Original Research

TRIMESTER-SPECIFIC THYROID HORMONE PROFILE OF NORMAL PREGNANT WOMEN OF A NORTH INDIAN CITY

Priyanka Ambardar[1], Shaheen Akhtar[2], Monica Manhas[3], Sheetal Kotwal[4*], Mrityunjay[5]

[1]Demonstrator, PG Department of Physiology, GMC, Jammu, J&K, India.
[2]Assistant Professor, PG Department of Physiology, GMC, Jammu, J&K, India.
[3]Associate Professor, PG Department of Physiology, GMC, Jammu, J&K, India.
[4]Demonstrator, PG Department of Physiology, GMC, Jammu, J&K, India.
[5]Principal, JISMCH, Ludhiana, Punjab, India.
[*]**Corresponding Author:** Sheetal Kotwal
Email: sheetalkotwal1991@gmail.com

ABSTRACT

Background: Pregnancy induces significant physiological changes in thyroid function due to hormonal and metabolic demands. Accurate interpretation of thyroid function tests (TFTs) requires trimester-specific and population-specific reference ranges. **Aim:** To compare thyroid function parameters (TSH, total T3, total T4) between normal pregnant women across trimesters and age-matched non-pregnant women in Jammu, India. **Material and Method:** A comparative cross-sectional study was conducted at Government Medical College, Jammu, from March 31, 2024, to April 1, 2025. Total 240 participants (60 per group) were enrolled: non-pregnant (Group A), first trimester (Group B), second trimester (Group C), and third trimester (Group D). TFTs were measured using Chemiluminescent Microparticle Immunoassay (CMIA). **Results:** No significant differences were found in age or BMI across groups. TSH was lowest in the first trimester (0.899 ± 0.33 µIU/mL) and rose progressively to 2.41 ± 0.42 µIU/mL in the third trimester ($p < 0.0001$). Total T3 peaked in the second trimester (1.95 ± 0.13 ng/dL), while total T4 increased steadily from 8.45 ± 1.02 ng/dL in first to 12.61 ± 1.11 ng/dL in third trimester ($p < 0.0001$). Compared to non-pregnant values (TSH 2.51 ± 1.51 µIU/mL, T3 1.24 ± 0.24 ng/dL, T4 6.28 ± 1.24 ng/dL), pregnant women showed adaptive euthyroid changes. Overall, thyroid dysfunction prevalence was 36.5%. **Conclusion:** Significant trimester-specific alterations in thyroid hormones were observed, consistent with physiological adaptations. The findings highlight the need for localized, trimester-specific reference ranges in the Jammu region to improve diagnostic accuracy and maternal-fetal outcomes.

Keywords: Thyroid Function Tests, Pregnancy, Trimester-Specific Changes, TSH, Total T3, Total T4.

INTRODUCTION

Pregnancy represents a profound physiological state characterized by extensive adaptations across multiple organ systems to support fetal development and maternal health. These changes, driven by hormonal shifts, metabolic demands, and placental influences, differentiate the pregnant from the non-pregnant female physiology[1]. The endocrine system undergoes significant modifications during pregnancy, with the thyroid gland playing a pivotal role in regulating metabolism, energy homeostasis, and fetal neurodevelopment[2]. Thyroid hormones, primarily thyroxine (T4) and triiodothyronine (T3), are essential for maintaining these processes, and their dysregulation during pregnancy can result in adverse outcomes for both mother and the foetus, including preterm birth, intrauterine growth restriction, and cognitive impairments[3].

Pregnancy is considered a euthyroid state, but interpreting thyroid function tests (TFTs) requires trimester-specific reference intervals to avoid misdiagnosis[4]. Population-specific factors, such as iodine status, ethnicity, and body mass index, further influence these ranges, underscoring the need for localized norms rather than universal cutoffs[5].

Available epidemiological data reveal thyroid dysfunction prevalence in pregnancy at 0.3-0.5% for overt hypothyroidism, 4-17% for subclinical forms, and 0.1-1% for hyperthyroidism, with thyroid peroxidase antibodies (TPOAb) positivity in 5.1-12.4% of childbearing women[6].

Ethnic and regional differences, such as lower TSH in Asian non-pregnant women but similar pregnancy dynamics, emphasize the need for tailored assessments[7]. In India, studies report subclinical hypothyroidism in 21.5% of first-trimester women, advocating universal

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screening[8,9].

Present study addresses gaps in regional data for the population of Jammu region, a vast part of Jammu & Kashmir, India. Primary objective was to assess and compare TFTs (TSH, total T4, total T3) between normal pregnant and age-matched non-pregnant women while secondarily evaluating trimester-specific changes to discern pregnancy-induced patterns.

MATERIAL AND METHOD

This study was a comparative cross-sectional investigation aimed at evaluating thyroid function parameters in normal pregnant women across different trimesters and comparing them with age-matched non-pregnant women. Ethical approval was obtained from the Institutional Ethics Committee of Government Medical College, Jammu, before commencement. All participants provided informed written consent after being informed of the purpose, procedures, risks, and benefits of the study in their preferred language.

The study was conducted at the Department of Physiology of Government Medical College, Jammu, which is a tertiary care institution serving a diverse population from the Jammu region. Data collection took over one year from March 31, 2024, to April 1, 2025. Participants were recruited from the Obstetrics Outpatient Department (OPD) of SMGS Hospital, affiliated with the college, ensuring accessibility to both urban and rural demographics.

The sample population included healthy pregnant women attending antenatal clinics and age-matched non-pregnant women of childbearing age (18-35 years) from the same geographic region. Total 240 participants were divided into four groups (n=60 each) to ensure balanced representation:

- Group A: 60 healthy non-pregnant women of childbearing age (control group).
- Group B: 60 pregnant women in the first trimester (up to 12 weeks of gestation).
- Group C: 60 pregnant women in the second trimester (13-24 weeks of gestation).
- Group D: 60 pregnant women in the third trimester (25-37 weeks of gestation).

Gestational age was determined based on the last menstrual period and confirmed by ultrasound, where available. Participants were screened to exclude any confounding factors that could affect thyroid function.

Inclusion Criteria

- Healthy pregnant women with singleton pregnancies and age-matched non- pregnant women.
- Age between 18-35 years.
- Willingness to provide informed written consent.
- No history of significant medical conditions affecting thyroid function.

Exclusion Criteria

- Teenage pregnancies (under 18 years).
- Refusal to provide consent.
- Known history of thyroid disease, including those on antithyroid drugs or thyroid replacement therapy.
- Multiple pregnancies, pre-eclampsia, or gestational diabetes.
- Significant systemic or autoimmune diseases (e.g., diabetes mellitus, tuberculosis, or other comorbidities unless controlled and not affecting thyroid parameters).
- Ectopic pregnancy.
- History of thyroid surgery.

Data Collection: Upon enrolment, a structured questionnaire was administered to collect demographic details (age, education, socioeconomic status using the modified Kuppuswamy scale, smoking history), obstetric history (gravidity, parity, gestational age), and medical history (comorbidities). A thorough clinical examination followed, including anthropometric measurements, vital signs, general physical examination, and systemic examination.

Laboratory Methods: TFTs (total T3, total T4, TSH) were performed using Chemiluminescent Microparticle Immunoassay (CMIA) on an Abbott Alinity i analyzer.

Statistical Analysis: Data was analysed using SPSS version 21.0. Quantitative variables were compared using one-way ANOVA followed by post-hoc Tukey's test. Qualitative variables were expressed as frequencies/percentages and analyzed using Chi-square tests. $p < 0.05$ was considered significant.

Results: This comparative cross-sectional study involved 240 participants (60 per group): non-pregnant women (Group A), first-trimester pregnant women (Group B), second- trimester pregnant women (Group C), and third-trimester pregnant women (Group D).

Table 1: Demographic and Anthropometric Characteristics across Study Groups (Mean ± SD)

Parameter	Group A (Non-Pregnant)	Group B (1st Trimester)	Group C (2nd Trimester)	Group D (3rd Trimester)	p-value (ANOVA)
Age (years)	26.38 ± 3.33	27.40 ± 4.59	25.87 ± 3.41	25.62 ± 3.54	1.000 (NS)
BMI (kg/m²)	23.15 ± 3.82	22.98 ± 3.65	23.42 ± 4.01	24.10 ± 3.94	0.8325 (NS)

(NS: Not significant)

The study groups were well-matched at baseline.

Socioeconomic and educational profiles revealed a predominance of middle-class participants with high school education,

Smoking prevalence was 20% among non-pregnant women, dropped to 10% in the first trimester, and reached 0% in both the second and third trimesters, reflecting a clear pattern of smoking cessation or avoidance as pregnancy progressed.

As for vital signs across groups, pulse rate increased slightly from 76.5 ± 8.2 bpm in non-pregnant women to 80.9 ± 7.6 bpm in third trimester but was statistically insignificant.

Both systolic and diastolic blood pressure differed significantly across groups ($p < 0.05$ for both). Systolic BP was highest in non-pregnant women (128.2±30.4 mmHg), dropped markedly in the first trimester (118.5±12.1 mmHg), then rose gradually through the second (120.4±11.8 mmHg) and third trimesters (122.7±10.5 mmHg). Diastolic BP followed a similar U- shaped pattern, lowest in the first trimester (74.2±8.5 mmHg) and highest in the third (79.3±6.5 mmHg), nearing non-pregnant levels (78.6±9.2 mmHg).

In our study, comorbidities were infrequent overall. Hypothyroidism was most prevalent in the third trimester group (13.3%), diabetes showed even distribution with a slight peak in the third trimester (13.3%), and tuberculosis was highest in the second trimester (20.0%). No major abnormalities were noted on general or systemic clinical examinations, confirming the cohort's healthy status.

Table 2: Obstetric Characteristics across Pregnant Groups (Frequency, %)

Parameter	Group B	Group C	GroupD
Multigravida	46 (76.7%)	38 (63.3%)	36 (60.0%)
Primigravida	14 (23.3%)	22 (36.7%)	24 (40.0%)
Mean Gestational Age (weeks)	9.2 ± 1.4	17.9 ± 2.5	26.6 ± 2.0

(Gestational age differences: $p < 0.001$, all post-hoc comparisons significant)

Parity distribution indicated a predominance of multigravida women in early pregnancy, decreasing progressively toward term.

Table 3: Thyroid Function Tests across Study Groups (Mean ± SD)

Parameter	Group A	Group B	Group C	Group D	p-value (ANOVA)
Total T3 (ng/dL)	1.24 ± 0.24	1.68 ± 0.32	1.95 ± 0.13	1.82 ± 0.11	<0.0001
Total T4 (ng/dL)	6.28 ± 1.24	8.45 ± 1.02	10.12 ± 0.95	12.61 ± 1.11	<0.0001
TSH (µIU/mL)	2.51 ± 1.51	0.899 ± 0.33	1.754 ± 0.44	2.41 ± 0.42	<0.0001

DISCUSSION

The present study provides insights into the physiological variations in thyroid function tests (TFTs) among normal pregnant women across trimesters compared to age- matched non-pregnant women in the Jammu region. The demographic homogeneity observed, with no significant differences in age or BMI across groups ($p>0.05$), aligns with previous research[1]. This consistency minimizes confounding, similar to other observations, where comparable age distributions (mid-20s) were reported in Indian cohorts[2], ensuring reliable comparisons of thyroid parameters.

Smoking prevalence was higher in non-pregnant women (20.0%) and decreased during pregnancy, possibly due to awareness or health advice, corroborating studies which linked tobacco exposure to altered TSH and free T3 levels[3].

Vital signs showed changes consistent with physiological adaptations such as increased cardiac output in late pregnancy[10,11].

Obstetric characteristics indicated a higher multigravida proportion in early trimesters (76.7% in the first), decreasing to 60.0% in the third, with significant gestational age progression ($p<0.001$). This pattern may influence thyroid dynamics, as multiparity has been associated with subtle hormonal shifts in prior studies[4,12]. Comorbidities were low, but hypothyroidism (13.3% in the third trimester) and tuberculosis (20.0% in the second) highlight potential regional vulnerabilities, echoing Prabhat et al.[5].

Thyroid parameters exhibited distinct trimester-specific patterns, mirroring hCG-mediated suppression early on, as described by Pekonen F , Haddow JE et al. and Marwaha RK et al.[13,14,15].

Total T3 peaked in the second trimester (1.95 ± 0.13 ng/dL), stabilizing thereafter, aligning with increased metabolic demands and hCG stimulation, similar to Kumar A, Zarghami N, and Gogoi J et al.[16,17,18].

Total T4 progressively rose (from 8.45 ± 1.02 ng/dL in the first to 12.61 ± 1.11 ng/dL in the third trimester). Our observations are supported by Dhatt GS et al.[19] and La'ulu and Roberts[20].

Thyroid function is intricately modulated during gestation. Elevated estrogen levels stimulate hepatic synthesis of thyroid-binding globulin (TBG), leading to increased total T4 and T3 concentrations, while free hormone levels remain relatively stable or slightly adjusted[10]. Human chorionic gonadotropin (hCG), structurally similar to TSH, exerts a thyrotropic effect in the first trimester, suppressing TSH and mildly elevating free T4[11].

In the present study, TFTs of pregnant women reflected adaptive euthyroidism, with overall dysfunction at 36.5%, higher than global estimates (0.3-1%) but akin to Indian prevalence[21,22,23]. Regional factors like iodine sufficiency in Jammu may explain milder variations versus iodine-deficient areas[24].

These findings necessitate early screening, as non-pregnant reference values are inappropriate. Guidelines from the American Thyroid Association (ATA) advocate population- and trimester-specific TSH ranges, suggesting adjustments like 0.1-4.0 mU/L in the first trimester if local data are unavailable[19] otherwise non-pregnant references could misclassify up to 20.5% of cases[6].

CONCLUSION

Our study demonstrates significant trimester-specific alterations in thyroid function among normal pregnant women with TSH suppression in early gestation, T3 peaking mid-pregnancy, and progressive T4 elevation, compared to non-pregnant controls. These changes align with global physiological adaptations but highlight regional prevalence of dysfunction (36.5%), emphasizing the need for localized, trimester-specific reference ranges to prevent misdiagnosis and improve maternal-fetal outcomes.

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