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Impact of Obstructive Sleep Apnea on Quality of Life in Women with Polycystic Ovary Syndrome

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ABSTRACT

Background: Polycystic ovary syndrome (PCOS) and obstructive sleep apnea (OSA) are the two issues which coexist and share common metabolic and hormonal abnormalities. However, in the clinical and psychological worsening of the PCOS condition, OSA also plays and contributes its share. However, its impact on quality of life (QoL) in women with OSA remains underexplored.

Objective: To evaluate the association between OSA and quality of life (QoL) in women diagnosed with PCOS.

Methodology: The present study was included 47 women with PCOS. Study was of cross-sectional type. Berlin questionnaire or the Epworth Sleepiness Scale (ESS) scales were used for OSA diagnosis. On the basis of OSA, study cases were divided into two groups, i.e. PCOS only and PCOS with OSA. WHOQOL-BREF and PCOSQ were used for quality of life of the cases.

Results: A total of 47 women were included in this study. The mean age of study cases was 31.6 ± 9.1 years, with a BMI of 33.7 ± 8.2 kg/m². Among them, 18 (38.3%) confirmed OSA. Results showed that cases in the OSA group exhibited significantly higher BMI, LDL, HbA1c, and inflammatory markers. ODI and ESS scores were inversely related to QoL scores across multiple domains, whereas ESS was associated with higher levels of anxiety and depressive symptoms.

Conclusion: A considerable proportion of women with PCOS experience OSA, which correlates with reduced QoL and adverse metabolic indicators. These findings suggest the need for routine screening and potential intervention for OSA in PCOS management.

Keywords: POS; Obstructive Sleep Apnea; QoL; WHOQOL-BREF

Introduction

Polycystic ovary syndrome (PCOS) has evolved as one of the most common endocrine problems in women of reproductive age, with an estimated prevalence rate of 6-20% worldwide, depending on the diagnostic criteria used.¹ Besides chronic anovulation, hyperandrogenism, and polycystic ovarian morphology, PCOS is linked to a variety of metabolic, reproductive, and psychological complications. Besides affecting fertility and menstrual irregularity, PCOS has far-reaching consequences on general health, increasing the risk for insulin resistance, type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD), obesity, and low quality of life (QoL).²

Obstructive sleep apnoea (OSA), one of the types of sleep-disordered breathing, is defined by recurrent episodes of upper airway obstruction during sleep, which is now gaining importance as a comorbid disorder in the PCOS woman.^{3,4} Hypoxia, architecture sleep disturbance, and EDS characterize OSA, which has been implicated with obesity, insulin resistance, hypertension, and raised inflammatory markers.⁵ Prevalence of OSA among women is said to be lower than that observed amongst men; this condition is, however, markedly increased in the case of PCOS, who is at risk even when age and BMI are put into consideration.⁶

The pathophysiological link between PCOS and Obstructive Sleep Apnea is multifactorial.⁷ Their combined mechanisms include central adiposity, insulin resistance, androgen excess, and dysregulated autonomic function. Obesity acts as a major intersecting risk factor. Still, even lean women with PCOS may exhibit OSA, suggesting that additional hormonal and metabolic abnormalities contribute to sleep disturbances.⁸ Hyperandrogenism, a characteristic of PCOS, may alter muscle tone and ventilatory control in the upper airways.⁹ Low progesterone levels, frequently seen in anovulatory cycles, are concomitant with this pattern and may contribute to airway collapsibility at night.

Psychological difficulties associated with depression, anxiety, low self-esteem, and impaired social functioning have been attributed to both PCOS and OSA separately. Thus, these disorders can contribute significantly to a reduced QoL, especially concerning emotional wellbeing, physical functioning, and body image. Despite this, few studies have taken the combined effect of OSA and PCOS into consideration concerning the QoL.^{7,10} Most studies emphasize metabolic findings or fail to account for the sleep-relevant domains of QoL in women with PCOS.^{11,12}

Early identification and management of OSA in women suffering from PCOS could have significant clinical implications. Therapies such as CPAP can aid in improving insulin sensitivity and reducing blood pressure, though positive effects on sleep quality and psycholo-

gical health are still possible.¹³ However, it is important to realize that this population commonly overlooks OSA diagnosis due to the under-screening of OSA and misattribution of symptoms such as fatigue and mood disturbances solely to PCOS.

It is, therefore, crucial to separate the effects of either PCOS or OSA alone or in combination upon QoL since there is an overlap of symptoms and risk factors peculiar to each of these conditions. Adding to the already complicated matrix of OSA and daytime sleepiness is the fact that excessive daytime sleepiness may or may not be influenced by OSA and may affect a person's mental state, as well as functioning ability.

The understanding of the comorbid effect of PCOS and OSA is primarily limited to metabolic and cardiovascular involvement. In contrast, the problem of the combined effect on quality of life for diverse clinical populations at present remains largely ignored. Hence, this study proposes to fill up the gap by determining the prevalence of OSA among women suffering from PCOS and establishing its correlation with different dimensions of QoL. Understanding this relationship is necessary for developing integrated treatment strategies that encompass healthy sleep and reproductive health. This cross-sectional study provides the data for routine OSA screening in PCOS care pathways with evidence of the importance of multidisciplinary interventions in improving the general wellbeing of this vulnerable population.

Objective

To evaluate the association between obstructive sleep apnea and QoL in women diagnosed with PCOS.

Methodology

A cross-sectional study was conducted at PAF Hospital Karachi and Ruth Pfau Medical College, Karachi, between January 2022 and June 2022. This study was conducted in these two institutions because they provide dedicated outpatient services regardless of the nature of the patients. Women aged 18 years and above were eligible for this study if they had been diagnosed with PCOS based on the Rotterdam criteria. If any two among Oligo/anovulation, clinical or biochemical signs of hyperandrogenism, and ultrasound evidence of polycystic ovarian morphology were present in any case, this was used as a diagnostic criterion.

Exclusion criteria followed and included all participants who were currently pregnant or breastfeeding, using continuous positive airway pressure (CPAP) therapy for previously diagnosed OSA, or unable to provide informed consent.

All study participants were screened for OSA by using two validated tools. One was the Berlin Questionnaire, which assesses risk based on snoring behaviour, fatigue, and

comorbid hypertension, and the other one was the Epworth Sleepiness Scale (ESS), which evaluates the likelihood of falling asleep in various situations, with scores ≥ 11 indicating excessive daytime sleepiness (EDS).

Based on screening and diagnostic tests, study participants were assigned to the PCOS-only group, which included those women with low OSA risk on questionnaires or ODI below 5/hour or, if not adjusted in this group, then included in the PCOS + OSA group, which included confirmed OSA women (ODI equal to or above 5/hour).

All participants assessed for their quality of life and psychological well-being using two standardized tools. The WHOQOL-BREF questionnaire was utilized to assess domains such as physical health, psychological status, and environmental factors. Additionally, the PCOSQ (Polycystic Ovary Syndrome Health-Related Quality of Life Questionnaire) was employed to measure PCOS-specific concerns, including emotional health, body hair, weight issues, menstrual irregularities, and fertility

challenges. To assess psychological status, the Hospital Anxiety and Depression Scale (HADS) was administered. This 14-item scale quantifies symptoms of anxiety and depression, with higher scores reflecting greater symptom severity.

A detailed physical examination was conducted for all participants, including height, weight, body mass index (BMI), and circumferences of the waist, hips, and neck. Blood pressure was recorded after a 10-minute rest in a seated position. Fasting blood samples were collected in the morning following an overnight fast to analyze fasting glucose, HbA1c, lipid parameters (including LDL, HDL, total cholesterol, and triglycerides), C-reactive protein (CRP), and hormonal levels (testosterone, FSH, LH, SHBG, DHEAS, and estradiol). Metabolic syndrome was diagnosed based on the criteria established by the International Diabetes Federation (IDF), requiring central obesity (waist circumference >80 cm for South Asian women) plus any two of the following: elevated triglycerides, reduced HDL cholesterol, increased blood pressure, or impaired fasting glucose.

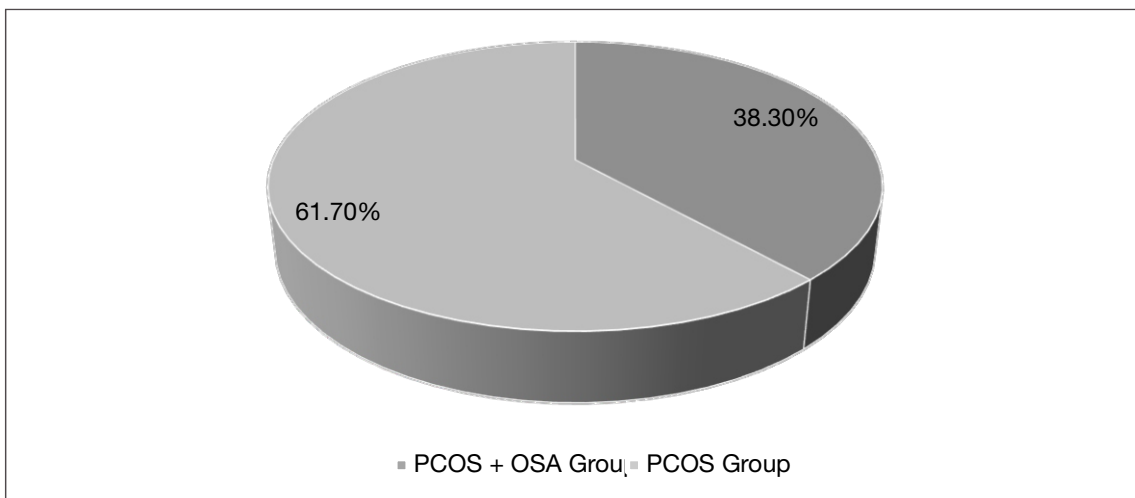


Figure 1. Distribution of studied participants

Initially, all data were entered into a specially designed Excel sheet, and all data were transferred into SPSS version 23 for analysis. Normally distributed variables were expressed as mean \pm standard deviation, while non-normally distributed variables were reported as median (interquartile range). For the comparison of groups, independent t-tests were used, and chi-square tests were applied to categorical variables. For comparison purposes, ANCOVA was used, and multiple linear regression models were used to associate ODI, ESS, QoL, and psychological health. P-value <0.05 was considered statistically significant during analysis.

The study protocol was reviewed and approved (Ref.

112/RMC/2022) by the institutional ethics review boards of Ruth Pfau Medical College, Karachi. All participants provided written informed consent before enrollment in the study.

Results

A total of 47 women were included in this study. The average age of the participants was 30.2 ± 9.0 years, with a mean BMI of 35.4 ± 8.0 kg/m². Based on sleep testing, 18 participants (38.3%) were diagnosed with obstructive sleep apnea, forming the PCOS+OSA group, while the remaining 29 participants (61.7%) without OSA were

Table 1. Baseline Characteristics of study participants

| Variable | PCOS+OSA (n=18) | PCOS only (n=29) |
|---|-----------------|------------------|
| Age (years) | 31.8 | 27.7 |
| Weight (kg) | 115.6 | 83.2 |
| BMI (kg/m ²) | 39.9 | 31.8 |
| Waist (cm) | 120.4 | 110.7 |
| Waist-to-hip ratio | 0.80 | 0.80 |
| Neck circumference (cm) | 35.2 | 37.0 |
| Systolic BP (mmHg) | 108.0 | 118.5 |
| Diastolic BP (mmHg) | 83.8 | 67.8 |
| Metabolic Syndrome (%) | 41.2 | 21.5 |
| Modified Ferriman–Gallwey score | 17.0 | 11.3 |
| Amenorrhoea (%) | 28.5 | 21.7 |
| Oxygen desaturation index (events/hr) | 13.1 | 3.0 |
| ESS | 10.0 | 9.3 |
| EDS (ESS > 10) (%) | 79.2 | 77.4 |
| Hormonal contraception – Combined OCP (%) | 0.0 | 19.6 |
| Metformin use (%) | 54.3 | 25.7 |
| Antidepressant use (%) | 25.1 | 17.6 |
| Levothyroxine use (%) | 26.9 | 12.3 |
| Spironolactone use (%) | 13.0 | 11.1 |
| Smokers (%) | 12.5 | 12.5 |
| Marital status – Married (%) | 75.8 | 53.8 |
| Education – Tertiary (%) | 59.5 | 98.2 |

Table 2. Metabolic and Hormonal Markers in participants of both groups

| Variable | PCOS+OSA (n=18) | PCOS only (n=29) |
|---------------------------------|-----------------|------------------|
| CRP (mg/l) | 4.6 | 1.9 |
| Fasting plasma glucose (mmol/l) | 5.2 | 4.9 |
| HbA1c (mmol/mol) | 36.1 | 31.2 |
| Cholesterol (mmol/l) | 4.9 | 4.9 |
| LDL (mmol/l) | 3.1 | 2.1 |
| HDL (mmol/l) | 1.0 | 1.6 |
| Triglycerides (mmol/l) | 1.6 | 1.7 |
| Cholesterol/HDL | 4.4 | 3.1 |
| ALT (U/l) | 20.4 | 12.8 |
| Hb (g/l) | 148.2 | 139.8 |
| Haematocrit (L/L) | 0.4 | 0.4 |
| Testosterone (nmol/l) | 1.8 | 1.5 |
| FSH (IU/l) | 5.6 | 6.6 |
| LH (IU/l) | 8.8 | 7.9 |
| SHBG (nmol/l) | 26.1 | 28.2 |
| Free androgen index | 4.9 | 3.5 |
| DHEAS (μ mol/l) | 7.3 | 7.3 |
| Androstenedione (nmol/l) | 4.0 | 4.5 |
| Oestradiol (pmol/l) | 203.2 | 161.4 |
| 25-OH Vit D (nmol/l) | 51.7 | 47.8 |

included in the PCOS-only group (Figure 1). Compared with the PCOS group, women with PCOS+OSA had higher weight (115.6kg:83.2kg), BMI (39.9Kg/m²: 31.8Kg/m²), waist circumference (120.4cm:11.7cm), and neck circumference (35.2cm:37.0cm). The PCOS+OSA group also had a higher prevalence of metabolic syndrome (41.2%:21.5%) and a greater oxygen desaturation index (ODI) (13.1:3.0). Excessive daytime sleepiness (EDS) was reported more frequently in the PCOS+OSA group (79.2%) compared to

PCOS only (77.4%). Amenorrhoea was more commonly reported among women with OSA, while the use of combined oral contraceptives was less frequent in this group (Table 1).

Results showed that study participants in the PCOS+OSA group exhibited higher levels of C-reactive protein (CRP) (4.6mg/l:1.9mg/l), HbA1c (36.1:31.2), low-density lipoprotein (LDL) (3.1mmol/l:2.1mmol/l), and cholesterol/HDL ratio compared to the participants in another group. Notably, HDL levels were lower in the

Table 3. Quality of Life and HAD results of participants of both groups

| Variable | PCOS+OSA (n=18) | PCOS only (n=29) |
|-----------------------------|-----------------|------------------|
| WHOQOL physical health | 55.4 | 67.8 |
| WHOQOL psychological health | 49.7 | 54.1 |
| WHOQOL social health | 70.0 | 72.5 |
| WHOQOL environment | 61.5 | 70.1 |
| PCOSQ emotions | 3.4 | 4.5 |
| PCOSQ hirsutism | 2.4 | 3.5 |
| PCOSQ weight | 1.2 | 2.3 |
| PCOSQ infertility | 3.0 | 4.1 |
| PCOSQ menstrual cycle | 3.1 | 3.7 |
| HAD anxiety | 9.8 | 10.4 |
| HAD depression | 8.6 | 7.2 |

PCOS+OSA group. These differences indicate a more adverse cardiovascular and inflammatory profile in women with concurrent OSA and PCOS. Additionally, the PCOS+OSA group demonstrated slightly higher testosterone (1.8nmol/l:1.5nmol/l) and free androgen index levels (4.9:3.5), although the difference in sex hormone-binding globulin (SHBG) and androstenedione was marginal. Oestradiol and 25-hydroxy vitamin D levels were also somewhat lower in the PCOS-only group (Table 2).

Results showed that participants with PCOS and OSA exhibited lower quality of life across multiple domains, as measured by the WHOQOL-BREF and the PCOSQ instruments. The physical health (55.4:67.8) and environment domains (61.5:70.1) of the WHOQOL-BREF were notably lower in the PCOS+OSA group than in the PCOS group. Anxiety levels in both groups were comparable, whereas depression was higher in PCOS+OSA group participants as compared with PCOS group participants (Table 3).

To find any associations of oxygen desaturation index (ODI), Epworth Sleepiness Scale (ESS), body mass index (BMI), and age with quality of life and mental health measures, multivariable linear regression analysis was performed. Higher ESS scores were significantly associated (Std. β -0.436, p-value 0.004) with reduced scores in the physical health and psychological domains

(Std. β -0.417, 0.013) of the WHOQOL-BREF, as well as increased HADS depression (Std. β 0.455, p-value 0.007) and anxiety scores (Std. β 0.489, p-value 0.003). In contrast, ODI was independently associated with lower scores in the PCOSQ weight, menstrual cycle, and infertility domains. BMI and age showed no significant associations (p-value > 0.05) in most models after adjusting for ODI and ESS (Table 4).

Discussion

This cross-sectional study intended to evaluate the association between obstructive sleep apnea (OSA) and quality of life (QoL) among women with polycystic ovary syndrome (PCOS) in a Pakistani population. The results showed that OSA is increased among women with PCOS, as it affects 38.3% of our cohort and is found to relate to poor QoL, worse metabolic profile, and higher markers of psychological distress. These findings extend the previous observations reported in international studies.^{7,8,12}

The high prevalence of OSA in the present study is consistent with earlier work conducted by different researchers, which includes a systematic review by Kahal et al., which reported that approximately one-third of women with PCOS may have OSA.¹⁴ Our findings strengthen this, revealing a similarly increased rate among the participants for the study area. However, this

Table 4. Association of Predictors with Quality of life and Psychological Outcomes in participants

| Outcome Measure | Predictor | Std. β | p-value |
|------------------------|-----------|--------------|---------|
| WHOQOL Physical Health | ODI | -0.302 | 0.048 |
| | ESS | -0.436 | 0.004 |
| | BMI | 0.127 | 0.351 |
| | Age | -0.093 | 0.571 |
| WHOQOL Psychological | ODI | -0.178 | 0.221 |
| | ESS | -0.417 | 0.013 |
| | BMI | 0.099 | 0.498 |
| | Age | 0.118 | 0.431 |
| WHOQOL Environment | ODI | -0.401 | 0.022 |
| | ESS | -0.091 | 0.610 |
| PCOSQ Weight | ESS | -0.461 | 0.009 |
| PCOSQ Infertility | ODI | -0.428 | 0.011 |
| PCOSQ Menstrual Cycle | ODI | -0.385 | 0.018 |
| HADS Anxiety | ESS | 0.455 | 0.007 |
| HADS Depression | ESS | 0.489 | 0.003 |

indicates that OSA may exist among women with varying BMI values. Thus, obesity remains an important but not sufficient risk factor observation also resounded by Lin et al., who demonstrated that even after weight control, OSA would still be at increased risk among women with PCOS.¹⁵

In this study, PCOS and OSA in women were associated with significantly poorer metabolic measures (e.g., higher LDL cholesterol, HbA1c, and CRP). These findings confirm previously reported data indicating that OSA further aggravates the metabolic burden experienced by women with PCOS.¹⁰ OSA is known to be associated with insulin resistance, systemic inflammation, and dyslipidemia in the general population, and our study shows that this association would also hold in the case of women with PCOS.

From a hormonal perspective, although free androgen index and testosterone were high in the women in the group PCOS+OSA, it was not statistically significant. This is consistent with the findings of Hatch et al., where

haphazard levels of androgen were noted in women with PCOS, regardless of whether or not there was any sleep disorder.¹⁶ However, the interaction between hyperandrogenism and OSA will have further scope to investigate, especially its potential for neuro-muscular mechanisms to influence airway resistance.

Quality of Life assessment using the PCOSQ and WHOQOL-BREF instruments revealed significantly impaired physical functioning, emotional well-being, and environmental satisfaction among women with OSA. The results of the present study are in line with the findings of a study conducted by Li et al., who showed that women with PCOS tend to report poorer QoL across various domains, particularly when metabolic and reproductive symptoms are severe.¹⁷ Furthermore, OSA has independently been linked to lower Quality of life in other populations, suggesting that its presence compounds the psychological burden already carried by women with PCOS.

Results from the present study indicated that EDS, as

measured by the ESS, would lower the QoL scores and increase anxiety and depressive levels regardless of confounding variables. This finding is corroborated by data from Fernandez-Mendoza et al. showing that EDS can be seen as an indicator of both metabolic and mental health problems, which non-OSA factors like mood disorders and sleep hygiene could also influence.¹⁸ In as much as obesity contributes to EDS, our study finds that EDS may also manifest independently of BMI, perhaps through hormonal and psychological pathways in PCOS. The present study's findings showed that regression analysis is strongly associated with ODI and ESS as predictors of QOL impairment. ODI had a stronger relationship with physical limitations and reproductive concerns, while the ESS had mental health and psychological functioning damages. The different patterns suggest that other dimensions of sleep disturbance interact with the body individually, affecting the physical versus emotional side.

In light of the results of the present study along with previous studies, PCOS can be defined as a life stage in which reproductive, metabolic, and psychological domains overlap with the sleep-related dysfunctions such as OSA. The observed independent associations between sleep indices and quality of life metrics imply an important clinical relevance for including sleep assessments into regular PCOS managements. Future longitudinal and interventional studies are warranted to further explore whether early detection and therapy for OSA could improve long-term health and well-being for the women suffering from PCOS.

Conclusion

The present study concluded that Obstructive sleep apnea poses a considerable burden in women with polycystic ovary syndrome and negatively impacts their quality of life, metabolic health, and psychological well-being. The study results stress the importance of proactively screening for and managing sleep-disordered breathing in women with PCOS, regardless of their BMI. Intervening for OSA in this population may improve health outcomes, decrease cardiometabolic risk, and provide patient-centered care in endocrinology and women's health.

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