

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Conflict of interest: Nil

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Journal of Chemical Health Risks
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