


COMPARATIVE ANALYSIS OF THYROID FUNCTION PROFILES BETWEEN POLYCYSTIC OVARY SYNDROME PATIENTS AND HEALTHY CONTROLS: A COMPREHENSIVE STUDY

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ABSTRACT

Objective: To assess the thyroid function status of patients with Polycystic Ovary Syndrome (PCOS) and to compare it with that of healthy women.

Methods: This was a descriptive cross-sectional study conducted in the Department of Biochemistry in collaboration with the Department of Obstetrics and Gynecology of a tertiary care hospital in Northern India. 30 patients diagnosed to have polycystic ovarian syndrome on the basis of the Rotterdam criteria were included in this study as cases (Group P). 30 healthy women were enrolled as the control group (Group H). The mean age and marital status of the patients were assessed. The body mass index of all the patients was also determined and compared. Systolic blood pressure, diastolic blood pressure, and pulse rate were also compared. A thyroid function test was done in both groups. The mean triiodothyronine (T3), T4, and thyroid-stimulating hormone (TSH) levels were compared in both groups. $p < 0.05$ was taken as statistically significant.

Results: The mean age of patients with PCOS and healthy individuals was 22.10 ± 3.97 years and 23.76 ± 3.97 years, respectively. The mean ages of both groups were found to be comparable in both studies ($p = 0.1108$). The mean body mass index (BMI) of groups P and H was found to be 27.23 ± 5.82 and 23.15 ± 4.12 , respectively. The women in group P were found to have a higher BMI as compared to women in group H, and the difference was found to be statistically significant ($p = 0.0027$). The mean pulse rate, systolic blood pressure, and diastolic blood pressure values were found to be comparable. The mean FT3 levels in groups P and H were found to be 3.11 ± 0.88 and 3.13 ± 0.42 ng/mL, whereas the mean free thyroxine levels in groups P and H were found to be 0.96 ± 0.16 and 0.89 ± 0.15 , respectively, $\mu\text{g/dL}$. The mean T3 and T4 levels of both groups were found to be comparable in both groups. However, the mean TSH level in groups P and H was found to be 4.95 ± 2.24 and 2.50 ± 1.19 0.3–4.5 $\mu\text{IU/ml}$, respectively. The mean TSH level in group P was found to be higher than group H, and the difference was found to be statistically significant ($p < 0.001$).

Conclusion: The prevalence of subclinical hypothyroidism was found to be significantly high in women with PCOS, making it necessary to do periodic thyroid function tests in PCOS.

Keywords: Polycystic ovarian syndrome, Thyroid function test, Body mass index, Insulin resistance.

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INTRODUCTION

Polycystic ovary syndrome (PCOS) is a complex endocrine disorder affecting individuals of reproductive age and stands as a significant concern in modern medicine. With an incidence of approximately 5–10% among women worldwide, PCOS poses a significant challenge due to its association with menstrual irregularities and infertility. The prevalence is reported to be steadily increasing because of the increased incidence of sedentary lifestyles and their consequences, such as obesity, metabolic syndrome, and insulin resistance. Defined by the Rotterdam criteria, PCOS manifests with a range of symptoms, including irregular menstrual cycles, hyperandrogenism, and polycystic ovaries on imaging [1]. PCOS not only has an adverse impact on reproductive health but also impacts the metabolic, cardiovascular, and psychological aspects of affected individuals. Furthermore, individuals with PCOS are known to have an increased incidence of abnormalities such as obesity, hypertension, non-alcoholic steatohepatitis, hirsutism, depression, anxiety, and sleep apnea [2].

The pathophysiology of PCOS involves hormonal imbalances, metabolic disturbances, and genetic predispositions. Insulin resistance, a common denominator in PCOS, exacerbates hyperinsulinemia, which, in turn, stimulates ovarian androgen production [3]. Hyperandrogenism contributes to irregular anovulatory cycles and the formation of ovarian cysts. Additionally, dysregulation of gonadotropin-releasing hormone further amplifies the syndrome's complexity. These hormonal

imbalances and their effects give rise to the heterogeneous clinical manifestations observed in PCOS patients. Despite substantial progress in understanding PCOS, there remains a critical gap in comprehending its relationship with thyroid function [4].

Recent investigations into the thyroid profile of PCOS patients have shed light on the association between thyroid hormones and PCOS. The thyroid profile, encompassing thyroid-stimulating hormone (TSH), free thyroxine (FT4), and triiodothyronine (T3), plays an important role in maintaining metabolic homeostasis. Studies suggest that PCOS patients often have alterations in their thyroid function. There is an increased incidence of subclinical hypothyroidism (SCH) as well as autoimmune thyroid disorders in patients with PCOS. Many studies have suggested that the thyroid dysfunction in PCOS may contribute to the exacerbation of metabolic disturbances and fertility challenges in affected individuals [5].

Thyroid dysfunction in cases of PCOS may further exacerbate the already-existing insulin resistance, thereby increasing already-heightened levels of androgens [6]. Additionally, altered thyroid function may interfere with the delicate feedback mechanisms governing the hypothalamic-pituitary-ovarian axis, potentially intensifying anovulation and menstrual irregularities. Increased levels of thyrotropin-releasing hormones seen in hypothyroidism may further affect the FSH: LH ratio, thereby further exacerbating already existing hormonal imbalances [7].

Understanding the thyroid profile in PCOS patients is important from the point of view of optimal management. The thyroid hormones are known to modulate ovarian function, and any disruption in their levels may further complicate already altered hormonal levels in patients with PCOS [8]. Thyroid dysfunction in PCOS has been linked to infertility, adverse pregnancy outcomes, increased cardiovascular risk, and the exacerbation of metabolic abnormalities [9]. Furthermore, abnormalities in thyroid function may further contribute to the persistence of anovulation and menstrual irregularities, thereby hampering fertility in PCOS patients [10]. Recognizing and addressing thyroid dysfunction in the management of PCOS could potentially enhance treatment outcomes and improve the overall well-being of affected individuals [11].

With this background, we undertook this cross-sectional study of patients with PCOS to assess their thyroid function status and compare it with that of healthy women.

METHODS

This was a descriptive cross-sectional study conducted in the Department of Biochemistry in collaboration with the Department of Obstetrics and Gynecology of a tertiary care hospital in Northern India. Patients diagnosed to have polycystic ovarian syndrome on the basis of Rotterdam criteria (hypogonadism, menstrual irregularities, and polycystic ovaries on ultrasound examination) were included in this study. Institutional ethical committee approval was obtained for undertaking this study. All patients were explained the nature of the study, and informed written consent was obtained from all the patients. The sample size was calculated on the basis of pilot studies done on the topic of PCOS and hypothyroidism. Assuming 90% power and a 95% confidence interval (CI), the sample size required was 25 patients. Based on the central limit theorem, the sample size was sufficient if it was more than 25; thus, 30 patients were included in our study in each group. A similar number of healthy women (n=30) were included as the control group. A total of 60 patients were divided into two groups as follows.

Group P (PCOS patients): 30 women with PCOS diagnosed on the basis of Rotterdam criteria.

Group H (Healthy women): 30 healthy women with no PCOS enrolled as the control group.

Demographic details such as age, occupation, and socioeconomic status of patients in both groups were noted. The height, weight, and body mass index of all the patients were noted and compared. Detailed menstrual history was taken in all the cases, and the presence of any significant systemic illness such as hypertension, diabetes mellitus, chronic obstructive airway disease, and a history of any thyroid illness was asked and noted. A history of drug intake that may affect thyroid hormone levels, such as lithium, amiodarone, phenytoin, or heparin, was asked and noted. A thorough clinical examination of all the cases was done, particularly the presence of thyroid enlargement or altered consistency if present was noted. A general and systemic examination was done, and any significant abnormality, if present, was noted.

Blood investigations such as complete blood count, C-reactive protein, erythrocyte sedimentation rate, and thyroid function tests were done in all cases. In selected cases, ultrasonography of the thyroid gland was performed. Thyroid function tests were conducted by collecting blood samples in the morning before breakfast. The normal reference values for T3, T4, and TSH were taken as 0.8–2 ng/mL, 5.5–12.2 µg/dL, and 0.3–4.5 µIU/ml, respectively.

The comparison of mean age, clinical features, and thyroid function tests was conducted between the two groups. Statistical Package for Social Sciences Version 21.0 software was used for statistical analysis. Independent sample t-tests were employed for continuous data comparison, and Chi-square tests were utilized for categorical data

between the groups. In cases of repeated observations, the choice between paired t-tests and repeated measures analysis of variance was made based on method suitability. A significance level of <0.05 ($p < 0.05$) was deemed statistically significant.

Inclusion criteria

1. Patients having polycystic ovarian syndrome on the basis of Rotterdam criteria (hypergonadism, menstrual irregularities, and polycystic ovaries on ultrasound examination) (cases)
2. Healthy women with no PCOS or any other significant illness enrolled as the control group
3. Individuals between 18 and 40 years of age
4. Those who gave written informed consent to be part of the study.

Exclusion criteria

1. Those who refused consent
2. Pregnant women
3. Patients on lithium, amiodarone, phenytoin, heparin, or any other drug known to affect thyroid function
4. Patients with significant psychiatric illness
5. Known cases of hypothyroidism or hyperthyroidism.

RESULTS

The analysis of the patients on the basis of age distribution showed that the mean age of patients with PCOS and healthy individuals was 22.10 ± 3.97 years and 23.76 ± 3.97 years, respectively. The mean ages of both groups were found to be comparable in both studies ($p = 0.1108$). Similarly, in groups P and H, 25 (83.33%) and 23 (76.67%) patients were married, respectively. The marital status of both groups was also found to be comparable, with no statistically significant difference ($p = 0.7480$) (Table 1).

In group P, 14 (53.33%) patients had a healthy weight, whereas 12 (40%) and 4 (13.33%) women were overweight and obese. In healthy control group H, 24 (76.67%) women had a normal healthy weight, whereas overweight and obesity were seen in 4 (6.67%) and 2 (6.67%) patients, respectively. The mean BMI of groups P and H was found to be 27.23 ± 5.82 and 23.15 ± 4.12 , respectively. The women in group P were found to have a higher BMI as compared to women in group H, and the difference was found to be statistically significant ($p = 0.0027$) (Table 2).

The mean waist circumference in groups P and H was found to be 86.26 and 83.15, respectively, whereas the hip circumference in groups P and H was 99.2 and 97.2, respectively. The mean H/W ratio was found to be 0.87 and 0.85, respectively (Fig. 1).

The mean pulse rate for Group P was 82.83, and for Group H, it was 84.15. In terms of systolic blood pressure, Group P had a mean of 113.5, while Group H had a mean of 117.26. For diastolic blood pressure,

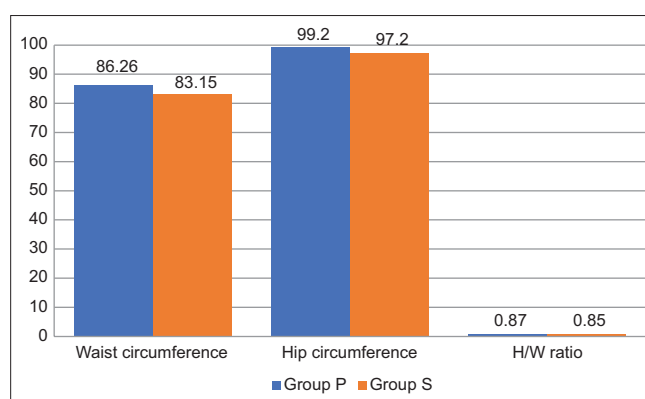


Fig. 1: Comparison of waist circumference, hip circumference, and hip/waist ratio

Table 1: Age groups and marital status of studied cases

Age group and marital status	Group P		Group H	
	No of patients	Percentage	No of patients	Percentage
Age groups				
18–20 years	15	50.00	9	30.00
21–25 years	10	33.33	11	36.67
26–30 years	4	13.33	9	30.00
Above 30 years	1	3.33	1	3.33
Total	30	100.00	30	100.00
	Mean age: 22.10±3.97		Mean age: 23.76±3.97	
p=0.1108 (Not significant)				
Marital status				
Married	5	16.67%	7	23.33%
Unmarried	25	83.33%	23	76.67%
Total	30	100.00%	30	100.00%

p=0.7480 (not significant)

Table 2: Comparison of body mass index in studied group

Body mass index	Group P		Group H	
	No of patients	Percentage	No of patients	Percentage
Healthy weight (18.5–24.9)	14	46.67	24	80.00
Overweight (25–29.9)	12	40.00	4	13.33
Obese (30 or above)	4	13.33	2	6.67
Total	30	100.00	30	100.00
	Mean BMI: 27.23±5.82		Mean Age: 23.15±4.12	

p=0.0027 (Significant)

Group P recorded a mean of 72.4, and Group H had a mean of 73.26. The mean pulse rate, systolic blood pressure, and diastolic blood pressure values were found to be comparable in both groups with no statistically significant difference ($p>0.05$) (Table 3).

The analysis and comparison of thyroid function tests in both groups showed that the mean FT3 levels in groups P and H were found to be 3.11 ± 0.88 and 3.13 ± 0.42 ng/mL, whereas the mean FT4 levels in groups P and H were found to be 0.96 ± 0.16 and 0.89 ± 0.15 µg/dL, respectively. The mean T3 and T4 levels of both groups were found to be comparable in both groups. However, the mean TSH level in groups P and H was found to be 4.95 ± 2.24 and 2.50 ± 1.19 0.3–4.5 µIU/mL, respectively. The mean TSH level in group P was found to be higher than group H, and the difference was found to be statistically significant ($p<0.001$) (Table 4).

DISCUSSION

The analysis of the patients on the basis of age distribution showed that the mean age of patients with PCOS and healthy individuals was 22.10 ± 3.97 years and 23.76 ± 3.97 , respectively. The mean ages of both groups were found to be comparable in both studies ($p=0.1108$). The mean BMI of groups P and H was found to be 27.23 ± 5.82 and 23.15 ± 4.12 , respectively. The women in group P were found to have a higher BMI as compared to the women in group H, and the difference was found to be statistically significant. Kedar *et al.* conducted a study to analyze thyroid dysfunction in women with polycystic ovarian syndrome [12]. The study found that the mean age of women in the PCOS group was 22.86 ± 3.5 years and in the control group was 24.3 ± 3.5 years. The BMI of the women in the PCOS group was 30.3 ± 7.6 kg/m², and in the control group it was 28.6 ± 5.6 kg/m². The higher BMI seen in the PCOS group in this study was similar to ours. Similar high BMIs in cases of PCOS have also been reported by authors such as Yuan *et al.* [13] and Barber *et al.* [14].

The mean waist circumference in groups P and H was found to be 86.26 and 83.15, respectively, whereas the hip circumference in groups P

Table 3: Pulse rate, systemic blood pressure and diastolic blood pressure

Pulse rate, systolic and diastolic blood pressure values	Group P		Group H		p-value
	Mean	SD	Mean	SD	
Pulse rate	82.83	10.75	84.15	14.10	p=0.6849
Systolic blood pressure	113.5	12.97	117.26	14.75	p=0.2987
Diastolic blood pressure	72.4	8.49	73.26	9.50	p=0.7129

Table 4: Comparison of thyroid function tests in both the groups

Thyroid function test	Group P		Group H		p-value
	Mean	SD	Mean	SD	
Mean FT3 Levels	3.11	0.88	3.13	0.42	p=0.9109
Mean free thyroxine levels	0.96	0.16	0.89	0.15	p=0.0857
Mean thyroid-stimulating hormone levels	4.95	2.24	2.50	1.19	p<0.001

and H was 99.2 and 97.2, respectively. The mean H/W ratio was found to be 0.87 and 0.85, respectively. The mean H/W ratio was higher in group P as compared to group H. Kumari *et al.* conducted a study to screen PCOS patients for the presence of obesity [15]. For this purpose, the authors measured waist circumference, hip circumference, and waist/hip ratio. The authors found the mean hip/waist ratio in PCOS patients to be higher as compared to the hip/waist ratio in healthy women, and the difference was reported to be statistically significant. The study concluded that the screening of obesity will help in the early detection of PCOS and management of obesity and PCOS, along with other associated problems like infertility and malignancy. A similar correlation between obesity and PCOS has also been reported by authors such as Naderpoor *et al.* [16] and Sam *et al.* [17].

The mean FT3 levels in groups P and H were found to be 3.11 ± 0.88 and 3.13 ± 0.42 ng/mL, whereas the mean FT4 levels in groups P and H were found to be 0.96 ± 0.16 and 0.89 ± 0.15 µg/dL, respectively. The mean T3 and T4 levels of both groups were found to be comparable in both groups. However, the mean TSH level in groups P and H was found to be 4.95 ± 2.24 and 2.50 ± 1.19 0.3–4.5 µIU/mL, respectively. The mean TSH level in group P was found to be higher than group H, and the difference was found to be statistically significant ($p<0.001$). Ding *et al.* conducted a meta-analysis to evaluate the prevalence of SCH in women with PCOS [18]. For this purpose, the authors undertook an extensive literature search in PubMed, Embase, Web of Science, and Cochrane Library databases. The prevalence of SCH in PCOS was calculated by the meta-analysis to produce an odds ratio (OR) with a 95% CI. A total of 6 studies, including 692 PCOS patients and 540 controls, were eligible for the meta-analysis. The combined OR of SCH risk for women with PCOS

compared with controls was 2.87 (95% CI=1.82–9.92; $p < 0.000001$). The OR increased to 3.59 when limiting the TSH cut-off to ≥ 4 mIU/L. On the basis of the findings of this meta-analysis, the authors concluded that women with PCOS are more likely to develop SCH. A similar increased incidence of subclinical hypothyroidism was also reported by authors such as Ganie *et al.* [19] and Benetti-Pinto *et al.* [20].

CONCLUSION

The increased incidence of subclinical hypothyroidism, as shown by elevated TSH levels in PCOS patients, makes it important to do thyroid function tests in these patients. Early diagnosis of thyroid dysfunction is important from the point of view of timely intervention.

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AUTHORS CONTRIBUTIONS

All authors have contributed to the preparation of the manuscript.

CONFLICT OF INTEREST

None.

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