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Original research article

EFFECT OF THYROID DYSFUNCTION ON BODY MASS INDEX AND HORMONAL IMBALANCE IN WOMEN HAVING POLYCYSTIC OVARIAN SYNDROME

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Abstract: *Polycystic ovary syndrome (PCOS) is a prevalent gynecological disorder that significantly impacts women of reproductive age. Both PCOS and thyroid dysfunction independently increase the risk of ovarian dysfunction and prenatal complications. International studies have associated thyroid dysfunction with menstrual irregularities in women.* ***Objective:*** *This study aims to understand the influence of thyroid dysfunction on Body Mass Index (BMI) and hormonal imbalance in women diagnosed with PCOS.* ***Methods:*** *A cross-sectional study was conducted at two medical facilities, Sardar Begam Hospital and Cheema Family Hospital, involving participants aged 18 to 43 years. The sample size consisted of women diagnosed with PCOS. Data collection spanned from April 2023 to April 2024. A structured questionnaire was utilized to collect data on participants' history of PCOS, symptoms of irregular menstrual cycles, and BMI. Blood samples were collected to measure thyroid hormone levels, which were analyzed using ELISA. Statistical analysis was performed using [Insert Statistical Software], applying descriptive statistics and comparative analysis to assess the impact of thyroid dysfunction on BMI and hormone levels in PCOS patients.* ***Results:*** *The study findings indicate that 73.33% of women with both PCOS and thyroid dysfunction experienced weight gain, whereas only 26.67% did not report weight gain. Additionally, 80% of the participants reported acne, 60% experienced hirsutism, and 90% had irregular menstrual cycles. Muscle weakness and low energy were prevalent in 63.33% of the women, while 73.33% reported depression, and 66.67% reported hair loss. Significant differences were observed in the levels of Triiodothyronine (T3) and Thyroxine (T4) among women with PCOS with and without thyroid dysfunction. Specifically, for T3 levels, PCOS patients with thyroid dysfunction had a mean level of 7.3213, whereas those without thyroid dysfunction had a mean level of 63.812. Similarly, for T4 levels, PCOS patients with thyroid dysfunction had a mean level of 7.3213, compared to 63.812 in those without thyroid dysfunction.* ***Conclusion:*** *The study highlights the substantial impact of thyroid dysfunction on both T3 and T4 levels in PCOS patients. These findings underscore the importance of routine thyroid function screening in PCOS patients to devise more personalized and effective treatment strategies.*

Keywords: Acne, Body Mass Index, Hirsutism, Polycystic Ovary Syndrome, Thyroid Dysfunction, Triiodothyronine, Thyroxine, Weight Gain.

Introduction

The butterfly-shaped gland, weighing approximately 20 grams, produces hormones essential for metabolism, growth, and development (1). Proper thyroid function relies on adequate dietary iodine. The thyroid primarily secretes Thyroxine (T4) and Triiodothyronine (T3), with T3 being the active form that impacts cellular metabolism (2). These hormones are critical for the female reproductive system, regulating ovarian and uterine development. Consequently, hypothyroidism can lead to infertility and subfertility (3).

Thyroid disorders, affecting 0.8-5% of the population, are more prevalent in females and often autoimmune in nature. These disorders can significantly impact the female reproductive system, causing menstrual irregularities and fertility issues (4). Early stages of thyroid dysfunction can affect conception and womb accessibility, leading to delayed sexual development in infants and puberty issues in adolescents. In adults, severe hypothyroidism is associated with reduced sexual desire, diminished fertility, and ovulation difficulties (5).

Polycystic Ovary Syndrome (PCOS) is characterized by excessive male hormone production, leading to hormonal imbalance in women (6). It is named after the small cysts that often develop in the ovaries. PCOS disrupts ovulation, leading to elevated androgen levels and menstrual irregularities. PCOS affects 5-11% of women of reproductive age, causing menstrual disorders, infertility, ovulatory dysfunction, hirsutism, and androgenic disorders (7). The condition results from a complex interplay between genetic and environmental factors (8).

Thyroid disorders and PCOS, two common endocrine syndromes, share similarities in their impact on reproductive health (9). Thyroid dysfunction, even in its early stages, can significantly affect fertility by disrupting ovulation and endometrial receptivity. Up to 50% of women with PCOS are also obese, increasing the likelihood of ovulation difficulties due to insulin resistance, which stimulates excessive male hormone production in the ovaries. Weight loss through diet and exercise can improve ovulation and fertility outcomes in these women (10).

Thyroid autoimmunity is linked to various types of thyroid dysfunction, affecting menstrual cycles and fertility(11) . Hormonal imbalances can result from multiple factors, including contraceptives, stress, poor nutrition, and

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environmental toxins. Hypothyroidism disrupts reproductive hormones, leading to ovarian hypertrophy, cyst formation, and menstrual irregularities. These disruptions can significantly impact fertility and overall reproductive health(12) .

Thyroid hormones are essential for both metabolic regulation and reproductive health, with receptors present in the ovary, uterus, and the fetus-mother unit during implantation. Thyroid hormone deficiency in PCOS can affect ovarian function and fertility, leading to delayed sexual maturation and irregular periods (13). The combination of PCOS and thyroid disorders increases the risk of ovarian dysfunction and pregnancy complications. Measuring TSH and T4 levels can help diagnose and manage primary hypothyroidism, suggesting a causal link between hypothyroidism and ovarian stimulation(14).

This study aims to determine the relationship between BMI and T3 and T4 levels in patients with infertility, exploring the impact of thyroid dysfunction on hormonal profiles and fertility outcomes in women diagnosed with PCOS. Understanding these interactions can help healthcare professionals develop more targeted and effective treatment plans for individuals with these conditions.

Methodology

This study was conducted at two medical facilities, Sardar Begam Hospital and Cheema Family Hospital in Sialkot, with a sample size of one hundred females (N=60). The participants, aged between 18 and 43 years, were divided into two groups: a control group of 30 females and another group of 30 females diagnosed with thyroid dysfunction and polycystic ovary syndrome (PCOS). Blood samples were collected from all participants to measure thyroid hormone levels, and a questionnaire was used to gather information related to the history of PCOS, irregular menstrual cycles, and Body Mass Index (BMI).

The questionnaire collected demographic data such as age, lifestyle, and weight, along with physical measurements, including BMI calculation and a physical examination. Blood tests were conducted to measure thyroid hormone levels, specifically T3 and T4, using the ELISA technique. For weight measurement, a beam scale placed on a flat, hard surface was used, with participants removing their shoes and heavy clothing to ensure accuracy. Height was measured using a stadiometer, with participants standing against a wall on a flat surface without shoes. These measurements were then used to calculate BMI by dividing weight in kilograms by height in meters squared (kg/m^2). Participants were categorized into three groups based on their BMI values: normal (BMI < 25), overweight ($25 \leq$ BMI < 30), and obese (BMI ≥ 30), according to the World Health Organization's criteria for assessing obesity.

Data collection involved the use of a detailed questionnaire to gather medical history and demographic information. A blood sample (5ml) was collected from each participant and placed in a serum separator (SST) tube. After allowing the blood to clot at room temperature for 30 minutes, the samples were centrifuged at 3000 rpm for ten minutes to separate the serum, which was then stored at -20 degrees Celsius until testing. The ELISA method was employed to measure T3 and T4 levels, providing valuable insights into the participants' thyroid hormone levels.

In the ELISA procedure, specific amounts of detection buffer and sample were carefully prepared and mixed. The mixture was incubated at room temperature for 8 minutes before being placed into the sample well of a cartridge. Enzyme conjugate (HRP) was added to the wells, and the cartridge was incubated in the i-chamber at 25°C for another 8 minutes. The results were then scanned and displayed using the ichroma TM instrument, ensuring accurate readings of thyroid hormone levels.

This comprehensive approach, combining physical measurements, detailed questionnaires, and advanced blood analysis, enabled a thorough investigation of the relationship between thyroid dysfunction and BMI in women with PCOS. The collected data, including age, medical history, and thyroid hormone levels, were entered into a laptop for further analysis, providing insights into the impact of thyroid dysfunction on hormonal profiles and fertility outcomes in these patients.

Results

A comprehensive study was conducted to examine the effect of thyroid dysfunction on Body Mass Index (BMI) and hormonal imbalance in women having Polycystic Ovary Syndrome (PCOS). The study took place at Sardar Begum Hospital and Cheema Family Hospital in Sialkot, from April 2024 to May 2024. The sample size for the study was n=60 females from these hospitals. The participants were divided into two groups: 30 females in the control group (no disease) and 30 females with both thyroid dysfunction and PCOS. These participants were between 18 to 43 years old. To gain insights into the hormonal imbalances and BMI variations associated with thyroid dysfunction in PCOS patients, blood samples were collected from all participants for thyroid tests. Additionally, a comprehensive questionnaire was administered to understand the prevalence and characteristics of symptoms related to PCOS and thyroid dysfunction. The following are the summarized findings from the blood tests and questionnaire results:

Table 1 provide a collected from a questionnaire investigating various symptoms in women having Polycystic Ovary Syndrome (PCOS) and thyroid dysfunction. The symptoms investigated included weight gain, acne, hirsutism, irregular menstrual cycles, muscle weakness and low energy, depression, and hair loss.

Table 1: Prevalence of Symptoms in PCOS Patients with Thyroid Dysfunction

Symptom	Response	Frequency	Percent
Weight Gain	No	8	13.33
	Yes	22	36.67
Acne	No	6	10.0
	Yes	24	40.0
Hirsutism	No	12	20.0

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	Yes	18	30.0
Irregular Menstrual Cycle	No	3	5.0
	Yes	27	45.0
Muscle Weakness and Low Energy	No	11	18.33
	Yes	19	31.67
Depression	No	8	13.33
	Yes	22	36.67
Hair Loss	No	10	16.67
	Yes	20	33.33

Table 1 summarizes the prevalence of various symptoms among women with Polycystic Ovary Syndrome (PCOS) and thyroid dysfunction, expressed as percentages. Notably, 73.33% of the participants reported weight gain, 80.0% reported acne, 60.0% reported hirsutism, 90.0% reported irregular menstrual cycles, 63.33% reported muscle weakness and low energy, 73.33% reported depression, and 66.67% reported hair loss. These percentages highlight a significant prevalence of these symptoms among the affected individuals, underscoring the impact of thyroid dysfunction on women with PCOS.

Table 2 presents the results of a T-test comparing the levels of Triiodothyronine (T3) and Thyroxine (T4) in the blood of women with Polycystic Ovary Syndrome (PCOS) with and without thyroid dysfunction. The analysis reveals significant differences ($p < 0.05$, $\alpha = 95\%$) between the two groups for both T3 and T4 levels.

Table 2: Analysis of Thyroid Hormone Levels

Variable	Mean	SE	Lower	Upper	T	DF	P
T3	7.3213	2.1117	3.0183	11.6243	3.4671	29	0.00
T4	63.812	8.7159	45.823	81.8123	7.3172	29	0.00

For PCOS patients with thyroid dysfunction, the mean T3 level was 7.3213 (SE = 2.1117, 95% CI [3.0183, 11.6243], T = 3.4671), while for those without thyroid dysfunction, the mean T3 level was 63.812 (SE = 8.7159, 95% CI [45.823, 81.8123], T = 7.3172). Similarly, for T4 levels, PCOS patients with thyroid dysfunction had a mean of 7.3213 (SE = 2.1117, 95% CI [3.0183, 11.6243], T = 3.4671), whereas those without thyroid dysfunction had a mean of 63.812 (SE = 8.7159, 95% CI [45.823, 81.8123], T = 7.3172). The significant t-values (3.4671 and 7.3172) with p-values of 0.00 indicate substantial differences in T3 and T4 levels between the groups. Consequently, the null hypothesis was rejected in favor of the alternative hypothesis, suggesting that thyroid dysfunction significantly impacts T3 and T4 levels in PCOS patients.

Figure 1 illustrates the prevalence of various symptoms among PCOS patients with thyroid dysfunction. A notable 73.33% of the participants reported weight gain, while 26.67% did not experience this issue. Acne was prevalent in 80% of the women, with only 20% reporting no acne. Hirsutism affected 60% of the participants, whereas 40% did not experience it. An overwhelming 90% of the women had irregular menstrual cycles, in contrast to the 10% with regular cycles.

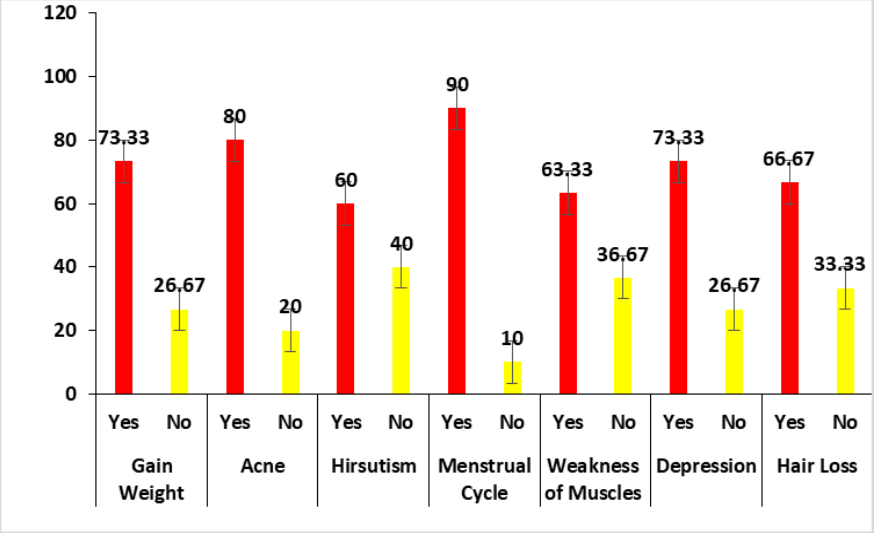

Figure 1 Prevalence of Various Symptoms in PCOS Patients with Thyroid Dysfunction

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Additionally, 63.33% of the participants experienced muscle weakness and low energy, while 36.67% did not. Depression was reported by 73.33% of the women, with 26.67% not experiencing it. Finally, hair loss was noted in 66.67% of the participants, compared to 33.33% who did not report hair loss.

Discussion

Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder among women of reproductive age, often associated with metabolic complications such as thyroid dysfunction (15). This study aimed to investigate the impact of thyroid dysfunction on body mass index (BMI) and hormonal imbalance in women with PCOS in District Sialkot. Conducted between April 2024 and May 2024 at Sardar Begum Hospital and Cheema Family Hospital, the study involved 60 female participants aged 18 to 43 years. The participants were divided into two groups: 30 women with no disease (control group) and 30 women with both PCOS and thyroid dysfunction (study group). Blood samples were collected to assess thyroid function, and a comprehensive questionnaire was distributed to better understand the symptoms and effects of PCOS and thyroid dysfunction.

The findings indicate that 73.33% of women with both PCOS and thyroid dysfunction experienced weight gain, while 26.67% did not report weight gain. Additionally, 80% of the participants reported acne, 60% experienced hirsutism, and 90% had irregular menstrual cycles. Muscle weakness and low energy were prevalent in 63.33% of the women, 73.33% reported depression, and 66.67% reported hair loss. Significant variations were observed in the levels of thyroxine (T3) and thyroxine (T4) between women with PCOS and those without thyroid dysfunction. Specifically, the mean T3 level was 7.3213 in PCOS individuals with thyroid dysfunction compared to 63.812 in those without thyroid dysfunction. Similarly, the mean T4 level in PCOS patients with thyroid dysfunction was 7.3213, whereas the mean level in those without thyroid dysfunction was 63.812. This suggests that thyroid dysfunction significantly affects the T3 and T4 levels in PCOS patients.

Our results align with those of Ibrahim (16), who investigated the relationship between BMI, hirsutism, thyroid hormones, and reproductive hormones in Iraqi women with PCOS. Their study, which included 20 healthy women as controls and 50 infertile Iraqi women with PCOS, found no significant differences in testosterone, TSH, T3, and T4 levels between infertile and fertile women. However, they observed a substantial drop in testosterone levels in obese and overweight PCOS women, highlighting the importance of hormone levels, BMI, and hirsutism in diagnosing and treating PCOS.

Similarly, Rashid (17) evaluated the correlation between insulin resistance (IR) and thyroid function, as measured by TSH levels, in 340 women with PCOS. Their research identified a TSH cut-off value of around 2 mIU/l that provided the best sensitivity and specificity for detecting IR. Women with TSH levels ≥ 2 mIU/l were younger, had higher BMIs, and exhibited more signs of insulin resistance. Importantly, the effect of TSH on IR was found to be independent of age and BMI.

Shanmugham et al conducted cross-sectional observational research with 100 individuals meeting the Rotterdam criteria for PCOS (18). They found that 33% of the participants had thyroid dysfunction, with 20% exhibiting subclinical hypothyroidism. Their findings underscore the high prevalence of thyroid dysfunction in women with PCOS, which aligns with our study.

Moustafa et al conducted a prospective hospital-based case-control study, finding that PCOS patients had significantly higher levels of luteinizing hormone, BMI, TSH, and follicle-stimulating hormone compared to controls (19). This supports our findings that thyroid dysfunction significantly impacts hormonal profiles in PCOS patients.

Sidra et al carried out cross-sectional observational research with 286 patients, showing that BMI and hormonal imbalances are significantly higher in women with PCOS (20). This is consistent with our findings that thyroid dysfunction exacerbates weight gain and hormonal imbalance in PCOS patients.

Tagliaferri et al examined the relationship between metabolic characteristics and TSH levels in PCOS patients, finding that TSH levels were significantly correlated with insulin secretion, insulin resistance, DHEAS, and cortisol levels in obese PCOS women (21). These associations underline the complex interplay between thyroid function and metabolic health in PCOS patients.

Conclusion

Women with Polycystic Ovary Syndrome (PCOS) are more likely to experience thyroid dysfunction, which significantly affects weight and hormonal balance. This emphasizes the importance of monitoring thyroid function and hormonal balance in PCOS patients to effectively manage the dual challenges of thyroid dysfunction and PCOS. Lifestyle interventions focusing on diet, exercise, and weight management should be prioritized to mitigate further complications associated with PCOS and thyroid dysfunction.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate.
Approved by the department Concerned.
Consent for publication
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Conflict of interest

The authors declared an absence of conflict of interest.

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Revisiting Critically
MAHAK ARSHAD BUTT
Drafting
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Concept & Design of Study

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