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Original Research Article

Comparative Study of Menstrual Irregularities and Infertility Patterns in Women with Thyroid Dysfunction

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Abstract:

Background: Thyroid dysfunction — encompassing overt hypothyroidism, hyperthyroidism, and subclinical hypothyroidism (SCH) — disrupts the hypothalamic–pituitary–ovarian (HPO) axis and adversely affects menstrual regularity and fertility. Comparative data across the full spectrum in Indian women remain limited.

Objectives: To compare menstrual irregularity patterns and infertility prevalence across women with overt hypothyroidism, hyperthyroidism, SCH, and euthyroid controls.

Methods: A prospective, observational study at Sri Krishna Medical College and Hospital (SKMCH), Muzaffarpur enrolled 280 reproductive-age women (18–40 years): hypothyroid (n=85), hyperthyroid (n=60), subclinical hypothyroid (n=55), and euthyroid controls (n=80). Thyroid function tests, prolactin, LH/FSH, anti-TPO antibodies, and transvaginal ultrasonography were assessed.

Results: Menstrual irregularities were most prevalent in hypothyroid (74.1%) and SCH (67.3%) women versus controls (22.5%, $p<0.001$). Overall infertility was highest in hypothyroid (49.4%), SCH (47.3%), and hyperthyroid (38.3%) groups versus controls (16.3%, $p<0.001$). Hyperprolactinaemia and anovulation were key mediating factors.

Conclusions: All forms of thyroid dysfunction significantly impair menstrual regularity and fertility. Routine thyroid screening in women with menstrual disturbances or infertility is recommended.

Keywords: Thyroid Dysfunction, Hypothyroidism, Hyperthyroidism, Subclinical Hypothyroidism, Menstrual Irregularities, Infertility, Anovulation, Hyperprolactinaemia.

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Introduction

Thyroid disorders affect 5–10% of reproductive-age women globally and approximately 42 million people in India.[1,2,3] Thyroid hormones modulate the HPO axis, SHBG, prolactin secretion, and direct ovarian function.[1,4]

Hypothyroidism causes menorrhagia, oligomenorrhoea, and amenorrhoea via TRH-mediated hyperprolactinaemia and impaired steroid metabolism, while hyperthyroidism causes polymenorrhoea and hypomenorrhoea through accelerated oestrogen clearance.[5,6,7] These disturbances extend to infertility through anovulatory cycles and luteal phase defects.[8,9] SCH, present in up to 14% of women with recurrent pregnancy loss, is increasingly implicated in reproductive dysfunction.[10,11,12]

Comparative data across the spectrum of thyroid disorders in the Indian context remain limited, with SCH frequently under-represented.[13,14,15] This study aimed to conduct a prospective comparative analysis of menstrual and infertility outcomes across all three thyroid dysfunction subtypes and euthyroid controls, including evaluation of mediating factors such as prolactin, LH:FSH ratio, and ovarian reserve.[16,17]

Materials and Methods

Study Design and Setting: A prospective, observational, cross-sectional study was conducted over July 2023- June 2025 at the Department of Obstetrics & Gynaecology, Sri Krishna Medical College and Hospital (SKMCH), Muzaffarpur, India.

Participants: A total of 280 women aged 18–40 years were allocated into four groups based on thyroid function tests: Group I – Overt Hypothyroidism (n=85), Group II –

Hyperthyroidism (n=60), Group III – SCH (n=55), and Group IV – Euthyroid Controls (n=80). Exclusion criteria included pregnancy, hormonal therapy, confirmed PCOS (Rotterdam criteria), non-thyroidal hyperprolactinaemia, uterine pathology, and systemic illness.

Biochemical and Hormonal Assessment: Fasting blood samples were collected on days 2–5 of the menstrual cycle. Serum TSH (0.4–4.2 mIU/L), Free T3, Free T4, prolactin, LH, FSH, oestradiol, anti-TPO antibodies, and fasting insulin were measured by chemiluminescent immunoassay (Roche Cobas e 601). Thyroid disorders were defined per ATA 2017 guidelines.[21]

Assessment of Menstrual Irregularities and Infertility: Menstrual patterns were documented using a validated proforma and classified per FIGO 2011 recommendations. Infertility was defined as failure to conceive after 12 months of regular unprotected intercourse. Ovulation was confirmed by mid-luteal progesterone (>3 ng/mL) and/or follicle tracking. Antral follicle count (AFC) was assessed by 3D transvaginal ultrasonography.

Statistical Analysis: Data were analysed using SPSS v26.0. Continuous variables are presented as mean±SD or median (IQR). Chi-squared test was used for categorical comparisons; ANOVA or Kruskal–Wallis for continuous variables. Binary logistic regression identified independent predictors of infertility (OR with 95% CI). $p<0.05$ was significant.

Results

Baseline Characteristics: Demographic and biochemical data are shown in Table 1. Mean age ranged from 28.9±5.8 (hyperthyroid) to 33.1±7.4 years (SCH). BMI was significantly higher in hypothyroid and SCH women (p=0.001). TSH was markedly elevated in overt hypothyroid (median 9.8 mIU/L) and suppressed in hyperthyroid (0.08 mIU/L) groups, confirming appropriate allocation.

Table 1: Baseline Demographic and Biochemical Characteristics (n=280)

Characteristic	Hypothyroid (n=85)	Hyperthyroid (n=60)	Subclinical Hypothyroid (n=55)	Euthyroid Control (n=80)	p-value
Age (years), Mean±SD	31.4±6.2	28.9±5.8	33.1±7.4	30.2±5.9	0.042
BMI (kg/m²), Mean±SD	27.3±4.1	22.6±3.4	26.8±4.5	23.1±3.2	0.001
TSH (mIU/L), Median (IQR)	9.8 (6.2–18.4)	0.08 (0.01–0.18)	5.6 (4.8–8.2)	2.1 (1.4–3.0)	<0.001
Free T4 (ng/dL), Mean±SD	0.62±0.18	2.84±0.62	0.91±0.14	1.12±0.20	<0.001
Free T3 (pg/mL), Mean±SD	2.4±0.6	6.8±1.2	2.9±0.5	3.1±0.4	<0.001
Duration of disorder (years)	4.2±3.1	3.6±2.8	2.1±1.9	—	0.038
Married, n (%)	61 (71.8)	42 (70.0)	38 (69.1)	58 (72.5)	0.921

SD = Standard Deviation; IQR = Interquartile Range. ANOVA/Kruskal–Wallis for continuous; Chi-squared for categorical variables.

Menstrual Irregularity Patterns: Menstrual irregularity prevalence was highest in hypothyroid (74.1%), SCH (67.3%), hyperthyroid (53.3%), and controls (22.5%, p<0.001). Oligomenorrhoea predominated in hypothyroid (44.7%) and SCH (43.6%) women; amenorrhoea was highest in hypothyroid (22.4%). Hyperthyroid women showed polymenorrhoea (30.0%) and hypomenorrhoea (35.0%). Menorrhagia was significantly more frequent in hypothyroid (31.8%) and SCH (27.3%) versus controls (8.8%). Only 25.9% of hypothyroid and 32.7% of SCH women had regular cycles versus 77.5% of controls (Table 2).

Table 2: Menstrual Irregularity Patterns Across Study Groups

Menstrual Pattern	Hypothyroid (n=85)	Hyperthyroid (n=60)	Subclinical Hypothyroid (n=55)	Euthyroid Control (n=80)	p-value
Oligomenorrhoea (>35 d)	38 (44.7)	6 (10.0)	24 (43.6)	6 (7.5)	<0.001
Polymenorrhoea (<21 d)	8 (9.4)	18 (30.0)	4 (7.3)	5 (6.3)	<0.001
Amenorrhoea (>3 cycles)	19 (22.4)	3 (5.0)	7 (12.7)	2 (2.5)	<0.001
Menorrhagia (>80 mL)	27 (31.8)	8 (13.3)	15 (27.3)	7 (8.8)	<0.001
Dysmenorrhoea (severe)	22 (25.9)	14 (23.3)	17 (30.9)	11 (13.8)	0.028
Hypomenorrhoea	11 (12.9)	21 (35.0)	6 (10.9)	4 (5.0)	<0.001
Regular cycle (21–35 d)	22 (25.9)	28 (46.7)	18 (32.7)	62 (77.5)	<0.001
Any irregularity	**63 (74.1)**	**32 (53.3)**	**37 (67.3)**	**18 (22.5)**	**<0.001**

All values are n (%). p-values by Chi-squared test.

Infertility Prevalence and Associated Parameters: Overall infertility was highest in

hypothyroid (49.4%), SCH (47.3%), and hyperthyroid (38.3%) women versus controls (16.3%, p<0.001). Anovulatory cycles were present in 48.2%, 49.1%, 36.7%, and 11.3% respectively. Hyperprolactinaemia affected 36.5% of hypothyroid women. An LH:FSH ratio >2 was noted in 25.5% of SCH and 21.2% of hypothyroid women, suggesting PCOS-like overlap. Recurrent pregnancy loss was significantly more common in hypothyroid (14.1%) and SCH (14.5%) groups (Table 3).

Table 3: Infertility Prevalence and Associated Reproductive Parameters

Parameter	Hypothyroid n (%)	Hyperthyroid n (%)	Subclinical Hypothyroid n (%)	Euthyroid Control n (%)	p-value
Primary infertility	28 (32.9)	14 (23.3)	16 (29.1)	8 (10.0)	<0.001
Secondary infertility	14 (16.5)	9 (15.0)	10 (18.2)	5 (6.3)	0.041
Anovulatory cycles	41 (48.2)	22 (36.7)	27 (49.1)	9 (11.3)	<0.001
Elevated prolactin (>25 ng/mL)	31 (36.5)	8 (13.3)	14 (25.5)	3 (3.8)	<0.001
LH:FSH ratio >2	18 (21.2)	7 (11.7)	14 (25.5)	6 (7.5)	0.003
Recurrent pregnancy loss (≥2)	12 (14.1)	5 (8.3)	8 (14.5)	3 (3.8)	0.018
Reduced ovarian reserve (AFC <7)	24 (28.2)	16 (26.7)	13 (23.6)	10 (12.5)	0.039
Overall infertility	**42 (49.4)**	**23 (38.3)**	**26 (47.3)**	**13 (16.3)**	**<0.001**

AFC = Antral Follicle Count; LH = Luteinising Hormone; FSH = Follicle-Stimulating Hormone. All p-values by Chi-squared test.

Logistic Regression: Predictors of Infertility: All three thyroid dysfunction forms were independently associated with infertility (Table 4). Overt hypothyroidism had the highest adjusted OR (aOR 4.14, 95% CI: 1.98–8.65), followed by SCH (aOR 3.87, 95% CI: 1.80–8.32) and hyperthyroidism (aOR 2.76, 95% CI: 1.29–5.91). Each unit TSH rise increased infertility odds by 17%. Hyperprolactinaemia was the strongest predictor (aOR 5.94, 95% CI: 2.41–14.62).

Table 4: Binary Logistic Regression — Independent Predictors of Infertility

Variable	Crude OR	95% CI	Adj. OR	95% CI	Wald χ^2	p-value
Overt hypothyroidism	4.92	2.41–10.04	4.14	1.98–8.65	18.42	<0.001
Hyperthyroidism	3.18	1.52–6.65	2.76	1.29–5.91	9.14	0.003
Subclinical hypothyroidism	4.42	2.09–9.36	3.87	1.80–8.32	15.67	<0.001
TSH (per unit increase)	1.21	1.12–1.31	1.17	1.08–1.27	12.88	<0.001
Elevated prolactin	7.68	3.22–18.32	5.94	2.41–14.62	22.14	<0.001
BMI (per unit)	1.08	1.02–1.15	1.06	1.00–1.12	4.12	0.042
Duration of disease (yrs)	1.14	1.04–1.25	1.11	1.01–1.22	5.88	0.015

Adjusted for age, BMI, and duration of thyroid disease. Reference = Euthyroid controls. Hosmer–Lemeshow: χ^2=6.84, p=0.553.

Discussion

All forms of thyroid dysfunction significantly impaired menstrual regularity and fertility, with hypothyroidism and SCH bearing the greatest reproductive burden, consistent with established literature.[1,2,8]

In hypothyroid women, oligomenorrhoea (44.7%) and amenorrhoea (22.4%) result from TRH-mediated hyperprolactinaemia suppressing GnRH pulsatility, confirmed by hyperprolactinaemia in 36.5% of this group.[16,17] Menorrhagia (31.8%) reflects anovulation-related progesterone deficiency.[5,6] Hyperthyroid women showed polymenorrhoea (30.0%) and hypomenorrhoea (35.0%) due to accelerated oestrogen metabolism, with an infertility rate of 38.3% driven by anovulation.[7,17]

SCH women demonstrated menstrual irregularity (67.3%) and infertility (47.3%) approaching overt hypothyroidism, with an aOR of 3.87 versus 4.14 — indicating that even modest TSH elevation exerts significant reproductive toxicity.[10,11,15] An LH:FSH ratio >2 in 25.5% of SCH and 21.2% of hypothyroid women suggests phenotypic overlap with PCOS through insulin resistance and deranged gonadotropin pulsatility.[22,23]

Recurrent pregnancy loss in hypothyroid (14.1%) and SCH (14.5%) groups reflects inadequate luteal support and impaired trophoblast function, corroborated by the established association between anti-TPO antibodies and miscarriage risk.[24,27,30] Elevated anti-TPO antibodies across all thyroid dysfunction groups further support routine autoimmunity screening in the infertility workup.[9,28]

Study strengths include the prospective design, large comparative sample, inclusion of SCH, and comprehensive hormonal profiling with confounder

adjustment. Limitations include tertiary-care selection bias, recall bias in menstrual history, and absence of post-treatment follow-up.

Conclusions

Thyroid dysfunction across its entire spectrum is significantly associated with menstrual irregularities and impaired fertility. Hypothyroidism and SCH exert the greatest burden, with nearly half of affected women experiencing infertility. Hyperprolactinaemia and anovulation are the principal mediating pathways. We recommend universal TSH and anti-TPO antibody testing in all women presenting with menstrual disturbances or infertility, with prompt thyroid-directed therapy to restore reproductive health.

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