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"EVALUATION OF THYROID STATUS IN NEWLY DIAGNOSED TREATMENT NAIVE WOMEN WITH POLYCYSTIC OVARIAN SYNDROME"

Dr Humairah Shafi[1*], Dr Samia Mearaj[2], Dr Khalid Ahmad Bhat[3], Dr Shabir Ud din Lone[4], Dr. Nazir Ahmad Pala[5], Dr. Sabhiya Majid[6], Dr. Sheikh Imran Sayeed[7]

[1*]Senior Resident, Department of Physiology, Government Medical College, Srinagar, J & K, India.
[2]Post Graduate Scholar, Department of Physiology, Government Medical College, Srinagar, J & K, India
[3]Post Graduate Scholar, Department of Physiology, Government Medical College, Srinagar, J & K, India
[4]Professor, Department of Physiology, Government Medical College, Srinagar, J & K, India.
[5]Associate Professor (Endocrinology), Department of Medicine, Government Medical College, Srinagar, J & K, India.
[6]Professor and Head, Department of Biochemistry, Government Medical College, Srinagar, J & K, India.
[7]Professor and HOD, Department of Physiology, Government Medical College, Srinagar, India.

***Corresponding Author:** Dr Humairah Shafi
*Senior Resident, Department of Physiology, Government Medical College, Srinagar, J & K, India.

ABSTRACT

Polycystic ovarian syndrome (PCOS) is the most common endocrine disorder among women of reproductive age, with significant reproductive and metabolic implications, including links to insulin resistance, dyslipidemia, and cardiovascular risks. Recent studies indicate an association between PCOS and thyroid dysfunction, particularly autoimmune thyroid disease, highlighting the need for a better understanding of this relationship to improve patient management, especially in high-prevalence regions like Kashmir. This study aimed to evaluate thyroid function status in newly diagnosed PCOS patients and assess the prevalence of autoimmune thyroid disease in this population. Conducted as a cross-sectional study, it included 90 newly diagnosed, treatment-naive PCOS patients aged 20–35 years with BMI 18.5–30 kg/m², along with 90 age and BMI-matched controls. PCOS diagnosis was based on the Rotterdam criteria, and thyroid function tests (T3, T4, TSH, anti-TPO antibodies), lipid profile, and insulin resistance markers (fasting insulin, HOMA-IR) were measured. Statistical analysis was conducted with significance set at $p < 0.05$. The results revealed significant differences between PCOS cases and controls in waist circumference, systolic and diastolic blood pressure, T3, T4, TSH, anti-TPO levels, and lipid profile components (TG, HDL, LDL). Insulin resistance markers (fasting insulin, HOMA-IR) were also markedly higher in the PCOS group. The study highlights a strong association between PCOS and thyroid dysfunction, particularly autoimmune thyroid disease, as well as insulin resistance and dyslipidemia, suggesting that routine screening for thyroid and metabolic abnormalities in PCOS patients may be beneficial for early intervention and improved long-term outcomes.

KEYWORDS: Polycystic ovarian syndrome, Thyroid function, Autoimmune thyroid disease, Insulin resistance, Dyslipidemia

Introduction:

Polycystic ovary syndrome (PCOS) is the most commonly occurring endocrine disorder among women of reproductive age, with wide-reaching consequences that affect every aspect of a woman's life, including her reproductive, cardiovascular, and metabolic health. [1] It is now recognized as an important metabolic as well as reproductive disorder, conferring a substantially increased risk for type 2 diabetes. [2,3,4,5,6,7]The prevalence of PCOS varies significantly based on the diagnostic criteria used to define the condition. The World Health Organization estimates that PCOS affected 116 million women worldwide as of 2010, accounting for approximately 3.4% of the female population. [8] PCOS is seen in 85–90% of women with oligomenorrhea and in 30–40% of women with amenorrhea.[9]The global incidence is estimated at 4% to 20%. In India, approximately 22.5% of women, or nearly one in five, are affected by PCOS.[10] Among Kashmiri women, the prevalence is notably high, reportedly among the highest globally.[11]

Patients with PCOS exhibit increased levels of gonadotrophin-releasing hormone (GnRH), which leads to an elevated LH/FSH ratio. Insulin plays a crucial role as the primary regulator of SHBG production in the liver; hyperinsulinemia in PCOS patients is associated with hyperandrogenemia and reduced SHBG levels. An inverse relationship between insulin and SHBG production has been observed in both men and women. Elevated insulin levels contribute to disturbances in the hypothalamic-pituitary-ovarian (HPO) axis, which are central to the pathogenesis of PCOS. Insulin inhibits hepatic SHBG production, thereby increasing levels of free and bioavailable androgens. This hyperinsulinemia-induced reduction in SHBG, combined with increased testosterone production, amplifies androgenic effects. Excessive insulin also increases GnRH pulse frequency, promotes LH dominance over FSH, enhances ovarian androgen production, impairs follicular maturation, and reduces SHBG binding. To manage these hormonal imbalances and symptoms, treatment for adolescent PCOS typically includes lifestyle interventions, local therapies, and medications.[12,13]

Thyroid disorders are also common in women with PCOS and are among the most prevalent endocrine disorders globally.[14,15] Subclinical hypothyroidism (SCH), characterized by elevated TSH levels despite normal FT4, is associated with decreased glucose disposal, increased SHBG, hyperlipidemia, elevated total cholesterol (TC), LDL cholesterol, total triglyceride levels, weight gain, and insulin resistance in the general population.[16] SCH affects 4-10% of the general population, though its prevalence is around 2% among young women aged 12–39 years.[14,15]

Dyslipidemia is another common metabolic disturbance in PCOS, typically characterized by elevated triglycerides and reduced HDL cholesterol. Dyslipidemia in PCOS is independent of BMI; however, obesity and insulin resistance exert a compounded negative effect, similar to patterns seen in T2DM. The etiology of dyslipidemia in PCOS is multifactorial, with insulin resistance playing a pivotal role by stimulating lipolysis and altering lipoprotein lipase and hepatic lipase expression. Consequently, insulin resistance in PCOS leads to hyperinsulinemia, which has diverse and complex effects on lipid metabolism, protein synthesis, and androgen production regulation.[17]

Material and methods:

This analytical cross-sectional, hospital-based study was conducted from June 2021 to August 2022 in the Postgraduate Department of Physiology and Department of Biochemistry at GMC Srinagar, in collaboration with the Department of Endocrinology at SMHS Hospital Srinagar. Ethical clearance was obtained from the Institutional Ethical Committee (Approval No: F (Minutes-BOPGS) Acad/KU/22, dated 02-02-2022), and written informed consent was acquired from all participants. The study adhered to inclusion and exclusion criteria to ensure a representative sample.

Exclusion criteria included pregnant and lactating women, known cases of Type 1 or Type 2 diabetes mellitus (DM), hyperprolactinemia, congenital adrenal hyperplasia, androgen secreting tumors, Cushing syndrome, familial/history of cardiovascular disease, renal disease, or any other

endocrinological disorder. Additionally, participants on medications that could increase body weight, such as contraceptive pills or steroids, as well as those on statin therapy were excluded from the study.

Standard Diagnostic Assessment for Cases:
All the diagnosed PCOS patients taken as cases were diagnosed on the basis of Rotterdam criteria.

Selection of Cases and Control
A questionnaire-based history was conducted to categorize participants into "cases" and "controls." A "PCOS case" was defined as a woman exhibiting symptoms suggestive of PCOS, such as oligo/amenorrhea or clinical features of hyperandrogenism. Only treatment-naive PCOS cases diagnosed according to the Rotterdam criteria were included in the study. In contrast, a "control" was defined as a woman with regular menstrual cycles and no clinical features of PCOS

METHODOLOGY

A total of 90 diagnosed, treatment-naive PCOS cases, aged 20 to 35 years with a body mass index (BMI) between 18.5 and 30 kg/m², were recruited from the Endocrinology Outpatient Department (OPD). These patients were primarily referred for symptoms of clinical hyperandrogenism, such as hirsutism, severe acne, alopecia, infertility, and menstrual disturbances, with symptoms persisting for over a year from June 2021 to August 2022.

Additionally, 90 healthy female subjects, matched for age and BMI, were enrolled as controls based on their history and clinical examination. A comprehensive history was taken for each participant, including details about age, marital status, medication use, and any addictions. Family history of autoimmune and non-autoimmune diseases was also recorded. Participants currently using oral contraceptives, oral hypoglycemic agents, or anti-thyroid drugs were excluded from the study.

Selected cases were examined for clinical signs of hirsutism, acanthosis nigricans, acne, and alopecia. Hirsutism was graded independently by an endocrinologist using the Modified Ferriman–Gallwey (FG) score, which assesses nine areas: upper lip, chin, chest, upper abdomen, lower abdomen, upper back, lower back, thighs, and upper arms. Each area was scored from 0 to 4, with a maximum possible score of 36. Hirsutism was diagnosed when a score above five was observed.

Following a 12-hour overnight fast, participants weight, height, and waist circumference (WC) were measured using a calibrated scale, with shoes and heavy clothing removed. BMI was calculated as weight in kilograms divided by height in meters squared. WC was measured at the midpoint between the inferior costal margin and the superior border of the iliac crest along the mid-axillary line. Arterial blood pressure was measured using an OMRON manual sphygmomanometer after the participant was seated for at least 15 minutes.

After overnight fasting, a 5 ml venous blood sample was drawn from each diagnosed case and healthy control in a heparinized blood collection tube with a green stopper. These fasting blood samples were used to measure fasting plasma glucose (FPG), fasting insulin levels, transaminases (LFTs), and lipid profiles. All participants underwent thyroid function tests, and anti-TPO antibodies were assessed to evaluate the impact of thyroid function on their metabolic parameters. An equal number of age- and BMI-matched healthy women served as the control group for comparison.

BIOCHEMICAL INVESTIGATIONS

All biochemical measurements were conducted at the F-Block Diagnostic Laboratory, Department of Biochemistry, Government Medical College, Srinagar. After an overnight fast, 5 ml of venous blood was drawn from each subject using a green stopper tube. The blood samples were centrifuged at 4000 rpm for 3 minutes, and the supernatant serum was separated for analysis of various biochemical parameters.

Statistical Methods:
The collected data were compiled in a spreadsheet (Microsoft Excel) and subsequently transferred to the data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA) for statistical analysis. Continuous variables were expressed as Mean ± SD, while categorical variables were summarized as frequencies and percentages. The data were presented graphically using bar and pie charts. For comparison of continuous variables between groups, Student's independent t-test or the Mann-Whitney U-test was used, depending on feasibility. For categorical variables, the Chi-square test or Fisher's exact test was applied as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results:
The study included a total of 180 subjects, with 90 cases and 90 controls. The demographic profiles of the cases and controls were comparable, with no statistically significant differences ($p > 0.05$). [Table 1].

Table 1: Demographic profile among the study population

Variables	Cases	Controls	P value
Age (years)	25.7±4.16	26.8±5.13	0.113
Married / Unmarried	33.3/66.7	30.0/70.0	0.631
BMI (Kg/m2)	25.3±2.53	24.9±1.64	0.209
Mean wait circumference	34.1+3.83	33.8+3.57	0.587

However, a statistically significant association was found between the two groups when compared based on comorbidities, family history of PCOS, BMI (kg/m²), waist circumference (inches), systolic blood pressure (SBP, mmHg), diastolic blood pressure (DBP, mmHg), and clinical hyperandrogenism ($p < 0.05$). In contrast, no statistically significant association was observed for age and age of menarche between cases and controls ($p > 0.05$). [Table 2].

Table2:Clinicalcharacteristicsof studysubjectsin twogroups

Variables		Cases[n=90]	Controls[n=90]	P-value
Age(Yrs)		25.7±4.16	26.8±5.13	0.113
Ageof menarche(Yrs)		11.9±1.42	11.6±1.34	0.147
Co-morbidities	DiabetesMiletus	6(6.7%)	0(0%)	0.028*
	Hypertension	1(2.2%)	0(0%)	0.497
FamilyhistoryofPCOS		12(13.3%)	3(3.3%)	0.031*
BMI(Kg/m^2)		27.1±2.67	25.2±1.643	<0.001*
Waistcircumference(Inches)		34.1±3.83	33.8±3.57	0.002*
SystolicBloodPressure(mmHg)		116.1±6.13	112.2±8.03	<0.001*
DiastolicBloodPressure(mmHg)		75.9±5.38	73.6±5.72	0.007*
Clinicalhyperandrogenism		48(53.3%)	2(2.2%)	<0.001*
Acne		9(10.0%)	2	
Hirsutism		27(30.0%)	0	
BothacneandHirsuitism		12(13.3%)	0	

The mean T3 level in the PCOS cases was 1.43 ± 0.667, compared to 1.19 ± 0.313 in the controls, showing a statistically significant difference ($p = 0.002$). The mean T4 level was 7.65 ± 1.72 in cases and 7.13 ± 1.69 in controls, also indicating a significant association ($p = 0.042$). The mean TSH level was higher in cases (4.37 ± 4.12) compared to controls (2.83 ± 1.57), with a highly significant difference ($p < 0.001$). The mean anti-TPO level was 47.10 ± 65.54 in cases and 31.15 ± 46.48 in controls, with a statistically significant association ($p = 0.014$).
[Table 3].

Table3:Thyroidfunctionstatusin casesand controls

Variables	Cases[Mean±SD]	Controls [Mean±SD]	P value
T3	1.43±0.667	1.19±0.313	0.002*
T4	7.65±1.72	7.13±1.69	0.042*
TSH	4.37±4.12	2.83±1.57	<0.001*
AntiTPO	47.10±65.54	31.15±46.48	0.014*

When comparing the lipid profiles between the two groups, triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL) levels were found to be significantly different, with p-values of 0.002, 0.002, and 0.026, respectively. No statistically significant association was observed for total cholesterol levels between cases and controls (p = 0.739). The mean TG level was 131.4 ± 56.6 in cases and 107.8 ± 45.6 in controls. The mean HDL level was lower in cases (43.9 ± 8.9) compared to controls (48.1 ± 9.6), while the mean LDL level was higher in cases (112.9 ± 55.3) than in controls (97.1 ± 28.9).[Table 4].

Table4:ComparisonbasedonLipidprofileincasesand controls

Variables	Cases [Mean±SD]	Controls[Mean±SD]	P value
Cholesterol	162.3±27.5	160.6±40.7	0.739
TG	131.4±56.6	107.8±45.6	0.002*
HDL	43.9±8.9	48.1±9.6	0.002*
LDL	112.9±55.3	97.1±28.9	0.026*

The mean total protein level in cases was 5.72 ± 3.16, compared to 6.70 ± 2.56 in controls, with a statistically significant difference (p = 0.024). The mean albumin level was 5.16 ± 1.64 in cases and 4.80 ± 1.17 in controls, though this difference was not statistically significant (p = 0.087). The mean total globulin level in cases was 2.05 ± 2.25, compared to 1.46 ± 1.73 in controls, with a significant difference (p = 0.041).

For liver function tests, the mean alkaline phosphatase (ALP) level was 108.0 ± 55.95 in cases and 73.9 ± 22.18 in controls, showing a highly significant difference (p < 0.001). Similarly, mean alanine transaminase (ALT) was significantly higher in cases (35.53 ± 19.63) than in controls (23.84 ± 21.21), with p < 0.001. The mean aspartate transaminase (AST) level was also significantly elevated in cases (33.51 ± 13.27) compared to controls (21.28 ± 10.44), with p < 0.001.
[Fig 1].

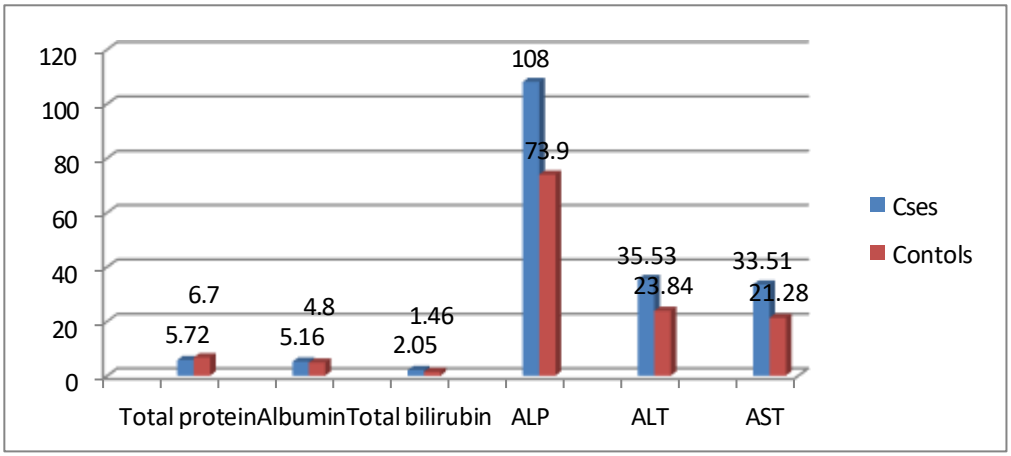

Fig 1.

Mean fasting blood glucose in Cases was 95.1+21.16 compared to 91.1+10.09 in Controls with an insignificant statistical difference (p 0.102) [Fig2].

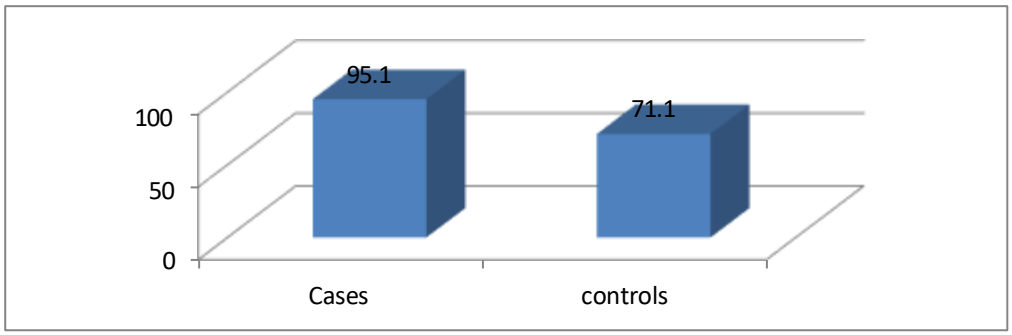

Fig 2.

Mean fasting insulin levels in Cases was 13.2+11.17 compared to 16.9+12.10 in Controls with a significant statistical difference (p 0.034) [Fig3].

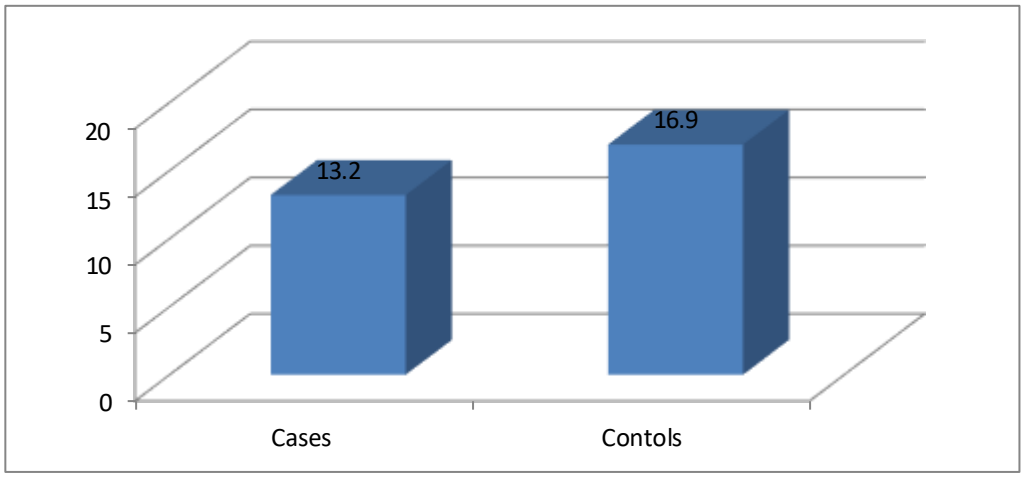

Fig 3.

Discussion:

Polycystic ovary syndrome (PCOS) is the most common endocrine disorder among women of reproductive age. It is a heterogeneous androgen-excess disorder that presents with various reproductive and metabolic dysfunctions. Although thyroid disorders and PCOS are clinically distinct, they share several common clinical and radiological features, including menstrual irregularities, infertility, spontaneous abortion, obesity, lipid abnormalities, and polycystic ovarian morphology. Despite the unclear pathophysiological links between PCOS and thyroid disorders, multiple overlapping factors may predispose individuals to both conditions, suggesting a potential underlying connection.[18]

This hospital-based analytical study, conducted in the Departments of Physiology and Biochemistry, included 90 newly diagnosed, treatment-naive PCOS cases and an equal number of age- and BMI-matched healthy controls. These cases were evaluated for thyroid function tests, anti-TPO antibodies, and their impact on metabolic parameters. Our findings align with previous studies indicating a correlation between PCOS, thyroid disorders, and metabolic syndrome, particularly in women of Kashmiri origin, highlighting the need for early screening due to the high prevalence of PCOS in this population.[2,11]

The study involved 180 participants, with both groups comparable in age (mean age of 25.7 ± 4.16 years in the study group and 26.8 ± 5.13 years in controls; p = 0.113). Similar results have been reported by Munaver SA et al. (2022) and Kamrul-Hasan A et al. (2020). [18,19]Marital status was also comparable, with no statistically significant association between marital status and study groups (p = 0.631), consistent with findings from Fatema K et al. (2021).[20]

BMI comparisons revealed no significant difference between cases and controls ($p = 0.001$), with the majority in both groups falling within the 25-29.9 kg/m² range. These results align with the studies by Fatema K et al. (2021) and the meta-analysis by Lim SS et al. (2012), which noted a higher prevalence of overweight and obesity in women with PCOS. [20,21]The mean waist circumference was also similar between groups (34.1 ± 3.83 inches in cases vs. 33.8 ± 3.57 inches in controls; $p = 0.587$), as observed by Kamrul-Hasan A et al. (2020).[18]

Significant differences were found in comorbidities, family history of PCOS, systolic blood pressure (SBP), diastolic blood pressure (DBP), and clinical hyperandrogenism ($p < 0.05$), with 53.3% of cases exhibiting hyperandrogenism (10% with acne, 30% with hirsutism, and 13.3% with both acne and hirsutism). No significant differences were found for age and age of menarche between cases and controls ($p > 0.05$). Although subclinical hypothyroidism (SCH) is often associated with elevated blood pressure, no significant differences in blood pressure were observed between PCOS patients with and without SCH, consistent with previous studies.

The elevated TSH levels observed in PCOS patients in this study may be due to increased thyrotropin-releasing hormone (TRH) in hypothyroidism, which stimulates prolactin secretion. Higher prolactin levels can suppress GnRH, potentially altering the LH:FSH ratio, as noted in PCOS (Aina DA, 2020).[22] Mean T3 and T4 levels were significantly higher in cases than controls (T3: 1.43 ± 0.667 vs. 1.19 ± 0.313, $p = 0.002$; T4: 7.65 ± 1.72 vs. 7.13 ± 1.69, $p = 0.042$). Mean TSH was significantly elevated in cases (4.37 ± 4.12) compared to controls (2.83 ± 1.57, $p < 0.001$), while anti-TPO levels were also higher in cases (47.10 ± 65.54) than controls (31.15 ± 46.48, $p = 0.014$). These findings align with Sinha U et al. (2013) and Novais JDSM et al. (2015), which reported elevated serum TSH and anti-TPO antibodies in PCOS patients, suggesting an increased prevalence of autoimmune thyroid disease in PCOS, possibly due to the hyperestrogenic state in these patients.[23,24]

Lipid profile differences were notable, with higher triglycerides (TG) and LDL and lower HDL levels in cases than controls. These findings are consistent with Aina DA (2020),which highlighted elevated triglyceride levels in PCOS patients with SCH, potentially due to thyroid hormone involvement in lipid metabolism. [22]

Protein and liver enzyme levels showed significant differences between groups, with higher ALP, ALT, and AST in cases than controls. These findings suggest potential hepatic involvement, which may contribute to the metabolic disturbances observed in PCOS.

Limitations

This study has some limitations. First, it is a hospital-based study, which may limit the generalizability of the findings to the broader population. Second, the cross-sectional design does not allow for causal inferences between PCOS and thyroid dysfunction. Longitudinal studies are needed to assess the progression and potential causative links between these conditions. Additionally, while the study controls for age and BMI, other confounding factors, such as diet, physical activity, and socioeconomic status, were not accounted for, which may influence metabolic and thyroid parameters. Lastly, the sample size, though sufficient for initial insights, may limit the detection of more subtle differences between subgroups.

In conclusion, our study observed a 27.8% prevalence of autoimmune thyroid disease in PCOS cases. The findings support existing evidence linking insulin resistance, thyroid dysfunction, and metabolic abnormalities in PCOS, emphasizing the importance of monitoring these factors to mitigate the risk of diabetes and cardiovascular complications. Future studies with larger sample sizes, a longitudinal design, and comprehensive control for confounding factors are recommended to further explore the pathophysiological connections between PCOS and thyroid disorders.

Contribution by authors

The contributions of the authors to this study are as follows: Dr. Humairah Shafi led the study and performed data extraction under the mentorship of Dr. Shabir Ud Din Lone. Patient selection was conducted in the OPD (Department of Endocrinology) under the co-supervision of Dr. Nazir Ahmad Palla, while laboratory work was carried out under the guidance of Dr. Sabhiya Majid. Dr. Samia Mearaj and Dr. Khalid Ahmad Bhat played a key role in drafting the manuscript. All authors actively participated in critically revising multiple drafts, provided valuable input, and gave their final approval. Each author has reviewed and approved the final version of the manuscript.

Author Disclosure Statement

The authors assert that there exist no commercial or financial associations that could be interpreted as a possible source of conflict of interest.

Competing interests

The authors assert that there were no conflicting interests.

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Search Strategy

In this study, publicly available data from published sources were utilized. A comprehensive search was conducted using PubMed, EMBASE, and MEDLINE (via PubMed) databases to retrieve all relevant literature on the topic. A combination of targeted keywords was employed to refine and optimize the search. Additionally, the reference lists of all relevant articles and reviews were thoroughly examined to identify supplementary information and ensure a comprehensive review of the existing literature.

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Ethical statement

Ethical approval was sought before the start of the study.

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