Research in Health Science
ISSN 2470-6205 (Print) ISSN 2470-6213 (Online)
Vol. 10, No. 3, 2025
www.scholink.org/ojs/index.php/rhs

Original Paper

Analysis of Factors Affecting Obstructive Sleep Apnea in Polycystic Ovary Syndrome Infertility Combined with Obstructive Sleep Apnea

Jiena Li[1], Ya Liu[1], Bo Chen[1], Weiwei Sun[2], Yanping Sun[2], Mei Wang[2], Wenming Cao[2*]

[1] Center for Reproductive Medicine, Department of Obstetrics and Gynecology, Heze hospital affiliated of Shandong first medical university, Heze Municipal Hospital, Shangdong, Heze 274000, China

[2] Department of Gynecology, Pingshan District Central Hospital, Shenzhen 518118, China

[*] Corresponding author: Wenming Cao, Department of Gynecology, Pingshan District Central Hospital of Shenzhen, No.51, Julongshan Road, Kengzi Street, Shenzhen 518122, China

Tel: 86-13686368551; E-mail: caowenming1983@126.com

Received: September 19, 2025 Accepted: November 1, 2025 Online Published: November 12, 2025

doi:10.22158/rhs.v10n4p53 URL: http://dx.doi.org/10.22158/rhs.v10n4p53

Abstract

Objective: To investigate the risk factors for obstructive sleep apnea (OSA) in infertile women with polycystic ovary syndrome (PCOS). Methods: This study enrolled 100 infertile PCOS patients. Based on polysomnography results, participants were divided into PCOS-only (AHI <5) and PCOS-OSA (AHI ≥5) groups. Clinical parameters, endocrine profiles, and metabolic markers were compared, with logistic regression analysis identifying independent risk factors. Results: Elevated body mass index (BMI), fasting insulin (INS), and triglycerides (TG) were identified as significant risk factors for OSA. In contrast, total testosterone (T) levels showed a negative association with OSA risk. Conclusions: The comorbidity of PCOS and OSA is strongly associated with disturbances in reproductive endocrine function and glycolipid metabolism. Routine OSA screening should be implemented in the clinical management of infertile PCOS patients.

Keywords

Polycystic ovary syndrome, obstructive sleep apnea, insulin resistance, glycolipid metabolism, infertility

1. Introduction

Polycystic ovary syndrome (PCOS) is a prevalent endocrine disorder affecting approximately 13% of reproductive-aged women (Ma Sicheng, & Yan Hongchao, 2023). Clinical manifestations often include menstrual irregularities, acne, hirsutism, and infertility, accompanied by metabolic disturbances such as obesity and insulin resistance. Compared with the general population, women with PCOS face elevated risks of hypertension, diabetes, and endometrial cancer, contributing to impaired quality of life and significant psychological burden (Li, N., Yang, R., Zhao, Y., et al., 2025; Yang, J., & Chen, C., 2024).

Emerging evidence suggests that pathophysiological features of PCOS—such as insulin resistance, hyperandrogenemia, and chronic low-grade inflammation—may predispose patients to obstructive sleep apnea (OSA) (Gu Fangyun, Hou Lihui, Xia Xiaoyan, et al., 2020). Hyperandrogenemia may contribute to OSA by promoting abdominal obesity or altering upper airway anatomy (Zhu Junbao, 2022). Conversely, OSA may exacerbate hyperandrogenemia through insulin resistance and reduced sex hormone-binding globulin levels, although the exact mechanisms remain unclear (Martins, F. O., & Conde, S. V., 2021; Epstein, S., Jun, D., Deng, J. C., & Zeidler, M., 2024). This study aims to identify clinical characteristics and risk factors, including hormonal and metabolic parameters, associated with OSA in infertile women with PCOS, thereby providing a theoretical and clinical basis for improved diagnosis and management.

2. Materials and Methods

2.1 Study Population

A total of 100 infertile women diagnosed with PCOS were recruited from the Reproductive Medicine Department of Heze Municipal Hospital between January 2023 and December 2024. The mean age of participants was 27.61 ± 4.89 years. Based on polysomnography results, patients were categorized into two groups: PCOS-only (AHI < 5 events/hour, n = 51) and PCOS with OSA (AHI ≥ 5 events/hour, n = 49). The study was approved by the Ethics Committee of Heze Municipal Hospital (Approval No. 2022-KY007), and written informed consent was obtained from all participants.

2.2 Diagnostic Criteria

PCOS was diagnosed according to the 2018 guidelines issued by the Chinese Medical Association Obstetrics and Gynecology Branch, which require the presence of oligomenorrhea, amenorrhea, or irregular uterine bleeding, plus one of the following: clinical or biochemical hyperandrogenism, or polycystic ovarian morphology on ultrasound (≥12 follicles per ovary). Other disorders causing hyperandrogenism or ovulatory dysfunction were excluded.

OSA was diagnosed based on the apnea-hypopnea index (AHI ≥ 5) as per standard guidelines (Wang Yaxin, Zhang Yanhui, Yan Jin, et al., 2024).

Exclusion criteria included ovarian insufficiency, other endocrine disorders, recent use of ovulation induction agents or hormonal therapy, use of medications affecting glucose or lipid metabolism, severe psychiatric conditions, and unwillingness to complete the study protocol.

2.3 Data Collection

Anthropometric measurements and fasting blood samples were collected on days 2–5 of the menstrual cycle (or randomly in cases of irregular cycles). Serum levels of hormones (e.g., TSH, T, AMH) and metabolic markers (e.g., FPG, INS, TG, TCHO) were measured using chemiluminescence assays. All participants underwent overnight polysomnography.

2.4 Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables with normal distribution are expressed as mean ± standard deviation and compared using the independent samples t-test. Categorical variables were compared using the chi-square test or Fisher's exact test. Multivariate logistic regression was performed to identify independent risk factors for OSA, with results reported as odds ratios (OR) and 95% confidence intervals (CI). A p-value < 0.05 was considered statistically significant.

3. Results

3.1 Univariate Analysis

Significant differences were observed between the PCOS-only and PCOS-OSA groups in BMI, total testosterone (T), anti-Müllerian hormone (AMH), fasting plasma glucose (FPG), fasting insulin (INS), and triglyceride (TG) levels ($P< 0.05$, Table 1).

Table 1. Clinical and Metabolic Characteristics of Study Participants

Variable	PCOS (n = 51)	PCOS with OSA (n = 49)	F	*P*
Age (years)	27.00±4.10	27.56±4.94	1.735	0.537
BMI（kg/m^2）	23.18±3.82	28.09±4.38	1.571	0.001
TSH(μIU/ml)	2.70±1.42	3.91±4.49	2.187	0.071
T(pmol/l)	0.69±0.28	0.55±0.23	1.471	0.019
AMH(ng/ml)	5.6±1.73	3.99±1.20	0.373	0.001
FPG(nmol/L)	4.94±0.66	5.28±0.83	1.420	0.025
INS(uU/ml）	20.54±9.36	30.83±10.91	0.175	0.001
TG(mmol/L)	1.73±0.53	2.22±0.58	0.680	0.001

Note. $P < 0.05$ was considered statistically significant, indicating clinically meaningful differences between groups.

3.2 Multivariate Logistic Regression

Multivariate analysis identified BMI, INS, and TG as independent risk factors for OSA in women with PCOS, while T was inversely associated with OSA risk (Table 2).

Table 2. Multivariate Logistic Regression Analysis of Risk Factors for OSA in PCOS Patients

Variable	B	S.E	WaldX^2	P	OR	95% CI
BMI	0.272	0.82	11.014	0.001	1.313	1.118–1.541
T	-3.033	1.070	8.034	0.005	0.048	0.006–0.392
INS	0.143	0.040	12.678	0.001	1.154	1.066–1.249
TG	1.283	0.594	4.668	0.008	3.609	1.127–11.562

Note. $P < 0.05$ indicates statistical significance, demonstrating that the identified variables are independent predictors of OSA in PCOS patients after adjusting for other factors.

4. Discussion

Polycystic ovary syndrome (PCOS) represents one of the most prevalent endocrine disorders affecting reproductive-aged women worldwide (Rodrigues, P., Marques, M., Manero, J. A., Marujo, M. D., Carvalho, M. J., & Plancha, C. E., 2023). While its exact pathogenesis remains incompletely understood, current evidence suggests involvement of genetic factors, adrenal dysfunction, and dysregulation of the hypothalamic-pituitary-ovarian axis. The clinical manifestations of PCOS extend beyond the characteristic hyperandrogenism (manifesting as hirsutism, acne, and alopecia) and anovulation to include significant metabolic disturbances, particularly insulin resistance and dyslipidemia. These abnormalities not only contribute to the hallmark reproductive dysfunction but also elevate long-term risks for type 2 diabetes, cardiovascular diseases, and endometrial cancer, substantially impacting patients' quality of life (Jafar, N. K. A., Fan, M., Moran, L. J., Mansfield, D. R., & Bennett, C. J., 2025).

The high prevalence of obstructive sleep apnea (OSA) in women with PCOS has gained increasing recognition (Liu, P., Zhang, Q., Ding, H., & Zou, H., 2024; Liu, X., He, R., Zhu, K., et al., 2024). While general population studies report OSA prevalence of 9-28% in women, the incidence among PCOS patients is substantially higher (Zeng Zhulan, Zhu Hongqiu, Wang Yajuan, et al., 2021). This association cannot be attributed solely to the high prevalence of obesity in PCOS populations, as our findings indicate that metabolic dysfunction plays an independent role in OSA pathogenesis. In this study, we identified elevated fasting insulin and triglyceride levels as independent risk factors for OSA in infertile women with PCOS, even after adjusting for body mass index. These results align with emerging evidence that insulin resistance and lipid metabolism abnormalities may precede and contribute to the development of sleep-disordered breathing through mechanisms involving chronic inflammation, sympathetic nervous system activation, and altered upper airway neuromuscular control (Du Mingyan, 2020).

The relationship between hyperandrogenism and OSA in PCOS appears complex. While some studies have suggested that elevated testosterone levels may promote OSA development through effects on upper airway collapsibility and ventilatory control, our logistic regression analysis revealed an inverse

association between serum testosterone levels and OSA risk (Ali Ismail, A. M., Mousa, N. M. A., Elgendy, S. K. M., et al., 2025). This seemingly paradoxical finding may be explained by several factors. The increased aromatase activity in adipose tissue of obese individuals could enhance conversion of androgens to estrogens, potentially lowering circulating testosterone levels (Zarei, M., Sabetkasaei, M., Mozafari, M., & Zaeri, S., 2025). Alternatively, the chronic intermittent hypoxia characteristic of OSA may disrupt gonadotropin-releasing hormone pulsatility, subsequently suppressing ovarian steroidogenesis (Liu Xuelian, Zhao Yali, Zhang Qiu, et al., 2020). This bidirectional relationship between androgen dynamics and sleep-disordered breathing warrants further investigation through longitudinal studies.

The clinical implications of the PCOS-OSA relationship are substantial. OSA remains significantly underdiagnosed in women with PCOS, despite its potential to exacerbate insulin resistance, dyslipidemia, and cardiovascular risk. Furthermore, our findings demonstrate that the coexistence of OSA in infertile PCOS patients is associated with more severe metabolic disturbances, potentially creating a vicious cycle that further impairs reproductive function. The impact of OSA extends to pregnancy outcomes, with established associations with gestational diabetes, preeclampsia, and other adverse perinatal complications. These considerations underscore the importance of integrating OSA screening into the routine assessment of PCOS patients, particularly those presenting with infertility.

This study has several limitations that should be acknowledged. The cross-sectional design precludes determination of causal relationships between metabolic parameters and OSA development. The use of total testosterone as the sole marker of hyperandrogenism may not fully capture bioavailable androgen activity. Additionally, the single-center recruitment and moderate sample size may affect generalizability of our findings. Future prospective, multi-center studies with larger cohorts and more comprehensive endocrine profiling are needed to validate these results and elucidate the temporal relationships between metabolic parameters, androgen levels, and OSA development in PCOS.

5. Conclusion

Our study demonstrates a high prevalence of OSA (49%) among infertile women with PCOS and identifies a distinct metabolic phenotype characterized by elevated BMI, fasting insulin, and triglyceride levels as independent risk factors. The inverse relationship observed between testosterone levels and OSA risk highlights the complexity of endocrine interactions in this population. These findings support the integration of OSA screening into standard PCOS management protocols, particularly in the context of infertility. Future research should focus on elucidating the underlying mechanisms linking metabolic health, androgen status, and sleep-disordered breathing, and evaluating whether targeted intervention for OSA can improve both reproductive and long-term metabolic outcomes in women with PCOS.

In summary, the occurrence of obstructive sleep apnea is closely related to polycystic ovarian syndrome. Currently, this study found that the prevalence of obstructive sleep apnea among infertility patients with childbearing age polycystic ovarian syndrome is 34.35%, predominantly mild cases. However, severe obstructive sleep apnea was found in 7% of polycystic ovarian syndrome patients. This study suggests that obstructive sleep apnea in polycystic ovarian syndrome patients may be related to changes in various indicators such as reproductive endocrinology and metabolic disorders. It is considered that screening for obstructive sleep apnea can be included as a routine assessment for polycystic ovarian syndrome patients, especially for infertility patients seeking assisted reproductive treatment.

Funding

Our work was supported by the Medical Science and Technology Development Program Project of Shan Dong Province (Grant No.202205030208; Research on the clinical characteristics and pregnancy outcomes of polycystic ovary syndrome combined with obstructive sleep apnea).

Acknowledgements

The authors sincerely thank the medical staff at the Reproductive Medicine Department of Heze Municipal Hospital for their invaluable assistance in patient recruitment and data collection.

References

Ali Ismail, A. M., Mousa, N. M. A., Elgendy, S. K. M., et al. (2025). Effect of lifestyle changes on liver enzymes, triglycerides, sex hormones, and daytime sleepiness in polycystic ovarian syndrome women with obstructive sleep apnea and fatty liver - a randomized controlled trial. *Prz Menopauzalny*, *24*(2), 94-101. https://doi.org/10.5114/pm.2025.152991

Du Mingyan. (2020). Analysis of the impact of sleep status and incidence on infertility patients with polycystic ovary syndrome (PCOS) during reproductive age. *World Journal of Sleep Medicine*, *7*(12), 2091-2093.

Endocrinology Group of the Obstetrics and Gynecology Branch of the Chinese Medical Association and Guideline Expert Group. Chinese Diagnosis and Treatment Guidelines for Polycystic Ovary Syndrome. *Chinese Journal of Obstetrics and Gynecology*, 2018, *53*(1), 2-6.

Epstein, S., Jun, D., Deng, J. C., & Zeidler, M. (2024). Effects of Obstructive Sleep Apnea on Airway Immunity and Susceptibility to Respiratory Infections. *Sleep Med Clin*, *19*(2), 219-228. https://doi.org/10.1016/j.jsmc.2024.02.002

Gu Fangyun, Hou Lihui, Xia Xiaoyan, et al. (2020). Meta-analysis of the correlation between sleep disorders and polycystic ovary syndrome. *International Journal of Reproductive Health/Family Planning*, *39*(4), 276-279.

Jafar, N. K. A., Fan, M., Moran, L. J., Mansfield, D. R., & Bennett, C. J. (2025). Sex Hormones, Sex Hormone-Binding Globulin and Sleep Problems in Females With Polycystic Ovary Syndrome: A

Systematic Review and Meta-Analysis. *Clin Endocrinol* (Oxf), *102*(6), 708-720. https://doi.org/10.1111/cen.15219

Li, N., Yang, R., Zhao, Y., et al. (2025). Obstructive sleep apnea as a predictive indicator for in vitro fertilization and embryo transfer outcomes in patients with polycystic ovary syndrome: a prospective cohort study. *Sleep Breath*, *29*(4), 237. https://doi.org/10.1007/s11325-025-03399-9

Liu Xuelian, Zhao Yali, Zhang Qiu, et al. (2020). Observation and clinical analysis of sleep status in infertility patients with polycystic ovary syndrome during reproductive age. *World Journal of Sleep Medicine*, *7*(5), 829-831.

Liu, P., Zhang, Q., Ding, H., & Zou, H. (2024). Association of obstructive sleep apnea syndrome with polycystic ovary syndrome through bidirectional Mendelian randomization. *Front Med* (Lausanne), *11*, 1429783. https://doi.org/10.3389/fmed.2024.1429783

Liu, X., He, R., Zhu, K., et al. (2024). Causal evidence of the relationship between polycystic ovary syndrome and obstructive sleep apnea in European and East Asian populations: a two-sample Mendelian randomization study. *J Thorac Dis*, *16*(11), 7372-7382. https://doi.org/10.21037/jtd-24-885

Ma Sicheng, & Yan Hongchao. (2023). Serum AMH levels, changes in antral follicle count, and their significance in patients with polycystic ovary syndrome combined with metabolic syndrome. *Shandong Medical Journal*, *63*(4), 82-84.

Martins, F. O., & Conde, S. V. (2021). Gender Differences in the Context of Obstructive Sleep Apnea and Metabolic Diseases. *Front Physiol*, *12*, 792633. https://doi.org/10.3389/fphys.2021.792633

Rodrigues, P., Marques, M., Manero, J. A., Marujo, M. D., Carvalho, M. J., & Plancha, C. E. (2023). In vitro maturation of oocytes as a laboratory approach to polycystic ovarian syndrome (PCOS): From oocyte to embryo. *WIREs Mech Dis*, *15*(3), e1600. https://doi.org/10.1002/wsbm.1600

Wang Yaxin, Zhang Yanhui, Yan Jin, et al. (2024). Relationship between sleep status, vitamin D deficiency, and polycystic ovary syndrome. *Chinese Clinical Research*, *37*(3), 469-472.

Yang, J., & Chen, C. (2024). Hormonal changes in PCOS. *J Endocrinol*, *261*(1). https://doi.org/10.1530/JOE-23-0342

Zarei, M., Sabetkasaei, M., Mozafari, M., & Zaeri, S. (2025). The expanding role of semaglutide: beyond glycemic control. *J Diabetes Metab Disord*, *24*(2), 160. https://doi.org/10.1007/s40200-025-01663-z

Zeng Zhulan, Zhu Hongqiu, Wang Yajuan, et al. (2021). Discussion on the relationship between sleep time and incidence in adolescents with polycystic ovary syndrome. *Guangming Traditional Chinese Medicine*, *36*(8), 1221-1223.

Zhu Junbao. (2022). Analysis of the impact of sleep status and incidence on infertility patients with polycystic ovary syndrome during reproductive age. *World Journal of Sleep Medicine*, *9*(6), 1066-1067, 1070.