ORIGINAL ARTICLE

# Assessment of Ovarian Reserve Among Infertile Women with Hypothyroidism

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***ABSTRACT***
***Background:*** *Infertility in women is influenced by multiple factors, including thyroid dysfunction, which can disrupt ovarian function, menstrual regularity, and overall fertility. Hypothyroidism, particularly due to autoimmune thyroid disease, has been linked to diminished ovarian reserve, making the evaluation of thyroid status essential in assessing reproductive potential.* ***Objective:*** *The aim of the study was to evaluate ovarian reserve and its association with thyroid function in infertile women with hypothyroidism.* ***Methods & Materials:*** *This cross-sectional study at the Department of Obstetrics and Gynaecology, Bangladesh Medical University (BMU), Dhaka, Bangladesh, from January to December 2025, included 60 infertile women with hypothyroidism. Thyroid function (TSH) and ovarian reserve (AMH, AFC, basal FSH, estradiol) were measured, with reserve classified as normal or diminished. Participants were stratified by thyroid status, and correlations between TSH and ovarian reserve were analyzed using SPSS v25 ($p < 0.05$).* ***Results:*** *In 60 infertile hypothyroid women (mean age 29.0 ± 4.4 years; BMI 25.1 ± 3.7 kg/m$^2$), 73.3% had primary infertility. Mean TSH was 7.8 ± 2.9 mIU/L (63.3% subclinical, 36.7% overt). Ovarian reserve showed mean AMH 1.9 ± 0.8 ng/mL, AFC 9.1 ± 3.4, and basal FSH 8.7 ± 2.1 IU/L, with 53.3% having diminished AMH. Overt hypothyroidism had lower AMH and AFC and higher FSH than subclinical, and TSH negatively correlated with AMH ($r = -0.41$) and AFC ($r = -0.36$).* ***Conclusion:*** *Thyroid dysfunction, particularly overt hypothyroidism, is associated with reduced ovarian reserve in infertile women, emphasizing the importance of thyroid evaluation in fertility management.*

***Keywords:*** *Ovarian Reserve, Hypothyroidism, Infertility.*

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## INTRODUCTION

Infertility is defined as the inability of a couple to achieve pregnancy after approximately one year of regular unprotected sexual intercourse in women under 35 years, or six months in women above 35 years of age. It may result from female factors, male factors, or a combination of both. Infertility can be classified as primary, when the couple has never conceived, or secondary, when at least one previous pregnancy has occurred [1,2]. Multiple factors, including age, acute or chronic illnesses, genetic predispositions, environmental exposures, lifestyle, infections, and specific reproductive disorders, can influence the fertility potential of either partner. Globally, infertility is a major reproductive health concern, significantly affecting women's physical and psychological well-being, social dynamics, and family planning decisions [3].

Thyroid disorders are among the most prevalent medical conditions affecting women of reproductive age [4-6]. The presence of thyroid hormone receptors on oocytes suggests that thyroid hormones play an essential role in ovarian function. Hypothyroidism is known to prolong the menstrual cycle, potentially leading to infertility due to disrupted peripheral estrogen metabolism, hyperprolactinemia, and altered gonadotropin-releasing hormone secretion [7]. Additionally, menstrual disturbances have been reported to increase up to threefold in patients with Hashimoto thyroiditis [7]. These observations emphasize the pivotal role of thyroid hormones in regulating female reproductive physiology, including the maintenance of ovulatory cycles, menstrual regularity, and overall fertility.

Hashimoto's thyroiditis, the most common autoimmune thyroid disorder among women of reproductive age, has a prevalence estimated between 5% and 15%, varying by demographic and geographic factors [8]. It is characterized by circulating anti-thyroid peroxidase antibodies, which gradually mediate autoimmune destruction of thyroid tissue, ultimately causing clinical hypothyroidism. Accumulating evidence indicates that both overt and subclinical thyroid dysfunction are associated with impaired female reproductive function, including diminished ovarian reserve, disrupted ovulatory cycles, and reduced fertility potential [9-11]. Furthermore, thyroid autoimmunity has been linked to poorer outcomes in assisted reproductive technologies, including decreased oocyte retrieval, compromised embryo quality, lower implantation rates, and higher risks of early pregnancy loss [12,13]. These findings demonstrate a clear connection between autoimmune thyroid disease and infertility.

Ovarian reserve, which refers to the quantity of oocytes remaining in the ovaries, is a critical determinant of a woman's reproductive capacity [14]. Biochemical markers such as follicle-stimulating hormone (FSH) and anti-Müllerian hormone (AMH) are commonly employed to assess ovarian reserve. Elevated FSH levels reflect reduced ovarian hormone production and a decline in ovarian reserve [15.16]. AMH, produced by granulosa cells of pre-antral and small antral follicles, serves as a reliable indicator of the remaining follicular pool; a decrease in serum AMH reflects reduced ovarian reserve [17]. Another widely used measure is the antral follicle count (AFC) [18], obtained via transvaginal ultrasonography by summing follicles measuring 2–10 mm [19]. AMH, a dimeric glycoprotein belonging to the Transforming Growth Factor-beta (TGF-β) family, regulates follicular growth and differentiation, and its serum levels decline naturally with age [20].

Several studies have demonstrated a relationship between elevated serum TSH levels and reduced ovarian reserve [21]. Women with autoimmune thyroid disease, even if clinically euthyroid, frequently exhibit lower AMH levels, suggesting that thyroid autoimmunity may impair ovarian follicular dynamics and reduce the functional pool of antral follicles without overt hormonal abnormalities [22,23]. Elevated TSH, commonly observed in Hashimoto thyroiditis, may also interfere with ovarian responsiveness and embryo implantation [24]. Despite growing evidence, the association between thyroid function and ovarian reserve remains inconsistent across studies, highlighting the need for additional research. Particularly, investigations focused on infertile women with hypothyroidism in Bangladesh are necessary to clarify the interaction between thyroid status and ovarian reserve [25,26].

Considering the high prevalence of hypothyroidism among women of reproductive age and its potential impact on ovarian function, understanding the interplay between thyroid dysfunction and ovarian reserve is crucial for optimizing fertility assessment and management. While several studies have suggested that elevated TSH and thyroid autoimmunity may be associated with diminished ovarian reserve, inconsistencies in findings, differences in population characteristics, and limited data from South Asian countries, including Bangladesh, create a gap in knowledge. Early identification of women with both hypothyroidism and reduced ovarian reserve could improve counseling, individualized fertility treatment planning, and reproductive outcomes. Therefore, this study was designed to address this gap, and the purpose of the study is to evaluate ovarian reserve and its association with thyroid function in infertile women with hypothyroidism.

## OBJECTIVE

To evaluate ovarian reserve and its association with thyroid function in infertile women with hypothyroidism.

## METHODS & MATERIALS

This cross-sectional study was conducted at the Department of Obstetrics and Gynaecology, Bangladesh Medical University (BMU), Dhaka, Bangladesh, from January to December 2025. A total of 60 infertile women with hypothyroidism were included, selected based on predefined inclusion and exclusion criteria. Baseline demographic and clinical data, including age, body mass index (BMI), duration of infertility, and type of infertility, were collected to evaluate the relationship between thyroid function and ovarian reserve.

**Inclusion Criteria:**

- Women aged 20–40 years diagnosed with primary or secondary infertility.
- Biochemically confirmed hypothyroidism (subclinical or overt).
- Women willing to provide informed consent for participation.
- Patients with regular or irregular menstrual cycles attending the Department of Obstetrics and Gynaecology, BMU.

**Exclusion Criteria:**

- Women with polycystic ovary syndrome (PCOS) or other endocrine disorders affecting ovarian reserve.
- History of ovarian surgery or chemotherapy/radiotherapy.
- Presence of congenital or acquired uterine anomalies.
- Women currently on fertility medications or thyroid hormone therapy that could alter ovarian reserve markers.
- Chronic systemic illnesses such as diabetes, hypertension, or autoimmune disorders other than thyroid disease.

Infertility was defined according to World Health Organization criteria as the inability to conceive after 12 months of regular unprotected sexual intercourse. Baseline demographic and clinical data were collected through structured interviews and review of medical records. BMI was calculated as weight in kilograms divided by the square of height in meters ($kg/m^2$) and categorized according to WHO standards.

Thyroid function was assessed by measuring serum thyroid-stimulating hormone (TSH) levels using standard immunoassay techniques. Participants were classified as having subclinical hypothyroidism (elevated TSH with normal free T4) or overt hypothyroidism (elevated TSH with low free T4) based on laboratory reference ranges.

Ovarian reserve was evaluated using serum anti-Müllerian hormone (AMH), antral follicle count (AFC), basal follicle-stimulating hormone (FSH), and basal estradiol levels. Serum AMH, FSH, and estradiol were measured on day 2–5 of the menstrual cycle using enzyme-linked immunosorbent assay (ELISA). AFC was assessed via transvaginal ultrasonography by counting follicles measuring 2–10 mm in both ovaries during the early follicular phase. Ovarian reserve was categorized as normal or diminished using established cut-offs (AMH ≥1.5 ng/mL, AFC ≥7).

Participants were stratified into subgroups based on thyroid status (subclinical versus overt hypothyroidism) to compare ovarian reserve parameters. Correlations between serum TSH levels and ovarian reserve markers (AMH and AFC) were also analyzed.

Statistical analyses were performed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Comparisons between subgroups were conducted using Student's t-test or chi-square test as appropriate. Pearson correlation coefficient (r) was used to assess relationships between TSH and ovarian reserve, with p-values <0.05 considered statistically significant. Written informed consent was obtained from all participants prior to enrollment.

**RESULTS**

**Table I** presents the baseline demographic and clinical characteristics of the study participants. Among the 60 women included in the study, 12 (20.0%) were aged 20–25 years, 28 (46.7%) were 26–30 years, 14 (23.3%) were 31–35 years, and 6 (10.0%) were older than 35 years. The mean age was 29.0 ± 4.4 years. Regarding BMI distribution, 30 (50.0%) participants had normal BMI, 24 (40.0%) were overweight, and 6 (10.0%) were obese, with a mean BMI of 25.1 ± 3.7 kg/m$^2$. The mean duration of infertility was 4.2 ± 2.1 years.

**Table – I: Baseline Demographic and Clinical Characteristics of the Study Participants (*n* = 60)**

| Variable | | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Age Group (years) | 20–25 | 12 | 20.0 |
| | 26–30 | 28 | 46.7 |
| | 31–35 | 14 | 23.3 |
| | >35 | 6 | 10.0 |
| | Mean ± SD (years) | 29.0 ± 4.4 | |
| BMI Category | Normal (18.5–24.9) | 30 | 50.0 |
| | Overweight (25–29.9) | 24 | 40.0 |
| | Obese (≥30) | 6 | 10.0 |
| | Mean ± SD (kg/m$^2$) | 25.1 ± 3.7 | |
| Duration of infertility (years) | | 4.2 ± 2.1 | |

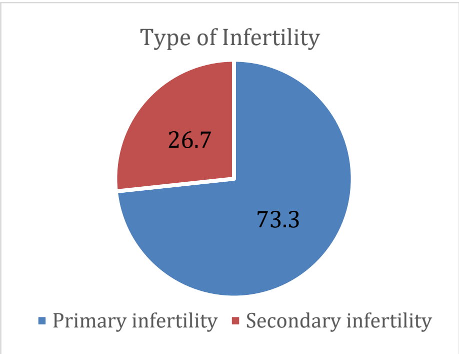


**Figure – 1: Distribution of Type of Infertility Among the Study Participants (*n* = 60)**

**Figure 1** illustrates the distribution of infertility type among the participants. Primary infertility was observed in 44 (73.3%) women, whereas 16 (26.7%) had secondary infertility.

**Table II** demonstrates the thyroid function profile of the study population. The mean serum TSH level was 7.8 ± 2.9 mIU/L. Subclinical hypothyroidism was identified in 38 (63.3%) participants, while 22 (36.7%) were diagnosed with overt hypothyroidism.

**Table – II: Thyroid Function Profile of the Study Participants (*n* = 60)**

| Parameter | | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Serum TSH (mIU/L) | | 7.8 ± 2.9 | |
| Hypothyroidism | Subclinical | 38 | 63.3 |
| | Overt | 22 | 36.7 |

**Table III** summarizes the ovarian reserve parameters of the participants. The mean serum AMH level was 1.9 ± 0.8 ng/mL, the mean AFC was 9.1 ± 3.4, the mean basal FSH was 8.7 ± 2.1 IU/L, and the mean basal estradiol level was 42.6 ± 13.8 pg/mL. Based on AMH criteria, 28 (46.7%) women had normal ovarian reserve, whereas 32 (53.3%) had diminished ovarian reserve. According to AFC criteria, 38 (63.3%) participants had normal reserve and 22 (36.7%) had diminished reserve.

**Table – III: Ovarian Reserve Markers of the Study Participants (*n* = 60)**

| Variable | | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Serum AMH (ng/mL) | | 1.9 ± 0.8 | |
| Antral Follicle Count (AFC) | | 9.1 ± 3.4 | |
| Basal FSH (IU/L) | | 8.7 ± 2.1 | |
| Basal Estradiol (pg/mL) | | 42.6 ± 13.8 | |
| AMH Category | Normal reserve (AMH ≥1.5 ng/mL) | 28 | 46.7 |
| | Diminished reserve (AMH <1.5 ng/mL) | 32 | 53.3 |
| AFC Category | Normal reserve (AFC ≥7) | 38 | 63.3 |
| | Diminished reserve (AFC <7) | 22 | 36.7 |

**Table IV** compares ovarian reserve parameters between women with subclinical and overt hypothyroidism. The mean AMH level was significantly lower in women with overt hypothyroidism (1.5 ± 0.6 ng/mL) compared to those with subclinical hypothyroidism (2.2 ± 0.7 ng/mL) ($p < 0.001$). Similarly, the mean AFC was lower in the overt group (7.2 ± 2.8 vs 10.3 ± 3.1; $p < 0.001$). Basal FSH was significantly higher in the overt group (9.8 ± 2.3 IU/L) compared to the subclinical group (7.9 ± 1.8 IU/L) ($p = 0.002$).

**Table – IV: Comparison of Ovarian Reserve Parameters Between Subclinical and Overt Hypothyroidism**

| Parameter | Subclinical (n=38) | Overt (n=22) | p-value |
|---|---|---|---|
| AMH (ng/mL) | 2.2 ± 0.7 | 1.5 ± 0.6 | 0.0001 |
| AFC | 10.3 ± 3.1 | 7.2 ± 2.8 | 0.0003 |
| FSH (IU/L) | 7.9 ± 1.8 | 9.8 ± 2.3 | 0.002 |

**Table V** presents the correlation analysis between serum TSH and ovarian reserve markers. A statistically significant negative correlation was observed between TSH and AMH ($r = -0.41$, $p = 0.006$) and between TSH and AFC ($r = -0.36$, $p = 0.014$), indicating that increasing TSH levels were associated with reduced ovarian reserve.

**Table – V: Correlation Between Serum TSH and Ovarian Reserve Markers**

| Variables | Correlation Coefficient (r) | p-value |
|---|---|---|
| TSH vs AMH | −0.41 | 0.006 |
| TSH vs AFC | −0.36 | 0.014 |

## DISCUSSION

Hypothyroidism is a prevalent endocrine disorder among women of reproductive age that can adversely affect reproductive function if not identified and managed appropriately. Ovarian reserve, as measured by markers such as anti-Müllerian hormone (AMH) and antral follicle count (AFC), reflects the quantity and functional quality of oocytes and serves as a critical indicator of fertility potential. The findings of this study demonstrate that higher severity of hypothyroidism, particularly in overt cases, is associated with reduced ovarian reserve, as evidenced by lower AMH and AFC levels and higher basal FSH. These results highlight the clinical significance of assessing thyroid function alongside ovarian reserve in infertile women to optimize fertility evaluation and guide individualized reproductive management.

Most infertile women with hypothyroidism in this study were in the younger reproductive age group, particularly 26–30 years, with a mean age of 29.0 ± 4.4 years. Half of the participants had normal BMI, while a substantial proportion were overweight or obese, yielding a mean BMI of 25.1 ± 3.7 $kg/m^2$. The mean duration of infertility was 4.2 ± 2.1 years, reflecting a relatively prolonged period before clinical evaluation. These demographic characteristics are comparable to those reported by Wadhwa et al., who observed a similar age distribution among infertile hypothyroid women and noted comparable BMI patterns without significant differences between groups [27]. Similarly, Deeba et al., in a large cross-sectional study of infertile women, documented mean age and BMI distributions consistent with populations undergoing thyroid assessment and reported a predominance of primary infertility, paralleling the trend observed in the present cohort [28]. The overall consistency in demographic characteristics across these studies supports the generalizability of findings in infertile women with hypothyroidism.

Analysis of infertility types revealed a predominance of primary infertility (73.3%) compared to secondary infertility (26.7%) among participants. This distribution closely aligns with Aseem et al., who reported that 73% of infertile women were classified as primary infertile, while 27% had secondary infertility, reflecting a remarkably similar pattern [29]. Such findings suggest that primary infertility may be more commonly associated with underlying endocrine disturbances, including thyroid dysfunction. In contrast, Fariha et al. observed that subclinical hypothyroidism was more frequently detected among women with secondary infertility (59.5%) than primary infertility (40.4%), although both types were substantially represented [30]. Collectively, these findings indicate that thyroid dysfunction plays a clinically relevant role in both primary and secondary infertility groups, highlighting the importance of routine thyroid evaluation in all infertile women.

Evaluation of thyroid function demonstrated a mean serum TSH level of 7.8 ± 2.9 mIU/L, with subclinical hypothyroidism accounting for 63.3% of cases and overt hypothyroidism for 36.7%. The predominance of subclinical hypothyroidism in this cohort mirrors findings reported by Pushpagiri et al., who noted that subclinical hypothyroidism was markedly more common than overt hypothyroidism among infertile women [31]. Similarly, Rajput et al. observed that 62.7% of infertile women with hypothyroidism had subclinical disease, whereas 37.3% had overt hypothyroidism [32]. These observations underscore the importance of routine thyroid screening in infertile women, as many may have subtle biochemical abnormalities without overt clinical symptoms.

Ovarian reserve assessment revealed relatively reduced parameters, with a mean AMH level of 1.9 ± 0.8 ng/mL, mean AFC of 9.1 ± 3.4, and mean basal FSH of 8.7 ± 2.1 IU/L. More than half of the participants (53.3%) had diminished ovarian reserve based on AMH, while 36.7% showed reduced reserve according to AFC. These findings are consistent with Rao et al., who observed lower AMH and AFC levels and higher basal FSH in women with subclinical hypothyroidism compared to euthyroid counterparts, suggesting compromised ovarian reserve in the presence of thyroid dysfunction [33]. Similarly, Zhang et al. reported that women with subclinical or overt hypothyroidism had significantly lower AMH levels and a higher prevalence of diminished ovarian reserve compared to women with normal thyroid function [34]. The concordance between these large-scale studies and the current findings reinforces the association between hypothyroidism and impaired ovarian reserve, highlighting the potential impact of thyroid dysfunction on reproductive potential in infertile women.

Comparative analysis between subclinical and overt hypothyroidism demonstrated significantly poorer ovarian reserve in the overt group, with lower AMH and AFC values and higher basal FSH levels. This pattern suggests that increasing severity of thyroid dysfunction may adversely affect ovarian reserve. Kucukler et al. observed a similar trend, with lower AMH and AFC measurements in women with overt hypothyroidism compared to subclinical cases, although differences were not statistically significant [35]. Furthermore, Shi et al. reported that both subclinical and overt hypothyroidism were associated with significantly reduced AMH compared with euthyroid controls, reinforcing the concept that thyroid dysfunction negatively influences ovarian reserve [36]. These findings emphasize that women with overt hypothyroidism are particularly susceptible to diminished ovarian reserve, underlining the need for thyroid evaluation during fertility assessment.

Correlation analysis revealed a significant negative relationship between serum TSH levels and ovarian reserve markers, with TSH inversely associated with AMH ($r = -0.41$, p

= 0.006) and AFC (r = –0.36, p = 0.014). These results align with Halici et al., who demonstrated significant associations between TSH and ovarian reserve markers in women seeking infertility care [37]. Similarly, Kabodmehri et al. found elevated TSH to be linked with lower AMH and higher likelihood of diminished ovarian reserve, particularly among women aged ≥35 years [38]. In addition, Soam et al. reported that infertile women with lower AMH had significantly higher TSH levels, reinforcing the negative correlation between thyroid dysfunction and ovarian reserve [39]. Collectively, these studies corroborate the present findings and highlight the clinical importance of evaluating thyroid status in assessing reproductive potential among infertile women with hypothyroidism. These observations support the conclusion that careful thyroid monitoring should be an integral part of fertility evaluation and management in this population.

## LIMITATIONS

This study had some limitations:

- Limited sample may restrict the generalizability of the findings.
- Single-center study, which may not reflect diverse populations.
- Geographically restricted participants, potentially affecting applicability to other regions or ethnic groups.

## CONCLUSION

Thyroid dysfunction is known to influence female reproductive health and may contribute to infertility by affecting ovarian reserve. In this study, infertile women with hypothyroidism predominantly presented with primary infertility, and subclinical hypothyroidism was more common than overt disease. Assessment of ovarian reserve revealed that diminished AMH and AFC were frequent, with overt hypothyroidism associated with poorer ovarian reserve and higher basal FSH. Moreover, TSH levels were inversely correlated with AMH and AFC, highlighting that elevated TSH may adversely affect ovarian reserve. These findings underscore the importance of routine thyroid evaluation in infertile women to optimize reproductive planning and management.


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## Conflicts of interest

There are no conflicts of interest.

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