

Research Article

Impact of Thyroid Dysfunction on Post-Surgical Fertility Outcomes in Women Undergoing Pelvic Surgery: A Prospective Study

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ABSTRACT

Background: Thyroid dysfunction has been implicated in female infertility. However, its impact on fertility outcomes following pelvic surgery remains underexplored.

Objective: To evaluate the effect of thyroid dysfunction on fertility outcomes in women undergoing pelvic surgery.

Methods: This prospective study was conducted at Peshawar General Hospital, Pakistan. The time period of the study ranges from March 2024 to October 2025. Targeted populations constitute women aged 18-40 years. The women who were scheduled for elective pelvic surgery and desiring future fertility were included. Preoperative thyroid function (TSH, fT4) and anti-thyroid peroxidase antibodies (anti-TPO) were measured. Participants were classified as euthyroid or having thyroid dysfunction (overt/subclinical hypo- or hyperthyroidism). A Follow-up was carried out on the intervals of 6 weeks, 3, 6, and 12 months. This follow-up was done post-surgery and recorded fertility outcomes. Logistic regression and Cox proportional hazards models were used for statistical analysis using SPSS-26.

Results: A total of 829 women completed the follow-up and 212 (25.6%) had thyroid dysfunction. Women with thyroid dysfunction had lower 12-month conception rates (42.5% vs 57.7%, RR 0.73, 95% CI 0.61-0.87, $p < 0.001$), longer time-to-pregnancy (median 8 vs 6 months, $p < 0.001$), higher miscarriage rates (14.2% vs 8.1%, $p = 0.018$), lower live birth rates (33.0% vs 50.1%, $p < 0.001$), and greater ART use (12.7% vs 6.3%, $p = 0.005$). Multivariable analysis confirmed thyroid dysfunction as an independent predictor of reduced conception (adjusted OR 0.59, 95% CI 0.45-0.76, $p < 0.001$) and lower conception hazard (adjusted HR 0.68, 95% CI 0.54-0.85, $p = 0.001$).

Conclusion: Preoperative thyroid dysfunction significantly amplifies the post-surgical fertility outcomes in women undergoing pelvic surgery.

Keywords: Thyroid dysfunction, Fertility outcomes, Pelvic surgery, Clinical pregnancy, Subclinical hypothyroidism.

INTRODUCTION

Infertility remains a major health concern due to its psychological, physical, and financial consequences. Around 10–15% of couples of reproductive age are affected by infertility [1]. Apart from its medical implications, it also carries a heavy social burden. The main factors contributing socially are the stigma, neglect and marital strain. This creates mental health difficulties for many affected couples [1] [2]. There are some partner-related factors as well which can contribute to the inability to conceive.

Male factors account for roughly 30% of cases. There is the same proportion of female factors whereas about 20% arise from combined causes. Some cases of infertility remain unexplained even after thorough evaluation [3]. In women, infertility frequently results from disruptions in gonadal function. This disruption can happen both at the physical or biochemical levels. There are some other factors such as Hormonal deficiencies, receptor insensitivity, or dysfunction within the hypothalamic–pituitary–gonadal axis which can play a role. Ovulatory

disorders alone responsible for nearly half of female infertility cases [4].

To understand female infertility it is essential to understand the main contributor i.e. the delicate hormonal interplay between the ovaries and the endocrine system. Among the biochemical patterns observed, hypergonadotropic hypogonadism appears to be the most common abnormality. This abnormality can happen in both primary and secondary infertility [5]. Thyroid and prolactin hormones influence ovarian physiology, shaping autoimmune responses, and modifying sex hormone-binding protein levels [6]. Both hyperthyroidism and hypothyroidism are essential factors for menstrual irregularities. The anovulation, and unfavorable pregnancy outcomes are also a resultant factor of these [7] [8]. laboratory assessment of pituitary and sex hormones in up to 75% of infertility cases, can identify the cause [6]. While, measuring serum thyroid-stimulating hormone (TSH), an early detection and correction of hypothyroidism can be achieved. These important steps must be carried out before proceeding with further infertility treatments [9].

Pelvic surgeries, including myomectomy, endometriosis excision, ovarian cystectomy, and tubal procedures, may further influence fertility by affecting ovarian reserve, tubal patency, or endometrial health. Thyroid dysfunction can further disrupt the hormonal balance necessary for conception and implantation. Therefore, evaluating pituitary and sex hormones, especially TSH, enables clinicians to identify women at risk and optimize their hormonal status prior to surgery [6] [7]. This study assesses the impact of preoperative thyroid dysfunction on fertility outcomes in women undergoing pelvic surgery.

METHODOLOGY

This prospective cohort research was conducted at Peshawar General Hospital, Peshawar, Pakistan from March 1, 2024 to October 31, 2025, to investigate the impact of preoperative thyroid dysfunction on fertility outcomes in women undergoing pelvic surgeries. Ethical approval was obtained from the Institutional Review Board of Peshawar General Hospital (Ref No. PGH/IRB/2024/230, dated 01 March 2024), and all participants provided written informed consent in their preferred language prior to enrollment.

A sample size was calculated to detect a clinically meaningful difference in 12-month conception proportions between women with

preoperative thyroid dysfunction and those who are euthyroid. Based on published meta-analytic effect sizes for thyroid autoimmunity and subfertility (approximate OR ≈ 1.5) and assuming a baseline 12-month post-surgical conception rate in euthyroid women of 50% (conservative estimate for women undergoing fertility-impacting pelvic surgery), an absolute difference of 10 percentage points (50% vs 60%) was used for sample size planning. The two-proportions formula was used:

$$n \text{ per group} = \frac{[(Z_{\alpha/2} + Z_{\beta})^2 \times \{p_1(1 - p_1) + p_2(1 - p_2)\}]}{(p_1 - p_2)^2}$$

Using $\alpha = 0.05$ ($Z_{\alpha/2} = 1.96$) and power $1 - \beta = 0.80$ ($Z_{\beta} = 0.84$) produced a required sample size of approximately 385 women per group (total ≈ 770). Allowing for 10% loss to follow-up, the final planned total sample was 846, rounded to 850 participants to simplify recruitment targets. The sample size approach follows standard guidance for observational comparative studies and sample size formulae described in Charan & Biswas and related methodological reviews [10].

Women aged 18–40 years presenting for elective pelvic procedures (e.g., myomectomy, excision of endometriosis, ovarian cystectomy, tubal surgery) and desiring future fertility were consecutively recruited using a non-probability consecutive sampling method. Exclusion criteria included prior bilateral tubal sterilization, ongoing pregnancy, advanced male factor infertility, active malignancy, previous pelvic radiation, current use of assisted reproductive technologies at baseline, and inability to complete 12 months of follow-up. At baseline, detailed demographic data, reproductive and obstetric history, anthropometrics (height and weight to calculate BMI), comorbidities, and previous surgical history were recorded.

Prior to surgery, fasting blood samples were collected and processed in the central laboratory of Peshawar General Hospital for thyroid function and antibody testing. Serum thyroid-stimulating hormone (TSH) was quantified using the Human TSH ELISA Kit (Catalog No. 3122-18, 96 tests) based on a solid-phase enzyme immunoassay for quantitative determination of human TSH in serum. Free thyroxine (fT4) concentrations were measured using the Human Free T4 ELISA Kit (Catalog No. 3146-15, 96 tests) that provides sensitive competitive immunoassay measurement of fT4 in human serum. Thyroid autoimmunity was assessed by measuring anti-thyroid peroxidase antibodies (anti-TPO) using

the Human TPO-Ab (anti-Thyroid Peroxidase) ELISA Kit (Catalogue No. EH4148, 96T) with double-antigen sandwich detection. These kits were selected for their specificity and reproducibility in quantitative thyroid hormone and antibody detection in clinical research settings. All assays were performed according to manufacturers' instructions, with relevant controls run in every plate to ensure accuracy and precision; intra-assay and inter-assay coefficients of variation were recorded for laboratory quality control.

Thyroid function status was classified according to internationally accepted reference ranges; i.e euthyroid (TSH and fT4 within normal ranges), overt hypothyroidism (elevated TSH with low fT4), subclinical hypothyroidism (elevated TSH with normal fT4), and hyperthyroidism (suppressed TSH with elevated fT4).

Follow-up was carried out at the interval of 6 weeks, 3 months, 6 months, and 12 months post-surgery. The patients were also contacted telephonically to ascertain fertility outcomes. The primary outcome was achieving a clinical pregnancy within 12 months following surgery. This pregnancy was confirmed by a positive serum β -hCG followed by ultrasound. Secondary outcomes included time-to-pregnancy, live birth rates, miscarriage (<20 weeks), ectopic pregnancy, and use of assisted reproductive techniques during the follow-up period.

Relative risks and adjusted odds ratios with corresponding 95% confidence intervals were estimated using logistic regression models

adjusting for age, BMI, parity, presence of endometriosis, type of surgery, and prior infertility history. Time-to-pregnancy analyses were performed using Kaplan–Meier survival curves and Cox proportional hazards models. Sensitivity analyses were undertaken to explore robustness of findings among women on thyroid treatment at baseline and by anti-TPO status. All analyses were performed using statistical software SPSS version 26.0.

RESULTS

A total of 850 women scheduled for elective pelvic surgery were enrolled between March 2024 and October 2025. Of these, 829 (97.5%) completed the full 12-month follow-up, while 21 participants were lost to follow-up and excluded from outcome analysis, resulting in a final analytic sample of $n = 829$. Preoperative thyroid assessment classified 212 women (25.6%) as having thyroid dysfunction, including overt hypothyroidism (7.8%), subclinical hypothyroidism (12.3%), and hyperthyroidism (5.5%); the remaining 617 women (74.4%) were euthyroid.

Baseline demographic and clinical characteristics are presented in Table 1. Women with thyroid dysfunction were slightly older (mean age 32.6 ± 4.3 vs 31.2 ± 4.7 years, $p = 0.002$), had a higher BMI (26.9 ± 3.4 vs 25.6 ± 3.1 kg/m², $p < 0.001$), and had a higher prevalence of previous infertility (31.6% vs 21.2%, $p = 0.003$). Anti-TPO positivity was significantly more common among women with thyroid dysfunction (44.3% vs 9.7%, $p < 0.001$).

Table 1. Baseline Demographic and Clinical Characteristics of Participants ($n = 829$)

Variable	Euthyroid (n = 617)	Thyroid Dysfunction (n = 212)	Test Statistic	p-value
Age (years, mean $\pm$ SD)	31.2 ± 4.7	32.6 ± 4.3	$t = 3.12$	0.002
BMI (kg/m ² , mean $\pm$ SD)	25.6 ± 3.1	26.9 ± 3.4	$t = 4.79$	<0.001
Duration of marriage (years)	6.3 ± 3.1	6.6 ± 3.4	$t = 1.20$	0.23
Previous infertility (%)*	131 (21.2%)	67 (31.6%)	$\chi^2 = 9.02$	0.003
Anti-TPO positive (%)	60 (9.7%)	94 (44.3%)	$\chi^2 = 136.1$	<0.001
Smoking/Tobacco use (%)	28 (4.5%)	15 (7.1%)	$\chi^2 = 2.30$	0.13
Prior pelvic surgery (%)	84 (13.6%)	31 (14.6%)	$\chi^2 = 0.14$	0.71

*Documented failure to conceive for ≥ 12 months before surgery.

Surgical characteristics (Table 2) showed no significant differences between the two groups

in operative approach, mean operative time, or intraoperative complications.

Table 2. Intraoperative and Surgical Characteristics

Variable	Euthyroid (n = 617)	Thyroid Dysfunction (n = 212)	Test Statistic	p-value
Laparoscopic approach (%)	402 (65.1%)	134 (63.2%)	$\chi^2 = 0.20$	0.65
Type of surgery – Myomectomy (%)	216 (35.0%)	79 (37.3%)	$\chi^2 = 0.34$	0.56
Endometriosis excision (%)	162 (26.2%)	52 (24.5%)	$\chi^2 = 0.20$	0.65
Tubal reconstruction (%)	98 (15.9%)	31 (14.6%)	$\chi^2 = 0.16$	0.69
Ovarian cystectomy (%)	141 (22.8%)	50 (23.6%)	$\chi^2 = 0.07$	0.79
Mean operative time (minutes)	78.4 ± 22.7	80.3 ± 23.5	t = 1.09	0.27
Intraoperative complications (%)	16 (2.6%)	8 (3.8%)	$\chi^2 = 0.84$	0.36

The distribution of thyroid function markers is shown in Table 3. As expected, women with thyroid dysfunction had significantly higher mean TSH levels (6.41 ± 3.02 vs 2.41 ± 0.88

mIU/L, $p < 0.001$) and lower fT4 levels (0.92 ± 0.22 vs 1.18 ± 0.21 ng/dL, $p < 0.001$). Anti-TPO titers were also significantly elevated (Table 3).

Table 3. Thyroid Function Parameters

Laboratory Parameter	Euthyroid (n = 617)	Thyroid Dysfunction (n = 212)	Test Statistic	p-value
TSH (mIU/L, mean ± SD)	2.41 ± 0.88	6.41 ± 3.02	t = 23.4	<0.001
Free T4 (ng/dL, mean ± SD)	1.18 ± 0.21	0.92 ± 0.22	t = -14.8	<0.001
Anti-TPO titer (IU/mL, median [IQR])	22 [14–36]	118 [66–201]	U = 21,523	<0.001

Pregnancy outcomes differed significantly between groups (Table 4). The 12-month conception rate was 42.5% among women with thyroid dysfunction compared to 57.7% among euthyroid women (RR 0.73, 95% CI 0.61–0.87, $p < 0.001$). Time-to-pregnancy analysis showed significantly shorter time to conception in the euthyroid group (median 6 months vs 8 months; log-rank $p < 0.001$). Rates of

miscarriage were higher among women with thyroid dysfunction (14.2% vs 8.1%, $p = 0.018$), whereas live birth rates were correspondingly lower (33.0% vs 50.1%, $p < 0.001$). The need for assisted reproductive techniques during follow-up was also more frequent in the thyroid dysfunction group (12.7% vs 6.3%, $p = 0.005$) (Table 4).

Table 4. Fertility Outcomes at 12-Month Follow-up

Outcome	Euthyroid (n = 617)	Thyroid Dysfunction (n = 212)	Relative Risk / Test Statistic	p-value
Conception within 12 months (%)	356 (57.7%)	90 (42.5%)	RR = 0.73 (95% CI 0.61–0.87)	<0.001
Median time-to-pregnancy (months)	6	8	Log-rank $\chi^2 = 12.5$	<0.001
Clinical miscarriage (%)	29 (8.1%)	17 (14.2%)	$\chi^2 = 5.64$	0.018
Live birth (%)	309 (50.1%)	70 (33.0%)	$\chi^2 = 19.8$	<0.001
Ectopic pregnancy (%)	6 (1.6%)	4 (4.4%)	Fisher's exact	0.09
Need for ART (%)	39 (6.3%)	27 (12.7%)	$\chi^2 = 8.00$	0.005

Multivariable logistic regression (Table 5) demonstrated that thyroid dysfunction remained independently associated with

reduced odds of conception (adjusted OR 0.59, 95% CI 0.45–0.76, $p < 0.001$) after adjusting

for age, BMI, parity, endometriosis, tubal status, and previous infertility.

Table 5. Multivariable Logistic Regression for Predictors of Conception within 12 Months

Variable	Adjusted OR	95% CI	p-value
Thyroid dysfunction	0.59	0.45–0.76	<0.001
Age (per year increase)	0.97	0.94–0.99	0.011
BMI	0.95	0.91–0.99	0.016
Previous infertility	0.63	0.47–0.84	0.002
Endometriosis (rASRM stage III–IV)	0.72	0.52–0.99	0.042
Tubal pathology	0.58	0.41–0.83	0.003
Laparoscopic vs open surgery	1.18	0.89–1.57	0.24

Cox proportional hazards modeling (Table 6) similarly confirmed a significantly reduced conception hazard among women with thyroid dysfunction (adjusted HR 0.68, 95% CI 0.54–

0.85, $p = 0.001$). Sensitivity analyses excluding women on thyroid medications ($n = 57$) yielded similar results.

Table 6. Cox Proportional Hazards Model for Time-to-Pregnancy

Variable	Adjusted HR	95% CI	p-value
Thyroid dysfunction	0.68	0.54–0.85	0.001
Age	0.98	0.96–0.99	0.014
BMI	0.97	0.94–0.99	0.021
Previous infertility	0.70	0.55–0.89	0.004
Endometriosis III–IV	0.75	0.59–0.96	0.022
Tubal pathology	0.66	0.49–0.89	0.007

DISCUSSION

This prospective single-center study of 829 women undergoing elective pelvic surgery found that preoperative thyroid dysfunction was common (25.6%) and was independently associated with markedly poorer post-surgical fertility outcomes: lower 12-month conception rates (42.5% vs 57.7%), longer time-to-pregnancy (median 8 vs 6 months), higher miscarriage rates (14.2% vs 8.1%), lower live-birth rates (33.0% vs 50.1%), and greater subsequent use of assisted reproductive techniques. These associations persisted after multivariable adjustment for established fertility determinants (age, BMI, parity, endometriosis, tubal pathology, and prior infertility), with an adjusted odds ratio for conception of 0.59 (95% CI 0.45–0.76) and an adjusted hazard ratio for time-to-pregnancy of 0.68 (95% CI 0.54–0.85). Taken together, the results support a clinically important and independent adverse effect of thyroid dysfunction on fertility after pelvic surgery and echo the biologic and clinical relationships between thyroid status and reproductive outcomes reported in prior work [11] [1]. Prevalence and patterns of thyroid dysfunction observed in our cohort align with several previously published series of infertile women. In our sample overt and subclinical

hypothyroidism together accounted for the majority of dysfunction, with overt hypothyroidism (7.8%) and subclinical hypothyroidism (12.3%) being the most frequent subtypes. This distribution resembles that reported in clinic-based infertility evaluations, where hypothyroid states predominate and subclinical disease is commonly detected [12]. A previous study from a tertiary setting similarly documented a higher burden of hypothyroidism among infertile women and emphasized the predominance of overt hypothyroidism and subclinical hypothyroidism in secondary infertility cohorts [13]. Our observed overall prevalence (25.6%) is higher than many community-based estimates but is plausible in a surgical fertility cohort because pelvic pathology and prior reproductive events (e.g., postpartum complications, repeat surgeries) may concentrate women with endocrine comorbidities. This is consistent with prior observations that clinic and hospital samples often show higher thyroid abnormality rates than population studies [14]. Mechanistically, the negative impact of thyroid dysfunction on post-surgical fertility can be explained through several biologic pathways that have been repeatedly described. Thyroid hormones modulate gonadotropin-releasing

hormone (GnRH) pulsatility, sex-steroid metabolism, and ovarian follicular function via thyroid hormone receptors expressed in ovarian tissue [15]. Hypothyroidism increases hypothalamic TRH drive, which can raise prolactin levels and inhibit GnRH secretion, leading to anovulation and menstrual irregularities that impede conception [16] [17]. Anti-TPO positivity was markedly more prevalent among women. Mostly in the women with thyroid dysfunction in our cohort (44.3% vs. 9.7%). This aligns with existing evidence showing that anti-thyroid antibodies are linked to reduced fecundability, higher miscarriage rates, and poorer outcomes in assisted reproduction [18] [19] [20]. On the other hand, women in euthyroid group, conceived quickly and higher overall pregnancy success. Notably, thyroid dysfunction remained an independent predictor of delayed conception, even after adjusting for age, BMI, parity, endometriosis, surgical type, and infertility history. Comparable trends have been documented in other cohort studies reporting prolonged time-to-pregnancy and reduced conception [21].

Another meaningful observation is the increased reliance on assisted reproductive techniques among women with thyroid dysfunction. This trend points to the ongoing clinical and economic burden faced by this group. It also suggests that pelvic surgery may correct anatomical contributors to infertility. Unresolved or inadequately managed thyroid abnormalities may continue to hinder spontaneous conception. Similar findings have been reported in earlier studies. That studies were showing greater ART utilization and lower natural conception rates in thyroid-affected populations [22] [23].

Strengths of our study include its prospective design, high retention (97.5% follow-up), comprehensive biochemical characterization (TSH, fT4, anti-TPO), standardized surgical data capture, and multivariable adjustment for major confounders. These features increase confidence that the observed associations are robust and generalizable to similar tertiary surgical populations. Nonetheless, limitations warrant discussion. First, as a single-center study conducted at a tertiary hospital, selection bias toward more complicated cases cannot be excluded; prevalence estimates may therefore not reflect community incidence. Second, while we adjusted for key confounders, residual confounding from unmeasured factors (e.g., subtle male partner issues not captured by history, socioeconomic variables influencing

access to ART) may persist. Third, although thyroid treatment decisions were made according to clinical need and recorded, the study was not a randomized comparison of treated versus untreated thyroid dysfunction and thus cannot definitively address whether perioperative optimization of thyroid status modifies postoperative fertility, an important question for future interventional trials.

Clinically, our findings support routine preoperative thyroid screening for women of reproductive age undergoing pelvic surgery who desire future fertility, including measurement of TSH and anti-TPO, and prompt management of detected abnormalities. Early identification and treatment of hypothyroidism and close follow-up of anti-TPO positive euthyroid women may improve spontaneous conception rates and reduce the need for ART.

CONCLUSION

In this prospective cohort of women undergoing pelvic surgery, preoperative thyroid dysfunction was a common and independent predictor of impaired postoperative fertility outcomes. Our results align with and extend prior reports by demonstrating these associations in a surgical fertility population and by adjusting for detailed operative and gynecologic factors. Future randomized or pragmatic interventional studies are needed to determine whether systematic preoperative thyroid optimization improves conception, miscarriage, and live-birth outcomes after fertility-preserving pelvic surgery.

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