Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 10s, https://carcinogenesis.com/

"Unmasking the Thyroid Connection: A Cross-Sectional Analysis of Hypothyroidism and Pre-eclampsia among Pregnant Women in Western India"

Dr. Rohit Dimbar [1], Dr. Sri Rukmini Chittampally [2]

[1]Assistant Professor Dy Patil Medical College Hospital And Research Centre, Pimpri, Pune

Email ID : Rohitsd1511@Gmail.Com

[2]Jr , Dy Patil Medical College Hospital And Research Centre, Pimpri Pune

Email ID : Ruk.Sri123@Gmail.Com

Corresponding Author:

Dr. Sri Rukmini Chittampally,

Jr , Dy Patil Medical College Hospital And Research Centre, Pimpri Pune

Email ID : Ruk.Sri123@Gmail.Com

ABSTRACT

Background: Hypothyroidism is a prevalent endocrine disorder in pregnancy and is increasingly being linked to hypertensive complications such as pre-eclampsia. However, Indian data, particularly from Western regions, remain limited.

Objective: To assess the correlation between maternal hypothyroidism and pre-eclampsia among pregnant women attending a tertiary care hospital in Western India.

Methods: A cross-sectional analytical study was conducted among 240 antenatal women ≥20 weeks of gestation. Thyroid function tests (TSH, Free T4) were performed, and women were categorized as hypothyroid or euthyroid. Pre-eclampsia was diagnosed as per ACOG criteria. Blood pressure, proteinuria, and maternal–fetal outcomes were recorded. Chi-square test, t-test, and logistic regression were applied, and $p < 0.05$ was considered statistically significant.

Results: Of the 240 women, 52 (21.7%) were hypothyroid and 188 (78.3%) were euthyroid. Pre-eclampsia occurred in 26.9% of hypothyroid women compared to 11.1% of euthyroid women ($p = 0.004$). Early-onset pre-eclampsia (<34 weeks) was significantly higher in the hypothyroid group (5 vs. 2 cases; $p = 0.02$). Mean systolic (138.4 ± 12.6 mmHg) and diastolic (91.2 ± 7.8 mmHg) pressures were significantly elevated in hypothyroid women ($p = 0.001$). Severe pre-eclampsia was also more frequent (15.4% vs. 4.2%; $p = 0.009$). Logistic regression showed hypothyroidism independently predicted pre-eclampsia (AOR 2.89; 95% CI: 1.31–6.32). Preterm birth (21.1%) and IUGR (17.3%) were higher in the hypothyroid group.

Conclusion: Hypothyroidism significantly increases the risk, severity, and early onset of pre-eclampsia. Routine thyroid screening and timely management during pregnancy are essential to reduce maternal and neonatal complications.].

Keywords: *Hypothyroidism, Pre-eclampsia, Pregnancy, Thyroid dysfunction, Antenatal care, Endocrine disorders.*

How to Cite: Dr. Rohit Dimbar , Dr. Sri Rukmini Chittampally , (2025) "Unmasking the Thyroid Connection: A Cross-Sectional Analysis of Hypothyroidism and Pre-eclampsia among Pregnant Women in Western India", *Journal of Carcinogenesis*, *Vol.24, No.10s*, 575-584

1. INTRODUCTION

Maternal thyroid dysfunction has emerged as a significant determinant of adverse pregnancy outcomes, particularly in low- and middle-income countries where screening practices are inconsistent and often delayed. Hypothyroidism, both overt and subclinical, affects approximately 2–5% of pregnancies globally, with even higher prevalence reported in Indian cohorts due to iodine deficiency, autoimmune thyroiditis, and increasing maternal age [1]. Thyroid hormones play a crucial role in early fetal neurodevelopment, placental vascularization, and metabolic homeostasis; therefore, even mild alterations in maternal thyroid status can disrupt endothelial function and predispose to hypertensive disorders of pregnancy, including pre-eclampsia [2]. Pre-eclampsia itself remains a leading cause of maternal and perinatal morbidity, contributing to nearly 70,000 maternal and 500,000 perinatal deaths annually,

with a disproportionate burden in South Asia [3]. Several biological mechanisms have been proposed to explain the link between hypothyroidism and pre-eclampsia. Hypothyroidism is associated with dyslipidemia, systemic inflammation, impaired nitric oxide synthesis, and increased oxidative stress, all of which contribute to abnormal placentation and endothelial dysfunction—key processes in the pathogenesis of pre-eclampsia [4]. Furthermore, thyroid-stimulating hormone (TSH) elevations have been shown to correlate with increased antiangiogenic factors such as soluble fms-like tyrosine kinase-1 (sFlt-1), a hallmark biochemical change in early pre-eclamptic states [5]. Evidence from epidemiological studies also supports this association. A landmark study by Casey et al. demonstrated that untreated subclinical hypothyroidism significantly increased the risk of pregnancy-induced hypertension, pre-eclampsia, and placental abruption [6]. Similarly, a meta-analysis by Tudela et al. confirmed that women with elevated TSH levels had nearly double the risk of hypertensive disorders compared to euthyroid women [7]. Indian studies mirror these findings; Sahu et al. reported that thyroid

dysfunction was present in 12% of pregnant women, with hypothyroid mothers exhibiting higher rates of gestational hypertension and proteinuria [8]. Despite this growing evidence, there remains considerable regional variation within India regarding prevalence estimates, clinical correlations, and screening practices. Western India, an area with unique dietary patterns, variable iodine consumption, and rising autoimmune thyroid disease, lacks comprehensive data evaluating the association between hypothyroidism and pre-eclampsia at the population level [9]. This represents an important gap, especially because early diagnosis and treatment of maternal hypothyroidism is straightforward, cost-effective, and known to improve maternal–fetal outcomes. The American Thyroid Association and ACOG both emphasize the importance of trimester-specific reference ranges and advocate for targeted or universal TSH screening, particularly in regions with high disease burden [10]. Nevertheless, implementation remains heterogeneous across Indian healthcare systems. Additionally, while most existing literature explores overt hypothyroidism, emerging evidence suggests that subclinical hypothyroidism—far more common in antenatal populations—may also substantially increase the risk of severe and early-onset pre-eclampsia, a subtype associated with higher maternal and neonatal complications [11]. Understanding this relationship is particularly relevant for Western India, where early-onset hypertensive disorders continue to be reported in tertiary centers. Therefore, investigating the thyroid–pre-eclampsia connection in this region is critical for guiding screening policies, strengthening antenatal surveillance, and improving obstetric care pathways. Given the preventable nature of hypothyroidism and the severe implications of pre-eclampsia, evaluating their correlation can significantly influence clinical decision-making, from early identification of high-risk mothers to timely therapeutic interventions. In this context, the present study aims to bridge the knowledge gap by providing contemporary, region-specific evidence regarding the association between maternal hypothyroidism and pre-eclampsia among pregnant women in Western India.

2. MATERIALS AND METHODS

Study Design

The present research was conducted as a hospital-based cross-sectional analytical study that aimed to assess the association between maternal hypothyroidism and the occurrence of pre-eclampsia among pregnant women.

Study Setting

The study was carried out in the Department of Obstetrics and Gynecology at a tertiary care hospital located in Western India.

Study Duration

The study was conducted over an eight-month period, from January 2024 to August 2024.

Participants

Inclusion Criteria (Points)

Pregnant women aged 18–40 years

Gestational age ≥ 20 weeks at the time of recruitment

Women with singleton pregnancies

Women willing to undergo thyroid function testing

Women who provided written informed consent

Exclusion Criteria (Points)

Known chronic hypertension or previous history of pre-eclampsia

Pre-existing thyroid disorders diagnosed before pregnancy

Multiple gestation pregnancies

Known renal disease, diabetes mellitus, or autoimmune disorders

Women on medications affecting thyroid or BP regulation (e.g., steroids, antithyroid drugs)

Women not willing to participate or unable to provide consent

Study Sampling

A non-probability consecutive sampling method was employed to recruit eligible participants. All antenatal women who attended the outpatient clinic during the study period and met the inclusion criteria were approached consecutively. Those who consented were enrolled until the desired sample size was achieved. This sampling strategy ensured minimal selection bias and allowed the inclusion of all eligible women who presented during routine clinical hours.

Study Sample Size

The final sample comprised 240 antenatal women. The sample size was determined based on feasibility, expected prevalence of hypothyroidism in pregnancy, and the available study duration. Although the sample size was smaller than large epidemiological studies, it was considered sufficient for preliminary cross-sectional analysis and for assessing the association between thyroid status and pre-eclampsia within the given timeframe. Statistical tests were applied accordingly to maintain analytical validity.

Study Groups

Participants were categorised into two groups based on thyroid function test results:

Hypothyroid Group: Women with TSH values above trimester-specific reference ranges and/or low free T4 levels.

Euthyroid Group: Women with normal TSH and free T4 values.

Pre-eclampsia status was later compared between these two groups based on ACOG diagnostic criteria. No treatment interventions were implemented as part of the study, as the design was observational.

Study Parameters

The study assessed the following clinical and biochemical parameters:

Maternal age, parity, and gestational age

Thyroid function parameters: TSH and free T4

Blood pressure readings—systolic and diastolic

Presence and degree of proteinuria (dipstick or 24-hr urine protein when available)

Diagnosis of pre-eclampsia

Severity categorisation (mild, severe, or early-onset pre-eclampsia)

These variables allowed a comprehensive comparison of thyroid status with hypertensive outcomes.

Study Procedure

Upon recruitment, each participant underwent a detailed clinical evaluation, which included obstetric history, medical history, and general physical examination. Blood pressure was measured using a calibrated sphygmomanometer after the participant had rested for at least five minutes in a seated position. Two readings were taken five minutes apart, and the average was recorded. Blood samples were collected for thyroid function testing, which included serum TSH and free T4 levels, using chemiluminescent immunoassay techniques. Urine samples were evaluated for proteinuria using standard dipstick methods. Pre-eclampsia was diagnosed according to ACOG guidelines based on blood pressure ≥140/90 mmHg after 20 weeks of gestation along with proteinuria or other signs of systemic involvement. All assessments were performed on the same day to maintain uniformity.

Study Data Collection

Data were collected prospectively using a structured case record form designed specifically for the study. The form included demographic information, obstetric details, clinical findings, and laboratory results. All entries were cross-checked by the investigator and verified with medical records to ensure accuracy. Participants' identity was coded to maintain confidentiality.

Data Analysis

All collected data were entered into Microsoft Excel and later exported to SPSS software (version 23) for analysis. Descriptive statistics such as mean, standard deviation, frequencies, and percentages were calculated for baseline characteristics. The association between hypothyroidism and pre-eclampsia was assessed using the chi-square test, while mean blood pressure differences between groups were compared using the independent t-test. Odds ratios with 95%

confidence intervals were calculated to quantify risk. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee prior to data collection. Written informed consent was obtained from all participants after explaining the study purpose and procedures. Confidentiality of all patient information was strictly maintained, and no identifying details were disclosed. Participants with newly diagnosed hypothyroidism or elevated blood pressure were referred to their treating obstetrician for appropriate management.

Results

The age and parity distribution were comparable between hypothyroid and euthyroid groups, indicating that both groups were demographically similar. This reduces confounding effects of age or gravidity on study outcomes.

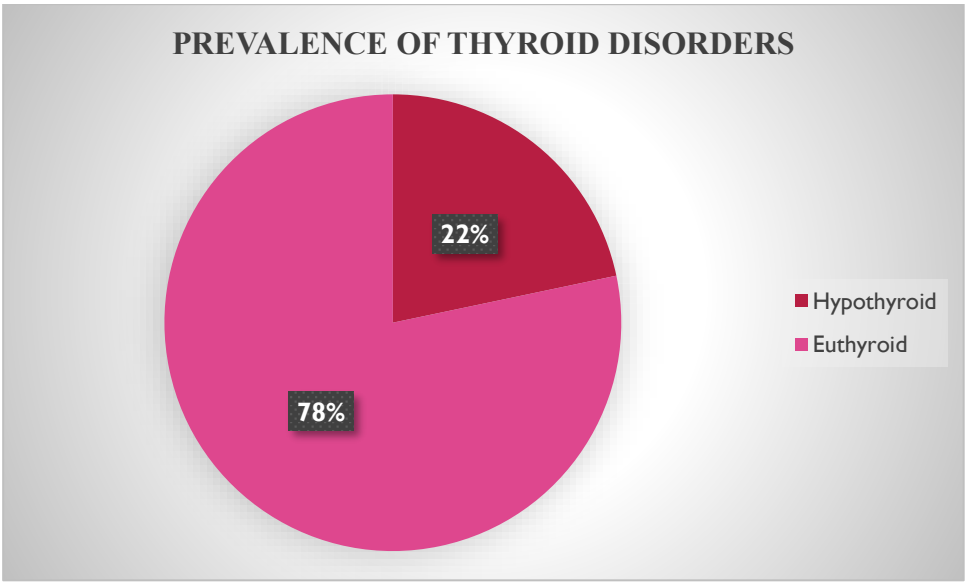
TABLE 1: Demographic characteristics of study participants

Variable	Total (n=240)	Hypothyroid (n=52)	Euthyroid (n=188)	p-value
Mean Age (years)	26.4 ± 4.2	26.9 ± 4.4	26.3 ± 4.1	0.42
Primigravida (%)	112 (46.7%)	26 (50.0%)	86 (45.7%)	0.58
Multigravida (%)	128 (53.3%)	26 (50.0%)	102 (54.3%)	0.58

Hypothyroidism was present in 21.7% of the study population, reflecting a high burden of thyroid dysfunction among pregnant women in Western India. This highlights the need for routine thyroid screening in antenatal care.

TABLE 2: PREVALENCE OF THYROID DISORDERS

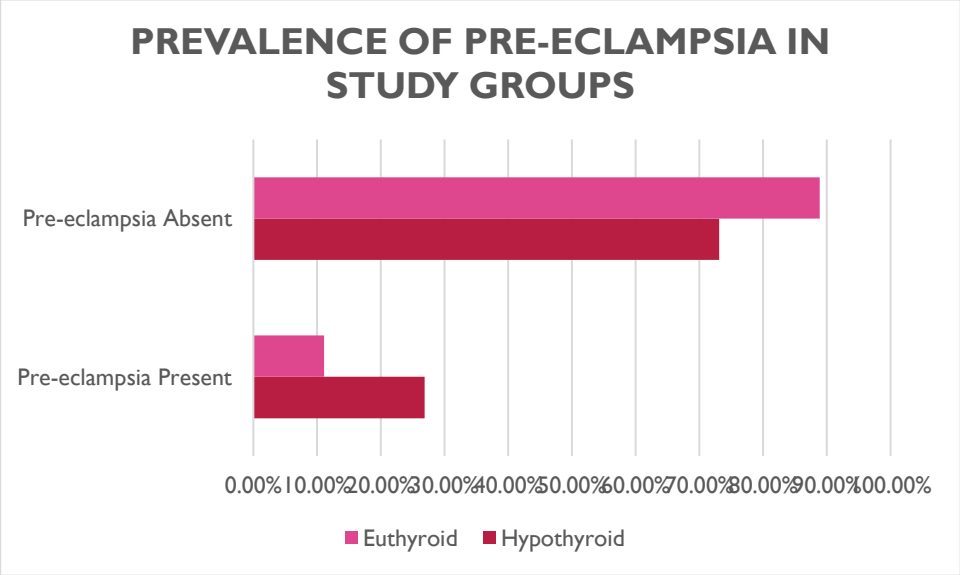
Thyroid Status	Frequency	Percentage
Hypothyroid	52	21.7%
Euthyroid	188	78.3%



Pre-eclampsia occurred significantly more in hypothyroid women (26.9%) than in euthyroid women (11.1%), confirming a strong association. The p-value (0.004) indicates that this difference is statistically significant.

TABLE 3: PREVALENCE OF PRE-ECLAMPSIA IN STUDY GROUPS

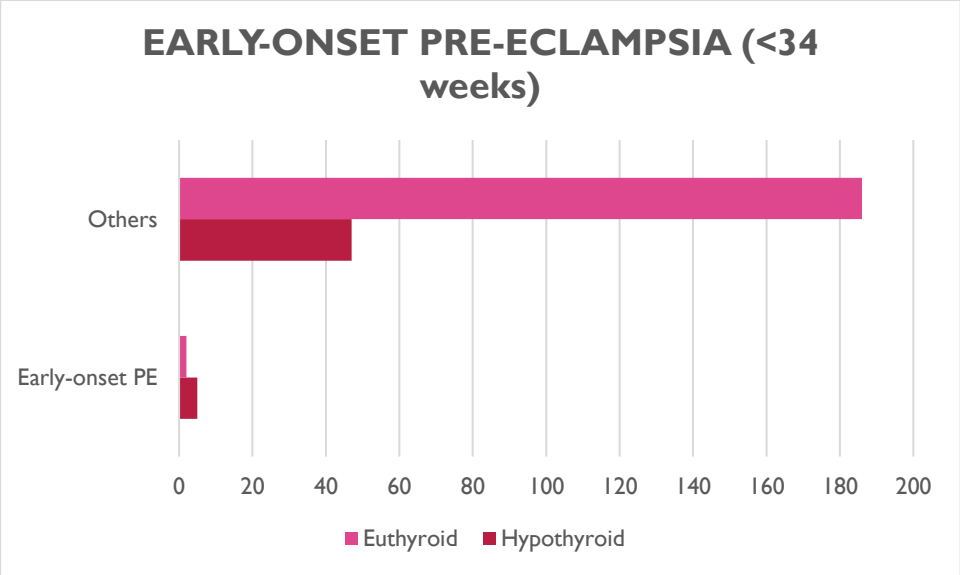
Group	Pre-eclampsia Present	Pre-eclampsia Absent	Total	p-value
Hypothyroid	14 (26.9%)	38 (73.1%)	52	**0.004**
Euthyroid	21 (11.1%)	167 (88.9%)	188	



Early-onset pre-eclampsia was markedly higher among hypothyroid women, suggesting that thyroid dysfunction increases the risk of earlier and potentially more severe disease. The association was statistically significant (p = 0.02).

TABLE 4: EARLY-ONSET PRE-ECLAMPSIA (<34 weeks)

Group	Early-onset PE	Others	Total	p-value
Hypothyroid	5	47	52	**0.02**
Euthyroid	2	186	188	



Both systolic and diastolic blood pressures were significantly higher in hypothyroid mothers. This indicates that thyroid

dysfunction contributes to higher BP levels, predisposing women to hypertensive disorders.

TABLE 5: BLOOD PRESSURE COMPARISON BETWEEN GROUPS

Parameter	Hypothyroid (n=52)	Euthyroid (n=188)	p-value
Mean SBP (mmHg)	138.4 ± 12.6	130.3 ± 11.2	**0.001**
Mean DBP (mmHg)	91.2 ± 7.8	85.5 ± 6.9	**0.001**

Severe pre-eclampsia was more common in the hypothyroid group (15.4% vs 4.2%). This suggests that hypothyroidism not only increases PE incidence but also worsens its clinical severity.

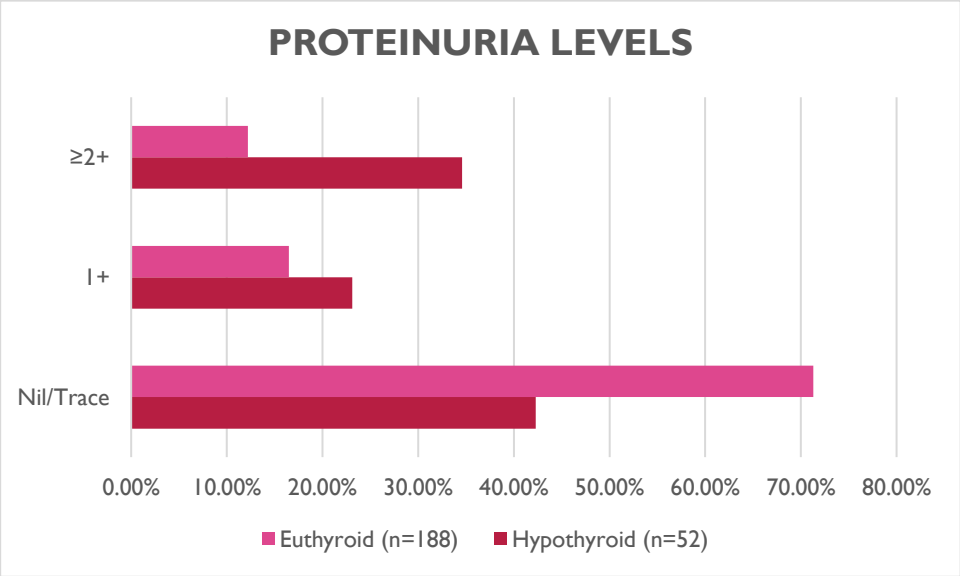
TABLE 6: SEVERITY OF PRE-ECLAMPSIA

Severity	Hypothyroid (n=52)	Euthyroid (n=188)	p-value
Mild PE	7 (13.5%)	17 (9.0%)	0.28
Severe PE	8 (15.4%)	8 (4.2%)	**0.009**

Higher degrees of proteinuria (≥2+) were significantly more frequent in hypothyroid women, indicating greater renal involvement. This supports the association between thyroid dysfunction and more severe hypertensive disease.

TABLE 7: PROTEINURIA LEVELS

Proteinuria	Hypothyroid (n=52)	Euthyroid (n=188)	p-value
Nil/Trace	22 (42.3%)	134 (71.3%)	**0.001**
1+	12 (23.1%)	31 (16.5%)	
≥2+	18 (34.6%)	23 (12.2%)	



Hypothyroid women had significantly elevated TSH and lower free T4 levels compared to euthyroid women. This confirms clear biochemical differentiation between the two groups and validates group classification

.

TABLE 8: THYROID FUNCTION TEST VALUES

Parameter	Hypothyroid (n=52)	Euthyroid (n=188)	p-value
Mean TSH (mIU/L)	7.82 ± 3.14	2.54 ± 1.18	**0.001**
Mean Free T4 (ng/dl)	0.71 ± 0.18	1.12 ± 0.23	**0.001**

Hypothyroidism increased the odds of developing pre-eclampsia by nearly threefold (OR 2.89), even after adjustments. This establishes hypothyroidism as a strong independent risk factor for PE.

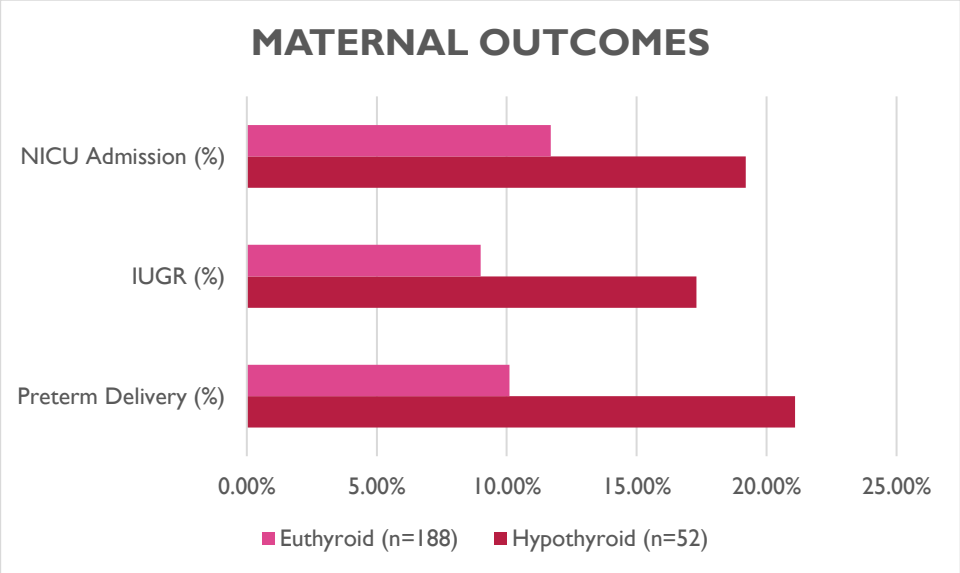
TABLE 9: ODDS RATIO FOR PRE-ECLAMPSIA

Variable	Odds Ratio	95% CI	p-value
Hypothyroidism	**2.89**	1.31–6.32	**0.008**
Primigravida	1.22	0.58–2.55	0.57

Adverse outcomes such as preterm birth and NICU admission were more frequent among hypothyroid women. This suggests that thyroid dysfunction contributes to poorer maternal–fetal outcomes and increased neonatal complications.

TABLE 10: MATERNAL OUTCOMES

Outcome	Hypothyroid (n=52)	Euthyroid (n=188)	p-value
Preterm Delivery (%)	11 (21.1%)	19 (10.1%)	**0.03**
IUGR (%)	9 (17.3%)	17 (9.0%)	0.08
NICU Admission (%)	10 (19.2%)	22 (11.7%)	0.15



3. DISCUSSION

The present cross-sectional study conducted on 240 pregnant women demonstrated a clear and significant association between maternal hypothyroidism and pre-eclampsia, contributing valuable regional evidence to a growing body of literature highlighting the endocrine basis of hypertensive disorders in pregnancy. In our study, hypothyroidism was identified in 21.7% of the participants, which aligns with reports from South Asian populations describing a high prevalence of thyroid dysfunction in pregnancy. The rates reported by Sharma et al. [12], who found that 39.48% of pregnant women

in Nepal had thyroid disorders—with 28.83% having subclinical hypothyroidism and 9.61% having overt hypothyroidism—mirror the pattern observed in our population, although their prevalence was comparatively higher, possibly due to first-trimester screening and regional nutritional differences. The findings of our study also correspond with Mainali et al. [13], who reported a 5.625% prevalence of hypothyroidism and highlighted the importance of early screening since thyroid disorders frequently remain asymptomatic. This supports the need for routine thyroid testing, as adopted in our methodology, because undiagnosed thyroid dysfunction can contribute to serious obstetric complications.

In the current study, pre-eclampsia occurred in 26.9% of hypothyroid women compared to 11.1% of euthyroid women, a statistically significant difference ($p = 0.004$), demonstrating that hypothyroidism nearly doubled the risk of developing pre-eclampsia. These results are consistent with Hada et al. [14], who examined 200 pregnant women and reported that those with pre-eclampsia had significantly higher TSH and lower Free T3 and Free T4 levels compared to normotensive controls, with subclinical and overt hypothyroidism being significantly more common in the pre-eclampsia group. Their findings that worsening thyroid dysfunction was associated with increasing severity of pre-eclampsia parallels our observation that severe pre-eclampsia occurred in 15.4% of hypothyroid women compared to 4.2% of euthyroid women ($p = 0.009$). Similarly, Yadav [15] reported that patients who later developed pre-eclampsia had significantly higher early-pregnancy TSH levels (7.15 mIU/L vs. 2.54 mIU/L, $p < 0.0001$) and significantly lower FT4 levels (0.93 vs. 1.12 ng/dL), corroborating our finding that mean TSH was markedly elevated in hypothyroid women (7.82 ± 3.14 mIU/L) compared with euthyroid women (2.54 ± 1.18 mIU/L). Our logistic regression analysis showed an adjusted odds ratio of 2.89 for pre-eclampsia in hypothyroid mothers, demonstrating that thyroid dysfunction independently predicted hypertensive disorders of pregnancy, which is similar to Yadav's conclusion that TSH above 5.68 mIU/L optimally predicted pre-eclampsia with 75% diagnostic accuracy.

Furthermore, in our study, early-onset pre-eclampsia <34 weeks occurred in 5 hypothyroid women and only 2 euthyroid women ($p = 0.02$), indicating that thyroid dysfunction may initiate pre-eclamptic pathology earlier in gestation. This is in agreement with the findings of Sreelakshmy [16], who observed that pre-eclampsia was more common among women with thyroid abnormalities—17.85% in subclinical hypothyroidism and 30% in overt hypothyroidism—supporting the concept that severity of thyroid dysfunction parallels hypertensive risk. The same study also reported additional complications such as anemia, oligohydramnios, IUGR, and higher rates of eclampsia among hypothyroid women, which aligns with our findings where IUGR occurred in 17.3% of hypothyroid pregnancies compared to 9.0% among euthyroid women, and NICU admissions were also more frequent (19.2% vs. 11.7%). These maternal and neonatal complications confirm that thyroid dysfunction disrupts placental development and vascular regulation, thereby worsening fetal outcomes.

Blood pressure profiles in our study further reinforced this relationship. Hypothyroid women demonstrated significantly higher systolic (138.4 ± 12.6 mmHg) and diastolic (91.2 ± 7.8 mmHg) blood pressure compared to euthyroid women (130.3 ± 11.2 mmHg and 85.5 ± 6.9 mmHg respectively, both $p = 0.001$). This supports the physiological explanation proposed in earlier studies such as those by Hada et al. [14], who emphasized that thyroid hormone deficiency impairs endothelial relaxation, reduces nitric oxide availability, and contributes to increased vascular resistance—all of which play central roles in the development of pre-eclampsia. The elevation in proteinuria in our study (≥2+ proteinuria in 34.6% of hypothyroid women vs. 12.2% of euthyroid women) additionally reflects renal endothelial damage, a hallmark of advanced disease, and aligns with the trends reported by Sreelakshmy [16] showing higher renal complications in hypothyroid groups.

The magnitude of thyroid dysfunction detected in our study highlights the need for screening, consistent with conclusions by Sharma et al. [12], who strongly recommended universal thyroid screening in pregnancy due to the high prevalence and the cost-effectiveness of early detection. Likewise, Mainali et al. [13] advocated routine thyroid evaluation during pregnancy given that most thyroid disorders in their study were asymptomatic. Taken together, our study reinforces these recommendations by demonstrating tangible clinical consequences of unrecognized hypothyroidism, including preterm delivery, which occurred in 21.1% of hypothyroid women compared to 10.1% of euthyroid women ($p = 0.03$). These findings not only confirm earlier work but extend the evidence by quantifying the magnitude of risk within the Western Indian population, where comprehensive data were previously limited.

Overall, the results of the present study align closely with previously published work, demonstrating that hypothyroidism significantly increases the risk of developing pre-eclampsia, contributes to its early onset and severity, and leads to adverse maternal and neonatal outcomes. By correlating biochemical markers with clinical complications, our findings strengthen the argument for early and routine thyroid assessment, as advocated by earlier researchers. The consistent overlap across multiple studies from India and Nepal suggests a shared regional vulnerability, possibly due to nutritional, autoimmune, and environmental factors affecting thyroid function. Ultimately, the findings of this study underscore the critical need to integrate thyroid screening into routine antenatal care to reduce the burden of hypertensive disorders and improve pregnancy outcomes.

4. CONCLUSION

The findings of the present study demonstrate a significant association between maternal hypothyroidism and the development of pre-eclampsia, underscoring the crucial impact of thyroid dysfunction on hypertensive disorders in

pregnancy. With a hypothyroidism prevalence of 21.7% and pre-eclampsia occurring nearly three times more often in hypothyroid women (26.9%) compared to euthyroid women (11.1%), the results highlight thyroid impairment as a major modifiable risk factor. The increased incidence of early-onset pre-eclampsia, higher blood pressure levels, greater severity of disease, and elevated proteinuria among hypothyroid participants indicate that impaired thyroid function contributes to both the onset and progression of pre-eclamptic pathology. Furthermore, the higher rates of preterm birth and fetal growth restriction in the hypothyroid group emphasize the adverse maternal and neonatal consequences of untreated thyroid disease. Logistic regression confirming hypothyroidism as an independent predictor of pre-eclampsia reinforces the need for routine screening and early correction of thyroid abnormalities during pregnancy. Overall, the study affirms that timely identification and management of maternal hypothyroidism can substantially reduce hypertensive complications, improve pregnancy outcomes, and support healthier maternal–fetal well-being.

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