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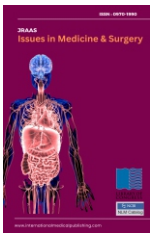

*Research Article*

**Section: Obstetrics & Gynecology**

# Prevalence of Subclinical Hypothyroidism in Polycystic Ovarian Syndrome

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## HIGHLIGHTS

- SCH is common in PCOS
- Routine thyroid screening
- Frequent menstrual irregularities
- Obesity is commonly observed
- No significant association

**Key Words:**
Polycystic ovary syndrome
Subclinical hypothyroidism
Thyroid stimulating hormone
Rotterdam criteria
Hyperandrogenism
Menstrual irregularities

## ABSTRACT

**Introduction:** Polycystic ovarian syndrome (PCOS) and hypothyroidism are common endocrine disorders affecting women of reproductive age, sharing clinical features such as menstrual irregularities, obesity, and infertility. This study aims to assess the prevalence of subclinical hypothyroidism (SCH) in women diagnosed with PCOS. **Aim & Objective:** To evaluate the prevalence of SCH in PCOS patients diagnosed using Rotterdam criteria, and to correlate thyroid dysfunction with clinical, anthropometric, and ultrasonographic parameters. **Materials & Methods:** An observational cross-sectional study was conducted among 80 reproductive-age women diagnosed with PCOS at a tertiary care hospital. Detailed history, anthropometric measurements (BMI, waist-hip ratio), clinical assessment for hyperandrogenism, thyroid profile (FT3, FT4, TSH), and transabdominal ultrasonography were performed. SCH was defined as elevated TSH with normal FT3 and FT4. **Results:** The mean age of participants was 24.63 ± 5.09 years. The majority were overweight (37.5%) or obese (38.75%). Menstrual irregularities were present in 90% of women. The prevalence of SCH was 18.75%, while 7.50% had overt hypothyroidism. The most common PCOS phenotype was O+H+P (53.75%). No statistically significant association was found between thyroid status and age, BMI, WHR, PCOS phenotype, or clinical features including acne, hirsutism, and menstrual complaints ($p>0.05$). However, a higher proportion of SCH was noted in patients with hair loss (33.3%) and heavy menstrual bleeding (23.1%). **Conclusion:** Subclinical hypothyroidism is prevalent in nearly one-fifth of women with PCOS, supporting routine thyroid screening in this population for early detection and management of thyroid dysfunction.

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## INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders affecting women of reproductive age. It is characterized by ovulatory dysfunction, hyperandrogenism, & polycystic ovarian morphology, although the clinical presentation varies considerably among individuals. Common manifestations include menstrual irregularities, infertility, acne, hirsutism, obesity, and metabolic abnormalities. As PCOS represents a syndrome rather than a single disease entity, diagnosis requires a combination of clinical, biochemical, and radiological findings while excluding other disorders that mimic similar features [1].

Globally, PCOS affects approximately 5–15% of women of reproductive age, with prevalence varying according to the diagnostic criteria used. The Rotterdam criteria generally identify a higher prevalence than the NIH or Androgen Excess Society (AES) criteria because they include a broader spectrum of phenotypes. In India, the reported prevalence ranges from 7% to 20%, with studies among adolescents and young women demonstrating rates as high as 20%. A survey among college-going women in Delhi NCR reported a prevalence of 17.4% using the Rotterdam criteria [2,3]. Beyond reproductive dysfunction, PCOS is associated with insulin resistance, obesity, dyslipidemia, metabolic syndrome, type 2 diabetes mellitus, non-alcoholic fatty liver disease, and adverse pregnancy outcomes. The syndrome also has a significant psychological impact, contributing to anxiety, depression, poor self-esteem, and reduced quality of life, making it an important public health concern [2,4].

The Rotterdam consensus (2003) remains the most widely accepted diagnostic framework for PCOS and requires the presence of any two of the following three features: oligo- or anovulation, clinical or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasonography after excluding other endocrine disorders. Earlier NIH criteria required both hyperandrogenism and ovulatory dysfunction, whereas AES criteria consider hyperandrogenism mandatory with either ovulatory dysfunction or polycystic ovaries. Consequently, the prevalence and phenotypic distribution of PCOS vary according to the diagnostic criteria employed [5,6]. Careful exclusion of disorders such as congenital adrenal hyperplasia, Cushing's syndrome, thyroid dysfunction, hyperprolactinemia, & androgen secreting tumors is essential to ensure accurate diagnosis [7].

Thyroid hormones regulate metabolism, reproductive function, and energy homeostasis through the hypothalamic-pituitary-thyroid axis. Subclinical hypothyroidism (SCH) is characterized by elevated serum thyroid-stimulating hormone (TSH) levels with normal free thyroxine (FT4) concentrations. Although patients are often asymptomatic, SCH has important reproductive and metabolic consequences. Its prevalence in the general population ranges from 4% to 10%, with women of reproductive age demonstrating prevalence rates of approximately 4–8% [8–10]. SCH has been associated with menstrual irregularities, impaired ovulation, infertility, adverse pregnancy outcomes, insulin resistance, dyslipidemia, metabolic syndrome, and progression to overt hypothyroidism, particularly in individuals with thyroid autoimmunity [9-12].

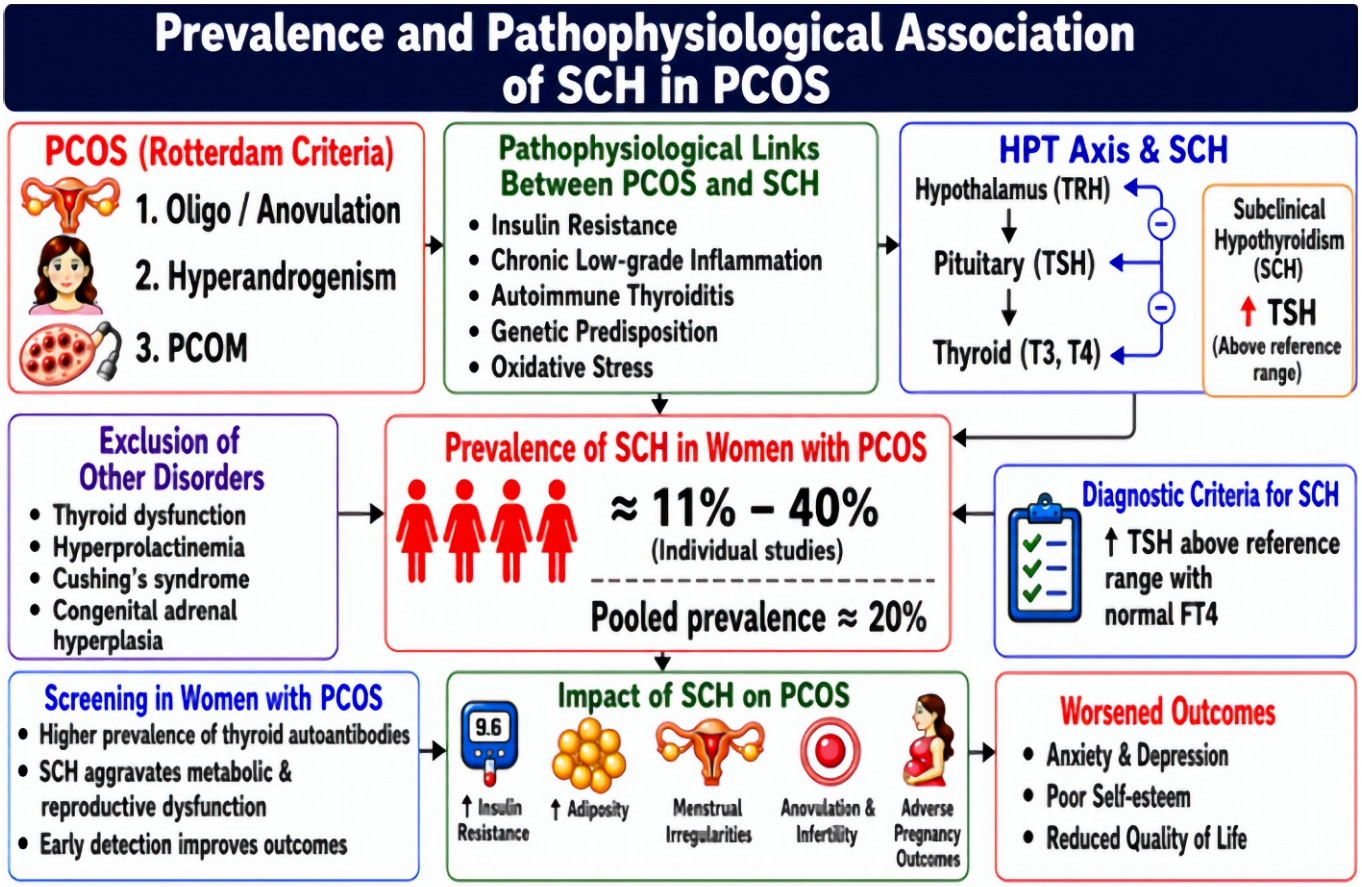


**Figure 1: Schematic representation of traumatic multiligament knee injury, arthroscopic findings, and single-stage ACL, PCL, and MCL reconstruction using peroneus longus and hamstring tendon grafts.**

Increasing evidence suggests a close relationship between PCOS and SCH. Both conditions share common pathogenic mechanisms, including obesity, insulin resistance, chronic low-grade inflammation, and autoimmune thyroid disease. Women with PCOS have a higher prevalence of thyroid autoantibodies and elevated TSH levels than healthy controls. The coexistence of SCH appears to aggravate metabolic dysfunction, resulting in increased insulin resistance, dyslipidemia, obesity, menstrual disturbances, and infertility compared with women having PCOS alone [13,14]. These findings support the importance of evaluating thyroid function in women with PCOS to facilitate early identification and comprehensive management.

Despite growing evidence, the reported prevalence of SCH among women with PCOS varies considerably, ranging from approximately 11% to 40%, while pooled analyses estimate an overall prevalence of nearly 20% [15,16]. In India, inconsistencies persist because of differences in TSH cut-off values, diagnostic criteria for PCOS, study populations, sample sizes, and methodologies. Furthermore, most available studies are cross-sectional, hospital-based, and include relatively small sample sizes. Limited evidence exists regarding the relationship between SCH and clinical manifestations, anthropometric parameters, biochemical abnormalities, and ultrasonographic findings in Indian women with PCOS. Standardized studies using uniform diagnostic criteria are therefore needed to clarify these associations and improve screening strategies [13,15,16].

**Figure 1**. Prevalence and pathophysiological association of subclinical hypothyroidism (SCH) in women with polycystic ovary syndrome (PCOS), highlighting diagnostic criteria, shared mechanisms, HPT-axis involvement, screening approaches, and metabolic and reproductive consequences.

The present study aims to determine the prevalence of subclinical hypothyroidism among women diagnosed with PCOS using the Rotterdam criteria. It also seeks to evaluate the association of SCH with clinical features, anthropometric measurements, biochemical parameters, thyroid function tests, and ultrasonographic findings. The findings are expected to improve understanding of thyroid dysfunction in women with PCOS and contribute to evidence-based recommendations for early diagnosis and comprehensive management.

## MATERIALS & METHODS

This observational cross-sectional study will be conducted in the Department of Obstetrics and Gynecology, K.D. Medical College Hospital and Research Centre, Mathura, Uttar Pradesh, after obtaining Institutional Ethics Committee approval. Women of reproductive age attending the outpatient department with symptoms suggestive of PCOS will be screened, and those fulfilling the Rotterdam criteria (presence of any two of the following: oligo/anovulation, clinical hyperandrogenism, or polycystic ovaries on ultrasonography) will be recruited after obtaining written informed consent. Women with overt hypothyroidism on treatment, thyroidectomy, prior head and neck irradiation, oral contraceptive use, pregnancy, lactation, Cushing syndrome, congenital adrenal hyperplasia, or virilizing tumors will be excluded. Consecutive sampling will be employed until the calculated sample size of 42 participants is achieved using the standard prevalence formula. All participants will undergo detailed history taking, anthropometric measurements, blood pressure recording, systemic examination, body mass index calculation, assessment of hirsutism using the modified Ferriman-Gallwey score, transabdominal pelvic ultrasonography, and thyroid function testing including serum free T3, free T4, and TSH levels. The study will adhere to the Declaration of Helsinki and Good Clinical Practice guidelines. A pilot study will be conducted to standardize study procedures and refine data collection tools, while validity and reliability will be ensured through standardized diagnostic criteria, calibrated instruments, trained personnel, and single-observer ultrasonography. Data will be collected using a predesigned proforma and analyzed using SPSS version 26 and Microsoft Excel. Descriptive statistics will summarize study variables, while continuous variables will be expressed as mean ± standard deviation and categorical variables as frequencies and percentages. The Chi-square test will be used for categorical comparisons, with a p-value <0.05 considered statistically significant.

## RESULT

**Table 1** showing the mean age of the 80 participants was **24.63 ± 5.09 years**. Most participants were aged **21–25 years (30.0%)**, followed by **17–20 years (28.8%)**, **31–35 years (21.2%)**, and **26–30 years (20.0%)**, indicating that the study population predominantly comprised young reproductive-aged women. **Table 2** illustrates that the educational distribution of the 80 study participants showed that primary education was most common (31.25%), followed by secondary (20.00%) and higher secondary (17.50%). Diploma and degree holders accounted for 13.75% and 10.00%, respectively, while 7.50% were illiterate, indicating that most participants had basic to intermediate education.Table 3: Marital Status Distribution of the Study Population (n = 80). **Table 3** illustrates that the distribution of marital status among the 80 study participants was nearly balanced, with 51.25% unmarried and 48.75% married, showing a slight predominance of unmarried women. **Table 4** illustrates that the most participants belonged to the **Upper Lower** socioeconomic class (36.25%), followed by **Lower Middle** (30.00%), **Upper Middle** (18.75%), and **Lower** (15.00%), indicating that the study population predominantly came from lower and lower-middle socioeconomic backgrounds. **Figure 2** shows that box–whisker plots show the distribution of height and weight among the 80 participants. The mean height was **154.6 cm** (140–173 cm) and the mean weight was **66.98 kg** (39–94 kg), indicating moderate variability, with greater variation in weight than height. **Figure 3** evaluates a box–whisker plot shows the BMI distribution among the 80 women with PCOS. The mean BMI was **28.19 kg/m²** (range: **14.24–45.39 kg/m²**), indicating wide variability, with the average falling in the overweight range and reflecting the heterogeneous anthropometric profile of the

study population. **Figure 4** examines the bar chart shows the distribution of BMI categories among the 80 women with PCOS. Most participants were **overweight or obese**, while fewer had **normal weight** or were **underweight**, highlighting the high prevalence of excess body weight in the study population. **Figure 5** focuses specifically on the distribution of waist circumference, hip circumference, and waist–hip ratio (WHR) among the 80 women with PCOS. The mean waist circumference was 72.47 cm, hip circumference 96.15 cm, and WHR 0.76, indicating moderate variability and suggesting central adiposity in a proportion of participants.

**Figure 6** shows that the bar chart shows the distribution of the Rotterdam diagnostic criteria among the 80 women with PCOS. Oligo/amenorrhea was the most common feature, followed by clinical hyperandrogenism and polycystic ovaries on ultrasonography. All participants fulfilled at least two of the three criteria required for a PCOS diagnosis. The bar chart shows the distribution of PCOS phenotypes based on the Rotterdam criteria. The **O + H + P** phenotype was the most common, followed by **O + H** and **O + P**, while **H + P** was the least frequent, demonstrating the heterogeneous presentation of PCOS **(Figure 7)**. **Figure 8** shows that 53.75% of participants fulfilled all three Rotterdam criteria, while 46.25% met two of the three criteria, indicating that most women had the complete PCOS phenotype, with the remainder showing partial phenotypes. In **Figure 9,** the bar chart shows the mean ± SD thyroid hormone levels among the 80 women with PCOS: **FT3: 3.47 ± 0.49**, **FT4: 1.21 ± 0.21**, and **TSH: 4.02 ± 3.15**. FT3 and FT4 showed low variability, whereas TSH exhibited greater variation, suggesting elevated TSH levels in a subset of participants.

**Figure 10** shows the thyroid status among the 80 women with PCOS. Most participants were **euthyroid (73.75%)**, while **18.75%** had **subclinical hypothyroidism** and **7.50%** had **overt hypothyroidism**, indicating that thyroid dysfunction, particularly subclinical hypothyroidism, was present in a substantial proportion of the study population. **Figure 11** shows the distribution of major clinical features among the 80 women with PCOS. **Acne (28.57%)** was the most common feature, followed by **hirsutism (22.73%)**, **weight gain (20.13%)**, **oily skin (14.94%)**, and **alopecia (13.64%)**, indicating that hyperandrogenic and metabolic manifestations were common.

**Figure 12** shows the horizontal bar chart shows menstrual and reproductive characteristics among the 80 women with PCOS. Oligomenorrhea (60%) was the most common finding, followed by amenorrhea (30%), infertility (22.5%), and heavy menstrual bleeding (16.2%), indicating that menstrual irregularities were highly prevalent. **Figure 13** shows that **80%** of the women had **polycystic ovaries on ultrasonography (USG)**, while **20%** had no polycystic ovarian morphology, indicating that ultrasonographic features were present in the majority of participants. **Table 5** shows thyroid status across different age groups. **Euthyroid** status predominated in all groups, while **subclinical hypothyroidism (SCH)** was present across all ages, with a relatively higher proportion in the **31–33 years** group. **Overt hypothyroidism** remained uncommon in all age categories. **Table 6** shows the relationship between age and serum TSH levels among the 80 participants. There was no significant correlation between age and TSH ($r = 0.016$, $p = 0.891$), indicating that TSH levels did not vary significantly with age. **Table 7** shows thyroid status across BMI categories among the 80 women with PCOS. Euthyroid status predominated in all BMI groups, with smaller proportions of subclinical and overt hypothyroidism. No significant association was found between thyroid status and BMI category ($p = 0.959$). **Table 8** shows the relationship between BMI and serum TSH levels among the 80 participants. There was a very weak, non-significant positive correlation between BMI and TSH ($r = 0.078$, $p = 0.489$), indicating no meaningful association. **Table 9** shows thyroid status according to the presence of polycystic ovaries on ultrasonography. Euthyroid status predominated in both groups, with slightly higher rates of subclinical and overt hypothyroidism among women with PCO. However, the association was not statistically significant ($p = 0.329$). **Figure 14:** The heatmap shows thyroid status across associated complaints among the 80 women with PCOS. Euthyroid status predominated in all complaint categories, while subclinical and overt hypothyroidism were less common, indicating no clear association between associated symptoms and thyroid status. **Figure 15:** The pie charts show thyroid status according to waist–hip ratio (WHR). **Euthyroid** status predominated in both **WHR <0.80** and **WHR ≥0.80** groups, with similar proportions of **subclinical** and **overt hypothyroidism**, indicating no marked variation in thyroid status by WHR.

**Figure 16:** The bubble plot shows the relationship between waist–hip ratio (WHR) and serum TSH levels among the 80 participants. There was a very weak, non-significant negative correlation between WHR and TSH ($r = -0.019$, $p = 0.865$), indicating no meaningful association. **Figure 17:** The clustered bar chart shows thyroid status across different PCOS phenotypes. Euthyroid status predominated in all phenotypes, while subclinical and overt hypothyroidism occurred less frequently. No significant association was found between PCOS phenotype and thyroid status ($p = 0.696$). **Figure 18:** The butterfly chart shows the distribution of subclinical hypothyroidism (SCH) and non-SCH participants across major clinical features. Non-SCH predominated in all categories, while SCH was most frequent in heavy menstrual bleeding, followed by amenorrhea, oligomenorrhea, and infertility, indicating no clear association between SCH and any single presenting complaint. **Figure 19:** The clustered bar chart compares subclinical hypothyroidism (SCH) and non-SCH participants across acne, hirsutism, oily skin, and hair loss. Non-SCH predominated in all groups, and no significant association was found between SCH and these clinical features (all $p > 0.05$), although hair loss showed a relatively higher proportion of SCH.

**Table 1: Age Distribution of the Study Population (n = 80)**

| Age Group | Number (n) | Percentage (%) |
|---|---|---|
| 17–20 years | 23 | 28.75% |
| 21–25 years | 24 | 30.00% |
| 26–30 years | 16 | 20.00% |
| 31–35 years | 17 | 21.25% |
| **Total** | 80 | 100% |
| **Mean age** | 24.63 ± 5.09 years | |

**Table 2: Education Distribution of the Study Population (n = 80)**

| Education Level | Number (n) | Percentage (%) |
|---|---|---|
| Illiterate | 6 | 7.50% |
| Primary | 25 | 31.25% |
| Secondary | 16 | 20.00% |
| Higher Secondary | 14 | 17.50% |
| Diploma | 11 | 13.75% |
| Degree | 8 | 10.00% |
| **Total** | **80** | **100%** |

**Table 3: Marital Status Distribution of the Study Population (n = 80).**

| Marital Status | Number (n) | Percentage (%) |
|---|---|---|
| Married | 39 | 48.75% |
| Unmarried | 41 | 51.25% |
| **Total** | 80 | 100% |

**Table 4: Socioeconomic Status Distribution of the Study Population (n = 80)**

| Socioeconomic Status | Number (n) | Percentage (%) |
|---|---|---|
| Lower | 12 | 15.00% |
| Lower Middle | 24 | 30.00% |
| Upper Lower | 29 | 36.25% |
| Upper Middle | 15 | 18.75% |
| **Total** | **80** | **100%** |

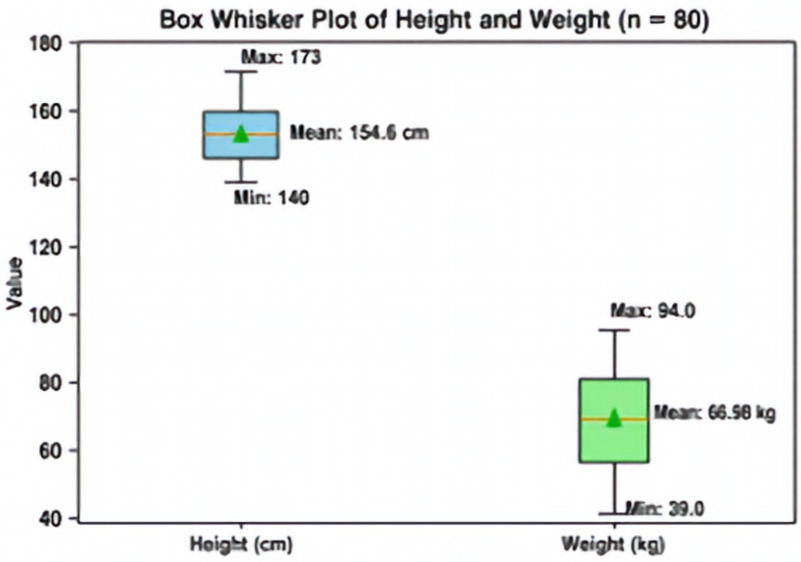


**Figure 2: Box–Whisker Plot of Height and Weight of the Study Population (n = 80)**

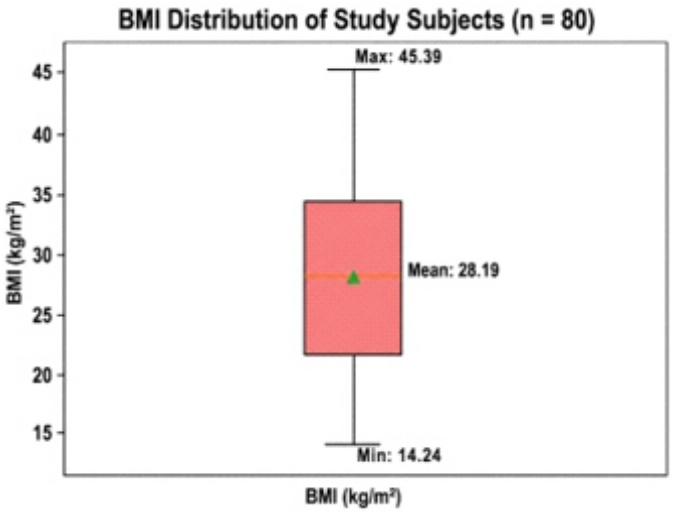


**Figure 3: Distribution of Body Mass Index (BMI) Among Study Subjects (n = 80**

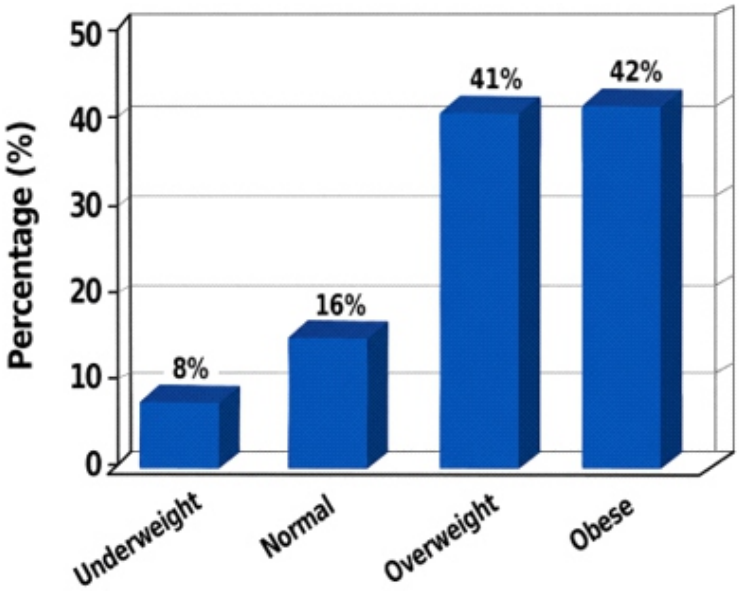


**Figure 4: BMI Categorization According to WHO Classification Among Study Participants (n = 80)**

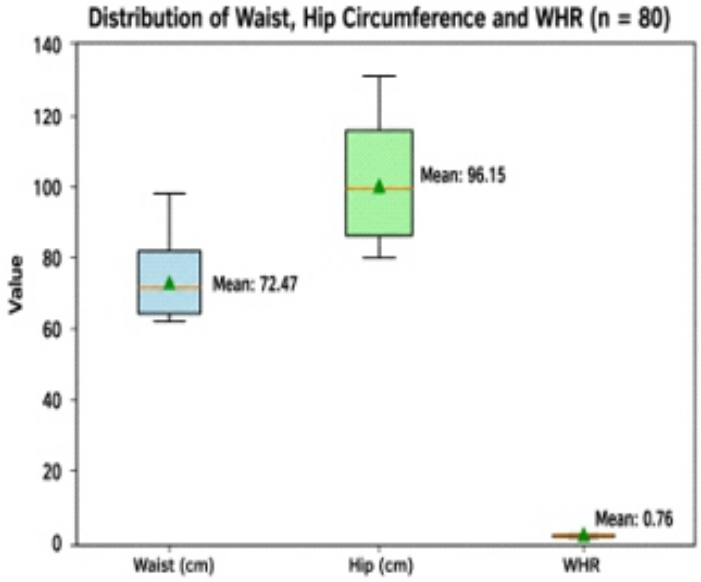


**Figure 5: Distribution of Waist Circumference, Hip Circumference, and Waist–Hip Ratio (WHR) Among Study Participants (n = 80)**

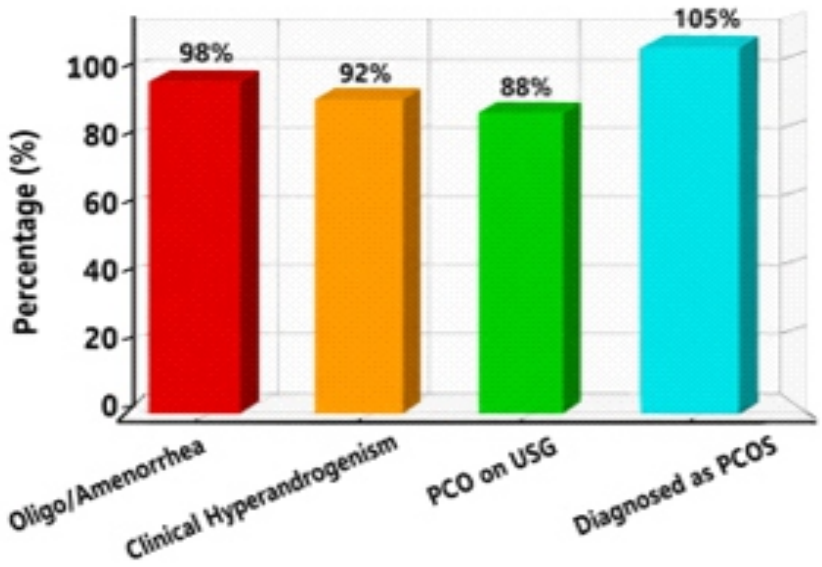


**Figure 6: Distribution of Diagnostic Criteria for PCOS Based on Rotterdam Criteria (n = 80)**

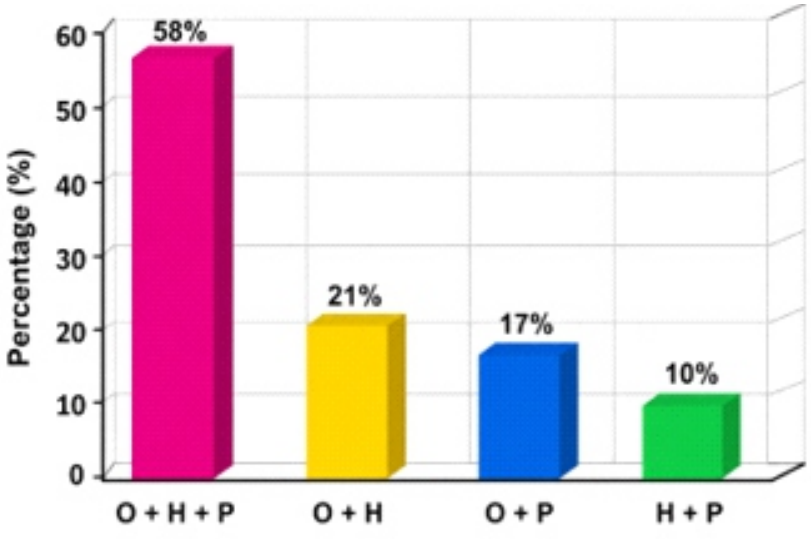


**Figure 7: Distribution of PCOS Phenotypes According to Rotterdam Criteria (n = 80)**

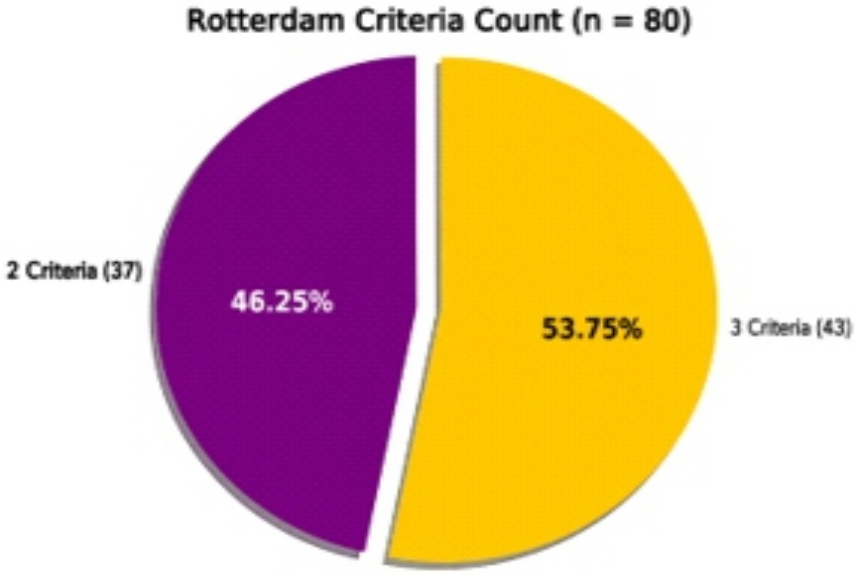


**Figure 8: Distribution of PCOS phenotypes based on Rotterdam criteria.**

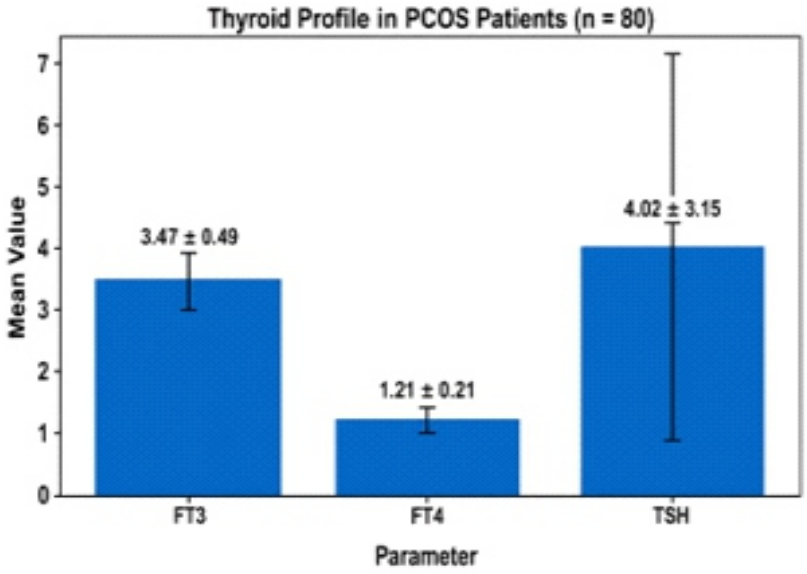


**Figure 9. Mean Thyroid Hormone Levels in PCOS Patients (n = 80)**

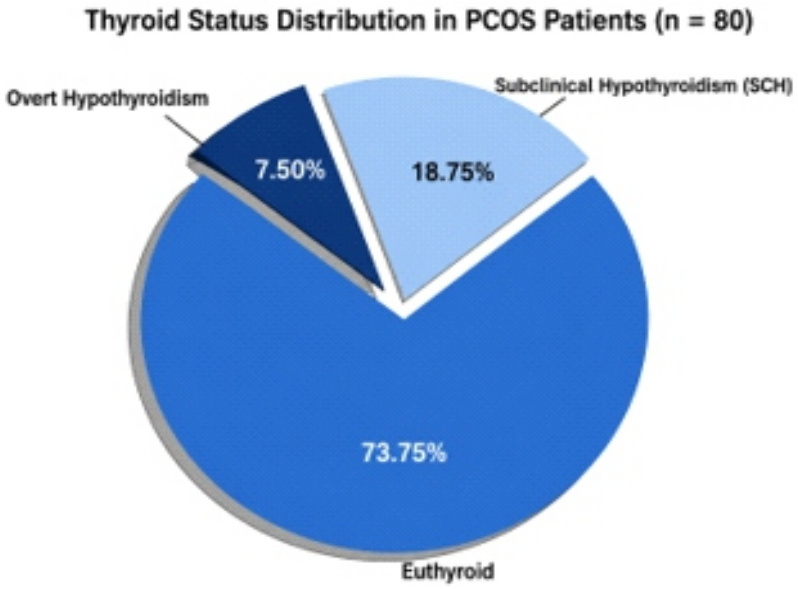


**Figure 10. Distribution of Thyroid Status Among PCOS Patients (n = 80)**

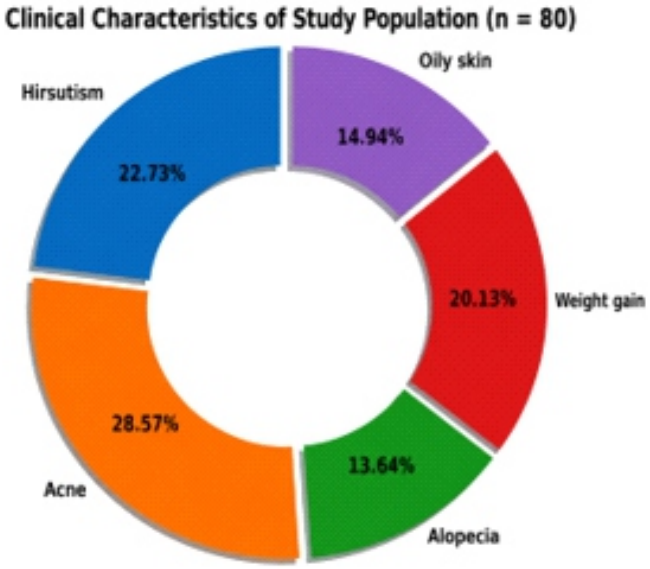


**Figure 11. Distribution of Clinical Characteristics Among the Study Population (n = 80)**

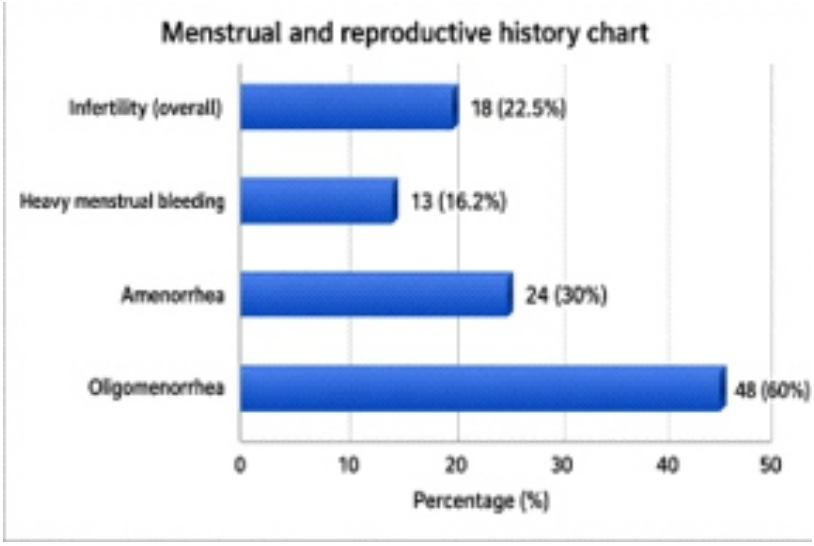


**Figure 12: Distribution of Menstrual and Reproductive History Among Study Participants (n = 80)**

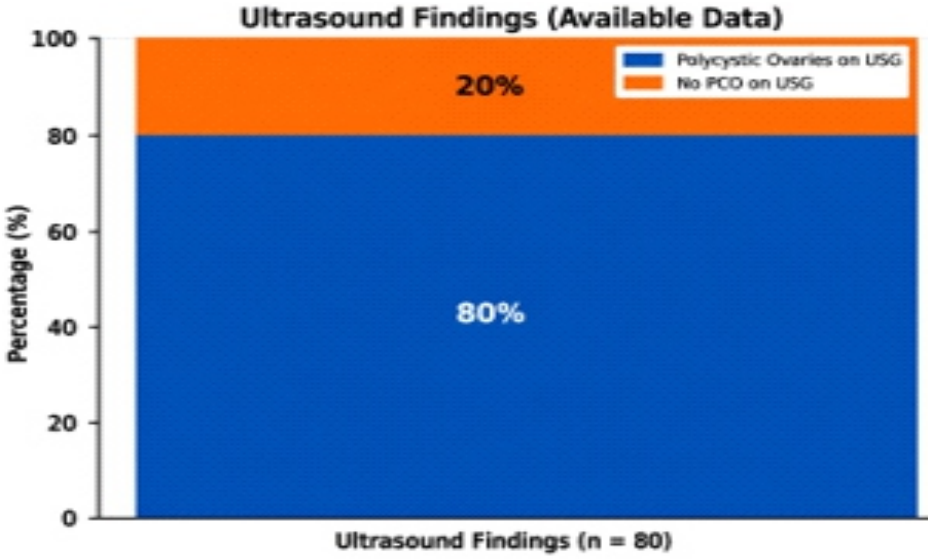


**Figure 13. Distribution of Ultrasound Findings Among PCOS Patients (n = 80)**

**Table 5: Association of Age with Thyroid Status (n = 80)**

| Age Group | Euthyroid n (%) | SCH n (%) | Overt Hypothyroidism n (%) | P-value |
|---|---|---|---|---|
| 17–20 years (23) | 15 (65.2%) | 5 (21.7%) | 3 (13.0%) | **0.861** |
| 21–25 years (24) | 19 (79.2%) | 4 (16.7%) | 1 (4.2%) | |
| 26–30 years (16) | 13 (81.2%) | 2 (12.5%) | 1 (6.2%) | |
| 31–33 years (17) | 12 (70.6%) | 4 (23.5%) | 1 (5.9%) | |

**Table 6: Correlation between Age and TSH Levels (n = 80)**

| Variables | Correlation Coefficient (r) | p-value |
|---|---|---|
| Age vs TSH | 0.016 | 0.891 |

**Table 7: Association of TSH Status with BMI Category (n = 80)**

| BMI Category | Euthyroid n (%) | SCH n (%) | Overt Hypothyroidism n (%) | P value |
|---|---|---|---|---|
| Underweight (7) | 6 (85.7%) | 1 (14.3%) | 0 (0%) | 0.959 |
| Normal (12) | 9 (75.0%) | 2 (16.7%) | 1 (8.3%) | |
| Overweight (30) | 21 (70.0%) | 7 (23.3%) | 2 (6.7%) | |
| **Obese (31)** | 23 (74.2%) | 5 (16.1%) | 3 (9.7%) | |

**Table 8: Correlation between BMI and TSH Levels (n = 80)**

| Variables | Correlation Coefficient (r) | p-value |
|---|---|---|
| BMI vs TSH | 0.078 | 0.489 |

**Table 9: Association of TSH Status with USG Findings (PCO) (n = 80)**

| USG Finding | Euthyroid n (%) | SCH n (%) | Overt Hypothyroidism n (%) | P-value |
|---|---|---|---|---|
| No PCO (16) | 14 (87.5%) | 1 (6.2%) | 1 (6.2%) | 0.329 |
| PCO Present (64) | 45 (70.3%) | 14 (21.9%) | 5 (7.8%) | |

**Table 10: Association of TSH Status with Main Complaints (n = 80)**

| Main Complaint | Euthyroid n (%) | SCH n (%) | Overt Hypothyroidism n (%) | p-value |
|---|---|---|---|---|
| Oligomenorrhea | 37 (77.1%) | 8 (16.7%) | 3 (6.2%) | 0.702 |
| Amenorrhea | 17 (70.8%) | 5 (20.8%) | 2 (8.3%) | 0.927 |
| Weight gain | 22 (68.8%) | 7 (21.9%) | 3 (9.4%) | 0.702 |
| Infertility | 15 (78.9%) | 3 (15.8%) | 1 (5.3%) | 0.829 |

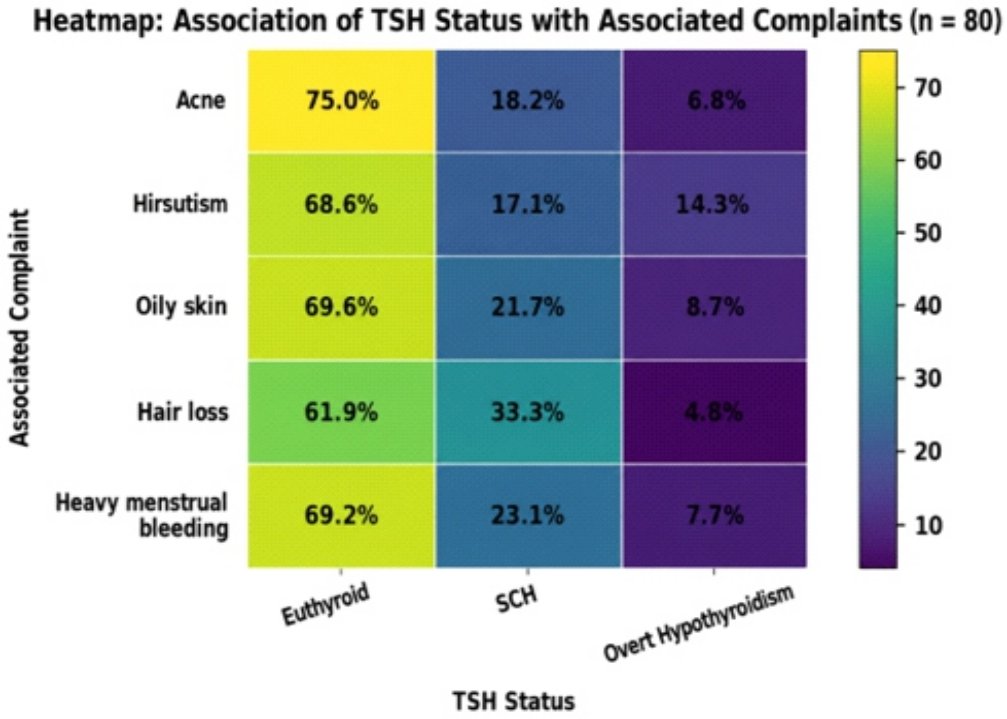


**Figure 14: Heatmap Showing Association of Thyroid Status with Associated Clinical Complaints in PCOS Patients (n = 80)**

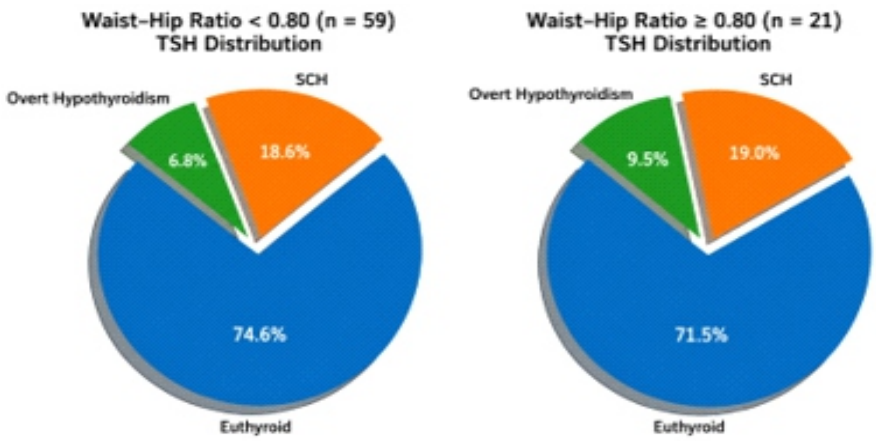


**Figure 15: Distribution of Thyroid Status According to Waist–Hip Ratio Categories in PCOS Patients (n = 80)**

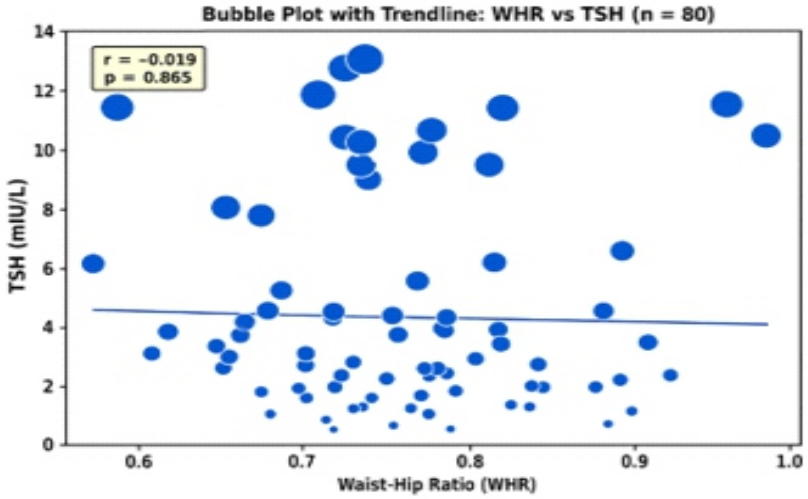


**Figure 16: Bubble Plot with Trendline Showing Correlation Between Waist–Hip Ratio and TSH Levels in PCOS Patients (n = 80)**

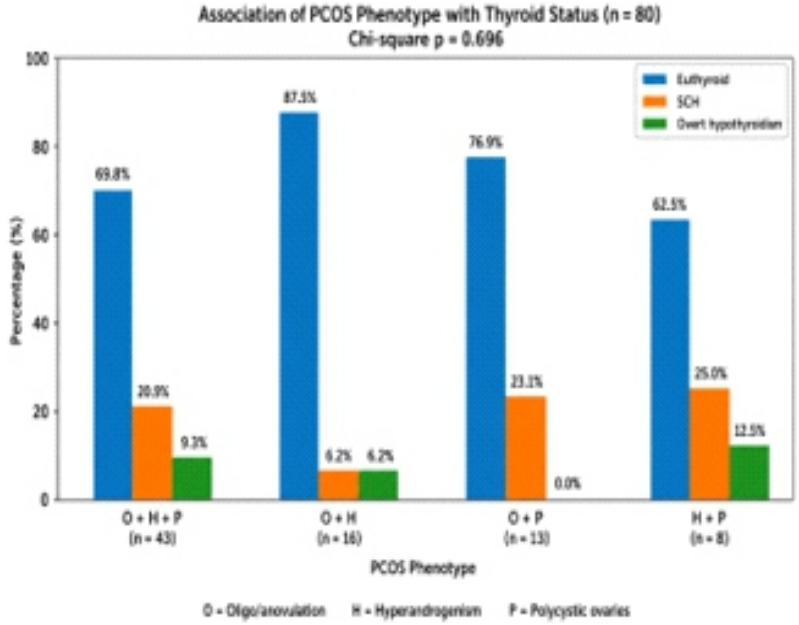


**Figure 17: Association of PCOS Phenotype with Thyroid Status Among Study Participants (n = 80)**

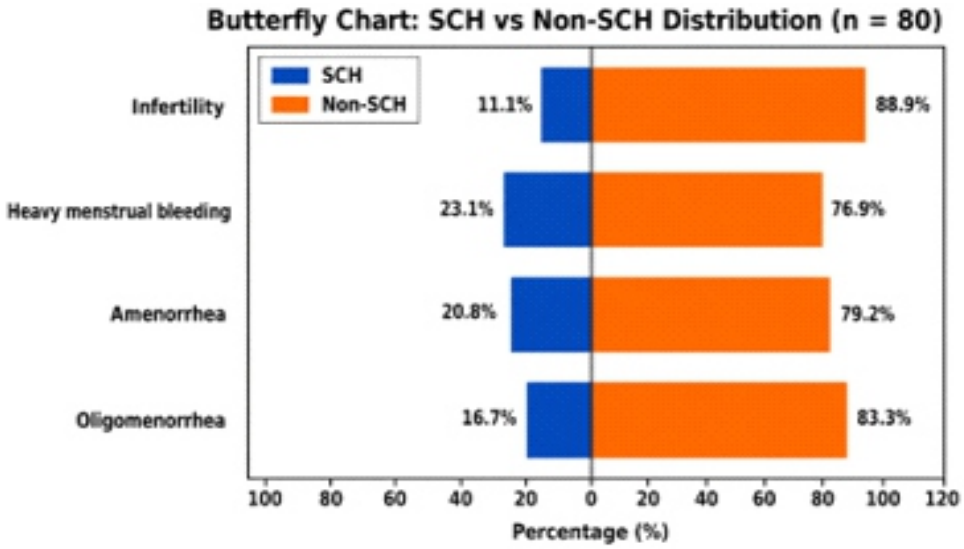


**Figure 18: Butterfly Chart Showing Distribution of Subclinical Hypothyroidism (SCH) and Non-SCH Among Major Clinical Features in PCOS Patients (n = 80)**

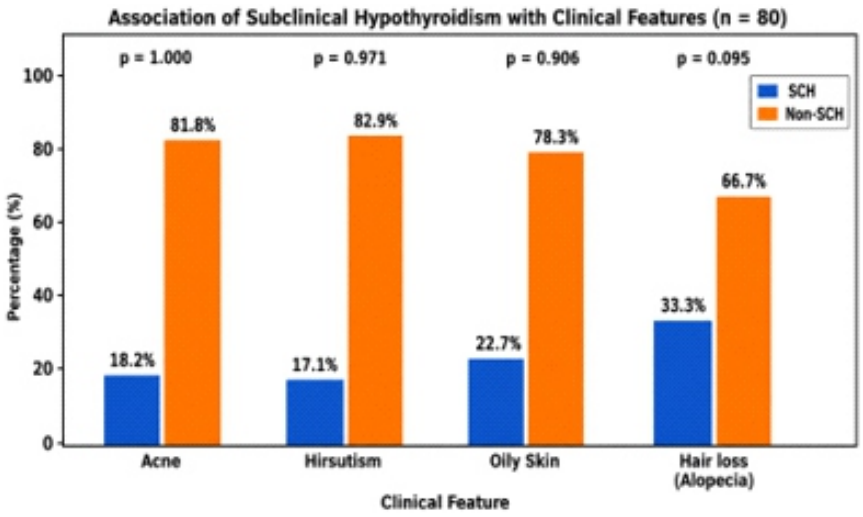


**Figure 19: Association of Subclinical Hypothyroidism with Selected Clinical Features in PCOS Patients (n = 80)**

## DISCUSSION

Polycystic ovary syndrome (PCOS) is one of the most prevalent endocrine disorders affecting women of reproductive age, with a global prevalence of 5–15% and Indian estimates ranging from 7–20%, depending on the diagnostic criteria used. The Rotterdam criteria identify a broader spectrum of phenotypes than the NIH and AES criteria, resulting in higher reported prevalence rates [1,2]. Beyond reproductive manifestations such as menstrual irregularities, anovulation, and hyperandrogenism, PCOS is strongly associated with obesity, insulin resistance, dyslipidemia, metabolic syndrome, and an increased risk of type 2 diabetes mellitus, making it an important public health concern [1,2]. Subclinical hypothyroidism (SCH), defined by elevated TSH with normal FT4 levels, affects approximately 4–10% of the general population and is more common in women. The coexistence of PCOS and SCH has attracted considerable attention because both conditions share common mechanisms, including obesity, insulin resistance, chronic inflammation, and thyroid autoimmunity. Women with both disorders often demonstrate greater metabolic disturbances, adverse lipid profiles, menstrual dysfunction, and impaired fertility than women with PCOS alone [3–6].

The present study included 80 women with a mean age of **24.63 ± 5.09 years**, with most participants belonging to the 21–25-year age group, reflecting the period during which PCOS is most frequently diagnosed. Similar observations were reported by Polyzos et al., although they found no significant association between thyroid dysfunction and ovarian reserve, suggesting that thyroid abnormalities occur irrespective of age-related ovarian function [17]. Nearly half of the participants were unmarried, consistent with the young age profile, while the predominance of women from lower socioeconomic groups reflects the demographic characteristics commonly observed in tertiary care hospitals. Previous studies have also demonstrated a higher burden of PCOS among women from lower socioeconomic backgrounds, emphasizing the influence of social determinants on reproductive and metabolic health [19–21]. Educational attainment was generally limited in the present cohort, and previous evidence indicates that lower health literacy may adversely influence disease awareness, treatment adherence, and endocrine outcomes among women with PCOS [18].

Anthropometric assessment demonstrated a mean BMI of **28.19 kg/m²**, indicating that most participants were overweight or obese. The mean weight was **66.98 kg**, and central adiposity, assessed by waist circumference and waist–hip ratio, was also common. These findings are consistent with earlier reports demonstrating that obesity is highly prevalent among women with PCOS and contributes significantly to insulin resistance, cardiovascular risk, and metabolic syndrome [22]. Studies by Zhu and Dai further demonstrated that increased waist circumference and waist–hip ratio are associated with insulin resistance and adverse metabolic profiles, particularly among women with SCH, highlighting the importance of evaluating central obesity in PCOS [23,24]. However, despite the high prevalence of obesity, BMI and waist–hip ratio showed no significant association with thyroid status or serum TSH levels in the present study, findings comparable with those of Tagliaferri, AlFaisal, and Rahbar, who similarly reported that obesity alone is not an independent determinant of thyroid dysfunction in PCOS [27,29,30,33].

More than half of the participants fulfilled all three Rotterdam diagnostic criteria, while the remainder satisfied two of the three criteria, confirming the heterogeneous nature of PCOS. Lauritsen et al. similarly demonstrated that the Rotterdam criteria identify a broader spectrum of PCOS phenotypes than stricter diagnostic definitions, thereby increasing prevalence estimates [25]. In the present study, ultrasound revealed polycystic ovarian morphology in 80% of women, supporting its value in diagnosis. However, thyroid status was not significantly associated with ultrasonographic ovarian morphology or PCOS phenotype, consistent with previous reports showing that mild thyroid dysfunction does not substantially alter the clinical phenotype of PCOS [26,28,34].

The prevalence of thyroid dysfunction observed in the present study is clinically important. Although **73.75%** of participants were euthyroid, **18.75%** had subclinical hypothyroidism and

**7.50%** had overt hypothyroidism, indicating that nearly one-fourth of women with PCOS exhibited some degree of thyroid dysfunction. These findings closely resemble previous Indian studies reporting SCH prevalence ranging from approximately 13% to 22% among women with PCOS [26]. Similar evidence indicates that thyroid autoimmunity and elevated TSH levels occur more frequently in women with PCOS than in healthy controls, supporting routine thyroid function assessment in this population [13,26].

Clinical manifestations in the present study were dominated by acne, hirsutism, weight gain, and oily skin, while oligomenorrhea (60%) and amenorrhea (30%) represented the most common menstrual abnormalities. These observations agree with previous studies describing hyperandrogenism and ovulatory dysfunction as the cardinal manifestations of PCOS [25,26]. Although women with SCH showed slightly higher frequencies of menstrual disturbances and hair loss, none of these associations reached statistical significance. Similarly, thyroid dysfunction was not significantly associated with infertility, obesity, acne, hirsutism, or ultrasonographic findings. These observations are consistent with several studies demonstrating that SCH primarily influences metabolic parameters rather than the overt clinical manifestations of PCOS [24,27,31,32].

The relationship between thyroid dysfunction and metabolic abnormalities remains clinically relevant. Previous investigations have shown that women with PCOS and SCH frequently exhibit higher fasting insulin, HOMA-IR, triglycerides, total cholesterol, and BMI than euthyroid women with PCOS [14,16,24]. Although the present study did not demonstrate statistically significant associations between thyroid status and BMI, waist–hip ratio, menstrual complaints, or PCOS phenotype, the observed prevalence of SCH reinforces the importance of routine thyroid screening. Mild thyroid dysfunction may contribute to long-term metabolic complications even in the absence of obvious clinical manifestations. Earlier studies have similarly suggested that elevated TSH may coexist with normal FT3 and FT4 concentrations while still reflecting subtle impairment in tissue thyroid hormone activity [33]. Age was not significantly correlated with thyroid status or serum TSH levels, indicating that thyroid dysfunction may occur across the reproductive age spectrum in women with PCOS. Comparable findings have been reported by Polyzos and others, suggesting that thyroid abnormalities are independent of age but may influence menstrual disturbances and metabolic outcomes [17,28]. Likewise, no significant association was observed between SCH and different PCOS phenotypes, supporting earlier reports that subclinical thyroid dysfunction does not substantially modify the phenotypic expression of PCOS despite its metabolic implications [34]. Overall, the present findings demonstrate that thyroid dysfunction, particularly subclinical hypothyroidism, is relatively common among women with PCOS, although significant associations with clinical presentation, anthropometric indices, ultrasonographic findings, or PCOS phenotype were not identified.

The coexistence of SCH nevertheless represents an important metabolic concern because previous evidence consistently links it with insulin resistance, dyslipidemia, and adverse cardiovascular risk [13–16]. Routine thyroid function testing in women with PCOS may therefore facilitate early identification of thyroid abnormalities, allow timely intervention, and contribute to comprehensive management aimed at improving both reproductive and long-term metabolic outcomes [26,32].

## CONCLUSION

The present study demonstrates that subclinical hypothyroidism (SCH) is relatively common among women with Polycystic Ovary Syndrome (PCOS), with a prevalence of **18.75%**, while an additional **7.5%** had overt hypothyroidism. Most participants were young, overweight or obese, and presented with menstrual irregularities and hyperandrogenic features, reflecting the typical clinical profile of PCOS. Although thyroid dysfunction was frequently observed, no significant associations were found between thyroid status and age, BMI, waist–hip ratio, PCOS phenotype, ultrasonographic findings, or most clinical manifestations. These findings suggest that SCH may coexist with PCOS irrespective of clinical presentation or anthropometric characteristics. Therefore, routine thyroid function screening should be considered for all women diagnosed with PCOS to enable early detection and appropriate management of thyroid dysfunction, thereby potentially improving reproductive and metabolic outcomes. Further large-scale prospective studies are warranted to clarify the causal relationship between PCOS and SCH and to evaluate the long-term benefits of early diagnosis and treatment..

## LIMITATIONS & FUTURE PERSPECTIVES

The study's limitations include a single-centre setting, a relatively small sample size, and a short study duration, which may limit the broader applicability of the results. Future studies should incorporate multicentre designs with larger populations to enhance validity, assess long-term outcomes, and investigate advanced diagnostic & management approaches. Such efforts will improve overall patient care & help minimize complications.

## CLINICAL SIGNIFICANCE

The clinical significance of this study lies in its potential to bridge the gap between research findings and practical healthcare applications. It emphasizes the importance of translating scientific observations into meaningful improvem-ents in patient care, diagnosis, and treatment outcomes. By highlighting real-world relevance, the study contributes to evidence based medical practice and supports informed clinical decision making. Ultimately, the findings aim to enhance patient quality of life, optimize therapeutic strategies, and promote better disease management in clinical settings.

## ABBREVIATIONS

**BMI:** Body Mass Index

**FT3:** Free Triiodothyronine

**FT4:** Free Thyroxine
**H:** Hyperandrogenism
**O:** Oligo-/Anovulation
**P:** Polycystic Ovaries
**PCOS:** Polycystic Ovarian Syndrome
**SCH:** Subclinical Hypothyroidism
**TSH:** Thyroid-Stimulating Hormone

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## AUTHOR CONTRIBUTIONS

All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteria outlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

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Authors declared that there is no conflict of interest.

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All necessary consent & approval was obtained by authors.

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All necessary consent for publication was obtained by authors.

## DATA AVAILABILITY

All data generated and analyzed are included within this research article. The datasets utilized and/or analyzed in this study can be obtained from the corresponding author upon a re-asonable request.

## USE OF ARTIFICIAL INTELLIGENCE (AI) & LARGE LANGUAGE MODEL (LLM)

The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

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This article serves as an important educational tool for the scientific community, offering insights that may inspire future research diretions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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