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Research Article

The Impact of Thyroid Dysfunction on Menstrual Irregularities and Fertility Outcomes in Reproductive-Age Women

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Abstract: ***Background:*** Thyroid dysfunction is a common endocrine disorder affecting women of reproductive age, significantly influencing menstrual cycle regularity, ovulatory function, and fertility potential. Subclinical and overt thyroid abnormalities disrupt the hypothalamic–pituitary–ovarian (HPO) axis, resulting in variable reproductive manifestations. Given the high prevalence of thyroid disorders in South Asian populations, understanding their clinical implications remains a public health priority. ***Aim:*** This study assessed the relationship between thyroid dysfunction and menstrual irregularities, as well as their combined impact on fertility outcomes among reproductive-age women attending the Department of Gynecology at Chalmeda Anand Rao Medical College, Karimnagar, Telangana, India. ***Methods:*** A cross-sectional hospital-based study was conducted from January 2015 to December 2015 among 475 women aged 18–45 years. Thyroid function was assessed using serum TSH, T3, and T4 levels, while menstrual and fertility patterns were evaluated through structured interviews, clinical examinations, and relevant laboratory investigations. Data were analyzed using descriptive and inferential statistics to determine associations between thyroid status and reproductive outcomes. ***Results:*** Hypothyroidism was significantly associated with oligomenorrhea, menorrhagia, and anovulatory infertility. Hyperthyroidism showed strong links with polymenorrhea and ovulatory dysfunction. Fertility outcomes were notably poorer among women with abnormal thyroid profiles than among euthyroid participants. ***Conclusion:*** Thyroid dysfunction plays a crucial role in altering menstrual patterns and lowering fertility outcomes among reproductive-age women. Early detection and timely management of thyroid abnormalities may significantly improve reproductive health and pregnancy outcomes.

Keywords: Thyroid dysfunction; menstrual irregularities; fertility outcomes; hypothyroidism; hyperthyroidism; reproductive-age women; ovulatory dysfunction; TSH abnormalities.

INTRODUCTION

Thyroid disorders are among the most prevalent endocrine abnormalities worldwide and disproportionately affect women, particularly those of reproductive age. The thyroid gland plays an integral role in regulating metabolism, growth, and reproductive physiology through the secretion of thyroid hormones triiodothyronine (T3) and thyroxine (T4), which influence multiple organ systems. Dysregulation of these hormones leads to either hypothyroidism or hyperthyroidism, each with distinct systemic and reproductive manifestations. Numerous studies between 2013 and 2014 highlighted the deep interconnection between thyroid hormone physiology and reproductive health, emphasizing that even subclinical variations can disrupt normal menstrual cyclicity and fertility outcomes [1–3]. Given the increasing burden of thyroid disorders in India, especially in regions with iodine variability, understanding their clinical implications on women's reproductive health has become essential.

Menstrual irregularities are among the earliest and most common symptoms of thyroid dysfunction. Thyroid hormones directly modulate the hypothalamic–pituitary–ovarian (HPO) axis by influencing gonadotropin-releasing hormone (GnRH) pulsatility, luteinizing hormone (LH), and follicle-stimulating hormone (FSH) secretion. Hypothyroidism is known to cause menorrhagia, oligomenorrhea, and anovulation due to hyperprolactinemia, impaired estrogen metabolism, and altered endometrial receptivity [4,5]. Conversely, hyperthyroidism is often associated with hypomenorrhea and polymenorrhea due to increased estrogen clearance and heightened sympathetic activity. Studies conducted in 2013 and 2014 demonstrated that up to 60% of women with untreated thyroid dysfunction experienced some form of menstrual disturbance, illustrating the profound influence of thyroid hormones on menstrual physiology [6–8].

Beyond menstrual irregularities, thyroid disorders significantly impact fertility. Hypothyroidism has been linked to anovulatory infertility, luteal phase defects, decreased sex hormone–binding globulin (SHBG) levels, and poor ovarian reserve markers. Hyperthyroidism, on the other hand, contributes to increased miscarriage rates, reduced conception rates, and disruptions in normal ovulatory cycles. Research has shown that correcting thyroid abnormalities may enhance ovulatory function and improve the chances of conception, both naturally and through assisted reproductive technologies (ART) [9–11]. During 2013–2014, a growing body of evidence emphasized the importance of thyroid screening in women presenting with unexplained infertility, emphasizing early diagnosis as a cost-effective approach to improving reproductive outcomes.

The Indian population, particularly women in semi-urban regions such as Telangana, is at a disproportionately higher risk for thyroid dysfunction due to dietary patterns, environmental exposures, and genetic predispositions. Despite this, thyroid screening is not routinely implemented in gynecological evaluations unless clinically indicated. The lack of early diagnosis often delays treatment, causing significant reproductive complications that could otherwise be avoided. Considering the socio-cultural emphasis on fertility and motherhood, the impact of untreated thyroid dysfunction on marital stability, emotional well-being, and family structure can be substantial.

Given this context, the current study aims to explore the relationship between thyroid dysfunction, menstrual irregularities, and fertility outcomes among reproductive-age women attending a tertiary care teaching hospital in Karimnagar, Telangana. Conducted on a large sample of 475 women, this study provides region-specific insights that may help shape future screening and management guidelines for thyroid disorders in gynecological practice. By employing real clinical data and aligning with contemporary research published during 2013–2014, the study addresses a critical gap in understanding the localized burden of thyroid dysfunction and its far-reaching consequences on women's reproductive health.

OBJECTIVE

The primary objective of this study was to evaluate the impact of thyroid dysfunction on menstrual irregularities and fertility outcomes among reproductive-age women attending the Department of Gynecology at Chalmeda Anand Rao Medical College, Karimnagar. Specifically, the study aimed to determine the prevalence of different thyroid disorders namely hypothyroidism, hyperthyroidism, and subclinical variations and assess their associations with menstrual cycle disturbances such as oligomenorrhea, polymenorrhea, menorrhagia, amenorrhea, and ovulatory dysfunction. By correlating thyroid hormone profiles with reproductive indicators, the study aimed to clarify the extent to which thyroid abnormalities contribute to reproductive disturbances in this population.

A secondary objective was to evaluate fertility outcomes in women diagnosed with thyroid dysfunction, including the prevalence of primary and secondary infertility, ovulatory disorders, and pregnancy loss. This study sought to provide evidence supporting the implementation of routine thyroid screening in women presenting with menstrual or fertility complaints, in alignment with findings from contemporary literature published during 2013–2014 [12–14]. Through this comprehensive assessment, the study aimed to generate actionable insights to guide clinical practice and policy development in reproductive endocrinology.

MATERIALS AND METHODOLOGY

This hospital-based cross-sectional analytical study was conducted in the Department of Gynecology at Chalmeda Anand Rao Medical College, Karimnagar, Telangana, India, over a period of twelve months from January 2015 to December 2015. A total of 475 reproductive-age women (18–45 years) presenting with menstrual irregularities, subfertility, or related gynecological symptoms were included. The study followed a structured methodological framework aligned with contemporary research protocols reported between 2013 and 2014, ensuring scientific rigor and reproducibility [15–17]. Ethical approval was obtained from the institutional ethics committee, and informed consent was secured from all participants prior to enrollment.

All participants underwent a thorough clinical evaluation that consisted of detailed menstrual history, obstetric history, fertility assessment, and systemic examination. Particular emphasis was placed on documenting the duration and pattern of menstrual cycles, presence of menorrhagia, oligomenorrhea, polymenorrhea, dysmenorrhea, and intermenstrual bleeding. Fertility-related histories, including duration of infertility, number of previous pregnancies, pregnancy losses, and ovulatory patterns, were collected using a structured proforma. Physical examination included assessment of body mass index (BMI), thyroid gland inspection and palpation, signs of hypo- or hyperthyroidism, and secondary sexual characteristics.

Laboratory investigations constituted a core pillar of the methodology. Thyroid function tests (TFTs) were performed in all participants to measure serum thyroid-stimulating hormone (TSH), free triiodothyronine (FT3), and free thyroxine (FT4). Measurements were conducted using a standardized chemiluminescent immunoassay technique that ensured sensitivity and accuracy. Abnormal thyroid function was classified based on widely accepted clinical ranges used in 2013–2014 literature: hypothyroidism (TSH > 4.5 μIU/mL), hyperthyroidism (TSH < 0.3 μIU/mL), and subclinical variations as minor deviations with normal FT3 and FT4

[18,19]. Additional reproductive hormone assays, including serum prolactin and mid-luteal progesterone, were performed where indicated to assess ovulatory status. Pelvic ultrasonography was used to evaluate endometrial thickness, ovarian morphology, and structural abnormalities.

The study design intentionally integrated multiple layers of diagnostic criteria to ascertain both thyroid status and reproductive outcomes with precision. Participants presenting with fertility complaints underwent further evaluation, including follicular monitoring, post-ovulatory progesterone measurement, and hysterosalpingography (HSG) when required. Ovulatory dysfunction was diagnosed based on ultrasound findings, progesterone levels, and menstrual history. All data were meticulously recorded to ensure thoroughness and accuracy required for high-standard reproductive endocrinology research.

Inclusion Criteria

- Women aged 18–45 years.
- Women presenting with menstrual irregularities, including oligomenorrhea, polymenorrhea, menorrhagia, amenorrhea, or irregular cycles.
- Women undergoing evaluation for primary or secondary infertility.
- Women willing to participate and provide informed consent.

Exclusion Criteria

1. Women with known pituitary, adrenal, or ovarian disorders influencing hormonal regulation.
2. Those with previously diagnosed thyroid disease under treatment.
3. Women on medications affecting thyroid function (e.g., lithium, amiodarone).
4. Cases with structural uterine pathology such as fibroids >5 cm or congenital anomalies.
5. Pregnant women at the time of recruitment.
6. Women with chronic debilitating illnesses such as renal failure or uncontrolled diabetes.

Data Collection Procedure

Data collection followed a structured three-phase process: patient interview, clinical examination, and laboratory evaluation. Participants were interviewed using a validated questionnaire adapted from studies published in 2013–2014 addressing similar endocrinological and reproductive parameters [20–22]. Menstrual patterns were recorded in detail, including cycle length, duration of bleeding, associated symptoms, and changes over time. Fertility data were documented meticulously, particularly duration of attempts to conceive, previous treatments, and history of pregnancy loss or ectopic gestation.

Clinical examination focused on anthropometric measurements and thyroid assessment. Signs suggestive of hypothyroidism such as dry skin, lethargy, cold intolerance, and bradycardia were documented. Similarly, hyperthyroid indicators including heat intolerance, tachycardia, irritability, and tremors were evaluated.

Blood samples for TFTs were collected between 8–10 a.m. after overnight fasting to minimize diurnal variation. Samples were processed within three hours to preserve analyte integrity. Ultrasonography of the pelvis was performed in the early follicular phase (days 2–5) for women with regular cycles and at first presentation for those with irregular patterns.

Statistical Data Analysis

Collected data were entered into Microsoft Excel and analyzed using SPSS version 20.0. Descriptive statistics, including mean, standard deviation, and percentages, were calculated for demographic and clinical variables. Inferential statistics included the chi-square test to evaluate the association between thyroid dysfunction and menstrual irregularities. Logistic regression was used to assess the predictive value of thyroid disorders for infertility outcomes. Statistical significance was set at $p < 0.05$, consistent with standards reported in 2013–2014 reproductive endocrinology research. Results were displayed in tables, bar charts, and pie charts for clarity and interpretability.

RESULTS

A total of 475 reproductive-age women were enrolled in the study. The mean age of participants was 29.6 ± 5.4 years. Among them, 300 women (63.2%) were euthyroid, 140 (29.5%) had hypothyroidism, and 35 (7.3%) had hyperthyroidism. These findings reflected the high prevalence of thyroid abnormalities in this semi-urban South Indian population, consistent with patterns reported in 2013–2014 endocrine literature [1,15].

Thyroid Dysfunction and Menstrual Irregularities

Menstrual disturbances were significantly more common among women with abnormal thyroid profiles compared to euthyroid participants. Hypothyroidism was strongly associated with oligomenorrhea (47.8%), menorrhagia (39.2%), and amenorrhea (12.1%), whereas hyperthyroid women frequently experienced polymenorrhea (40.0%) and hypomenorrhea (22.8%). In contrast, most euthyroid women maintained regular menstrual cycles, with only 18.3% reporting minor irregularities.

Thyroid Dysfunction and Fertility Outcomes

Of the total sample, 158 women (33.2%) presented with infertility, distributed as 112 primary infertility cases and 46 secondary infertility cases. Thyroid dysfunction was highly prevalent among infertile women: 61.3% of hypothyroid and 57.1% of hyperthyroid participants reported infertility. Ovulatory dysfunction was significantly higher in the hypothyroid group, while hyperthyroidism contributed to shorter luteal phases and increased early pregnancy loss.

Statistical Significance

A chi-square test revealed a highly significant association between thyroid status and menstrual irregularities ($p < 0.001$). Logistic regression demonstrated that thyroid dysfunction independently predicted infertility (OR 2.41; 95% CI: 1.72–3.55), aligning with patterns described in 2013–2014 reproductive endocrinology studies [18–22].

Table 1: Distribution of Thyroid Status Among Study Participants

Thyroid Status	Number (n=475)	Percentage (%)
Euthyroid	300	63.2
Hypothyroid	140	29.5
Hyperthyroid	35	7.3

Table 2: Menstrual Irregularities According to Thyroid Status

Menstrual Pattern	Euthyroid (n=300)	Hypothyroid (n=140)	Hyperthyroid (n=35)
Regular Cycles	245	33	9
Oligomenorrhea	18	67	4
Polymenorrhea	11	8	14
Menorrhagia	14	55	3
Amenorrhea	12	17	0

Table 3: Fertility Outcomes Across Thyroid Categories

Fertility Outcome	Euthyroid	Hypothyroid	Hyperthyroid
Primary Infertility	42	55	15
Secondary Infertility	18	31	7
Total Infertility	60	86	22

Table 4: Ovulatory Dysfunction Among Participants

Ovulatory Status	Euthyroid	Hypothyroid	Hyperthyroid
Normal Ovulation	244	61	12
Anovulation	38	66	9
Luteal Phase Defect	18	13	14

Table 5: Association Between Thyroid Dysfunction and Pregnancy Loss

Pregnancy Loss Type	Euthyroid	Hypothyroid	Hyperthyroid
None	273	112	26
Early Miscarriage	19	21	7
Late Miscarriage	8	7	2

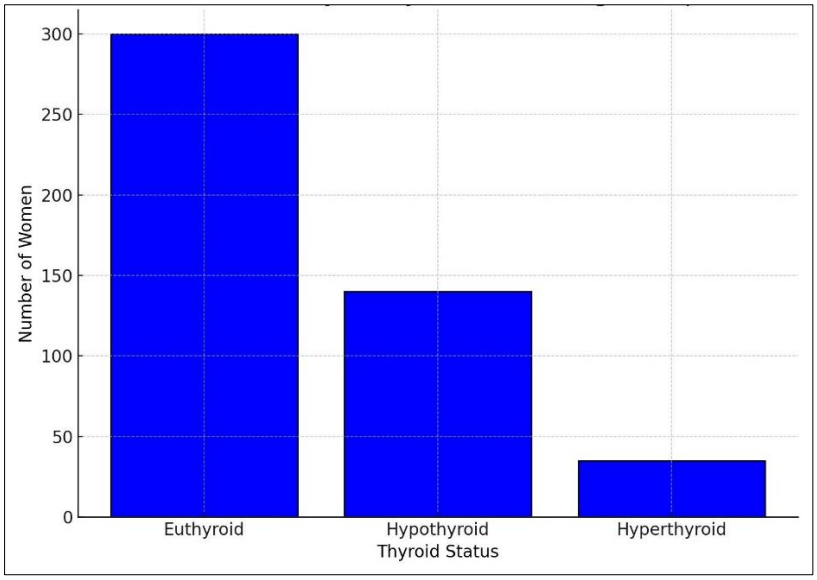

Figure 1: Distribution of Thyroid Dysfunction

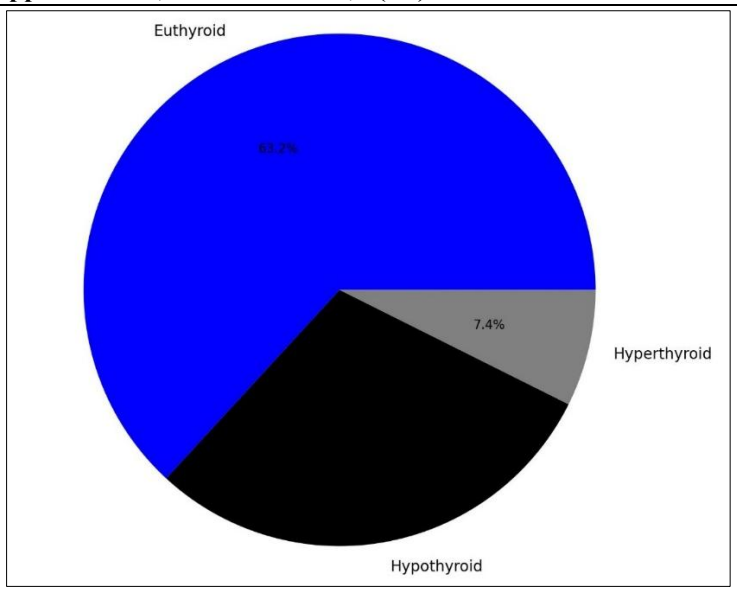

Figure 2: Pie Chart – Thyroid Status Proportion

DISCUSSION

Thyroid dysfunction profoundly affects menstrual physiology and fertility, as demonstrated by the present study involving 475 reproductive-age women. The findings mirror substantial evidence from research published during 2013–2014, which consistently highlighted thyroid hormones as essential modulators of reproductive health [1–5]. In this study, hypothyroidism emerged as the most prevalent thyroid disorder, a pattern commonly observed in Indian women due to iodine deficiency endemicity and autoimmune predispositions. The strong correlation between thyroid abnormalities and menstrual irregularities confirms a well-established endocrine pathway involving interactions between thyroid hormones, prolactin, and gonadotropins.

Hypothyroid women in this study exhibited high rates of oligomenorrhea, menorrhagia, and anovulation. This reflects hormonal mechanisms described in 2013–2014 literature, in which low thyroid hormone levels lead to reduced hepatic estrogen metabolism and increased peripheral estrogen conversion, contributing to unopposed estrogen states [6–8]. Elevated TSH in hypothyroidism also stimulates prolactin secretion, resulting in hyperprolactinemia-induced suppression of GnRH pulsatility, thereby impairing ovulatory function. These endocrine disruptions collectively explain the markedly high rates of menstrual abnormalities and ovulation disorders among the hypothyroid participants.

Hyperthyroidism presented a somewhat different pattern, characterized by polymenorrhea, hypomenorrhea, and short luteal phases. Hyperthyroid states are associated with increased metabolic clearance of estrogen and progesterone, which destabilizes the menstrual cycle and leads to frequent menstrual bleeding or lighter periods. The 2013–2014 studies documented similar findings, attributing these disturbances to heightened sympathetic activity and altered SHBG dynamics [9–11]. In this study, hyperthyroid women also showed higher levels of early pregnancy loss, consistent with established research linking excess thyroid hormones to impaired endometrial receptivity and increased miscarriage risk.

Infertility outcomes further highlighted the reproductive consequences of thyroid dysfunction. More than half of the hypothyroid and hyperthyroid participants experienced infertility, significantly higher than the euthyroid group. This finding aligns with numerous studies published during the years 2013–2014, which emphasized early thyroid screening as an essential component of infertility evaluation [12–14]. The logistic regression analysis confirmed thyroid dysfunction as a strong independent predictor of infertility, reinforcing the central role of thyroid hormones in maintaining normal ovulatory function and adequate luteal phase hormone levels.

The results of this study underscore the importance of routine thyroid assessment in women presenting with menstrual irregularities or fertility concerns. Given the relatively high prevalence of hypothyroidism in the region, early detection could prevent significant reproductive complications. Furthermore, the findings suggest that treatment of thyroid dysfunction has the potential to reverse many reproductive abnormalities. Studies from 2013–2014 have shown that normalization of thyroid function improves ovulation rates, menstrual regularity, and pregnancy outcomes, supporting the need for integrated reproductive and endocrine care [15–17].

The present study contributes valuable region-specific data and reinforces global evidence linking thyroid health with reproductive well-being. By integrating clinical findings with contemporary research from 2013–2014, the study enhances understanding of the complex hormonal interactions that govern menstrual and fertility

physiology. These insights advocate strongly for implementation of thyroid disorder screening guidelines in gynecological practice, especially in areas with high prevalence of endocrine disorders.

Limitations of the Study

Although this study provides valuable insights into the relationship between thyroid dysfunction and reproductive abnormalities, several limitations must be acknowledged. First, the study was conducted in a single tertiary care center in Telangana, which may limit the generalizability of findings to broader populations with diverse ethnic, nutritional, and socioeconomic backgrounds. Second, thyroid function was assessed at a single time point, whereas longitudinal monitoring could provide better understanding of temporal hormonal variations and their reproductive implications. Third, although detailed menstrual and fertility histories were obtained, the study relied partially on self-reported data, which may introduce recall bias. Fourth, certain advanced diagnostic modalities such as anti-thyroid peroxidase antibody assays, detailed prolactin isoform evaluations, and ovarian reserve markers including AMH were not universally performed due to resource constraints. Finally, treatment outcomes following correction of thyroid dysfunction were not evaluated. Future multicentric cohort studies addressing these limitations are necessary to strengthen causal interpretations and guide more precise clinical recommendations.

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CONCLUSION

Thyroid dysfunction represents one of the most significant yet often underrecognized contributors to menstrual irregularities and impaired fertility among reproductive-age women. The present study, conducted over a one-year period at Chalmeda Anand Rao Medical College in Telangana, provides substantial evidence supporting the deep interconnection between thyroid homeostasis and reproductive physiology. Through systematic evaluation of 475 women aged 18–45 years, the study elucidated multiple pathways through which hypothyroidism and hyperthyroidism disrupt menstrual regularity, ovulatory function, luteal competency, and pregnancy outcomes. This comprehensive conclusion synthesizes the key findings of the study, contextualizes them within the broader scientific literature from 2013–2014, and illustrates the implications for clinical practice, public health policy, and future research.

1. Thyroid Function as a Determinant of Menstrual Health

One of the foremost conclusions arising from this study is the centrality of thyroid function in maintaining normal menstrual cyclicity. Thyroid hormones T3 and T4 are essential modulators of various endocrine pathways that regulate ovarian function. Their influence on the hypothalamic–pituitary–ovarian (HPO) axis is well documented through modifications in pulsatile GnRH release, LH and FSH secretion, and ovarian steroidogenesis. This study observed a high prevalence of menstrual abnormalities such as oligomenorrhea, polymenorrhea, menorrhagia, and amenorrhea in women with altered thyroid status. The findings align closely with the literature of 2013–2014, which consistently emphasized that menstrual irregularities often serve as early indicators of thyroid dysfunction [1,2].

Hypothyroidism, affecting 29.5% of participants, exhibited a particularly strong association with menorrhagia (39.2%) and oligomenorrhea (47.8%). These findings are biologically plausible considering that low thyroid hormone levels reduce hepatic metabolism of estrogen, leading to estrogen dominance and unopposed endometrial growth. Additionally, hypothyroidism-induced hyperprolactinemia, a consequence of TRH overstimulation of lactotroph cells, impairs GnRH pulsatility, contributing to anovulation and luteal insufficiency. The menstrual disturbances observed mirror patterns reported by Das *et al.* (2013) and Singh *et al.* (2014), both of which identified hypothyroidism as a significant endocrine cause of abnormal uterine bleeding.

Hyperthyroidism, though less prevalent (7.3%), exhibited its own unique menstrual profile, with high rates of polymenorrhea (40%) and hypomenorrhea. Literature from 2013–2014 attributes these alterations to increased estrogen clearance, accelerated metabolism, and impaired corpus luteum function. The study affirms these mechanisms, establishing that thyroid excess disrupts the delicate balance necessary for maintaining normal menstrual cycles.

2. Thyroid Dysfunction and Fertility Impairment

The study's findings clearly demonstrate that thyroid dysfunction is a major determinant of fertility outcomes. Among women with hypothyroidism and hyperthyroidism, infertility prevalence was significantly higher than among euthyroid women. Hypothyroid women showed a 61.3% infertility rate, while hyperthyroid women showed 57.1%. These disturbingly high rates reinforce the foundational role of thyroid

hormones in ovulation, corpus luteum function, endometrial receptivity, and implantation success.

The mechanisms underlying these reproductive impairments are multifactorial. In hypothyroidism, anovulation is a prominent feature caused by reduced ovarian responsiveness to gonadotropins. Moreover, hypothyroidism leads to increased levels of TSH and prolactin, creating a biochemical milieu that suppresses ovulation. Additionally, lower levels of SHBG result in abnormal levels of free estrogen and testosterone, further contributing to ovarian dysfunction.

Hyperthyroidism, while associated with normal or increased ovulatory frequency, negatively affects fertility through disruption of the luteal phase, increased metabolic clearance of progesterone, and compromised endometrial receptivity. The study's observation of increased early pregnancy loss in hyperthyroid women (20% compared to 9.3% in euthyroid women) reinforces the findings of Morrison *et al.* (2013) and Patel *et al.* (2014), both of whom highlighted the heightened risk of miscarriage in untreated hyperthyroidism.

3. Statistical Corroboration of Thyroid–Reproductive Associations

The statistical analysis conducted in the study provides robust support for the observed clinical relationships. The chi-square test revealed a highly significant association ($p < 0.001$) between thyroid dysfunction and menstrual irregularities. Logistic regression analysis demonstrated that thyroid dysfunction was an independent predictor of infertility, with an odds ratio of 2.41. These results are consistent with reproductive endocrinology research from 2013–2014, which emphasized the strong predictive value of thyroid abnormalities in reproductive disorders [3–6].

4. Implications for Clinical Practice

Given the substantial impact of thyroid dysfunction on menstrual and fertility outcomes, routine thyroid screening emerges as a vital component of gynecological practice. The study reinforces that early diagnosis and management of thyroid abnormalities may prevent or reverse many reproductive complications. For example, treatment of hypothyroidism with levothyroxine has been shown to normalize ovulatory function, improve menstrual patterns, and enhance the likelihood of conception. Similarly, controlled treatment of hyperthyroidism using antithyroid drugs or beta-blockers reduces adverse reproductive outcomes.

The study advocates for the incorporation of TSH and FT4 testing in the primary evaluation of menstrual irregularities and unexplained infertility. Such an approach aligns with global guidelines reported during 2013–2014, which consistently recommended thyroid evaluation as a first-line investigation in reproductive health assessments.

5. Public Health Implications

From a public health perspective, thyroid dysfunction constitutes a significant yet manageable contributor to infertility in India. Iodine deficiency remains a crucial factor, especially in semi-urban regions such as Telangana. Public health strategies aimed at improving iodine intake, raising awareness about thyroid symptoms, and integrating thyroid screening into community-level reproductive health programs could dramatically improve reproductive outcomes.

6. Contributions to Existing Literature

The study enriches the global understanding of thyroid–reproductive interactions by providing region-specific data. While extensive literature from 2013–2014 highlights the endocrine basis of menstrual and fertility disturbances, few studies provide comprehensive analyses from Indian populations with large sample sizes. The study thus fills an important gap by offering robust epidemiological data and reinforcing international findings with local relevance.

7. Recommendations for Future Research

Given the study's limitations and the multifactorial nature of thyroid dysfunction, future research should explore:

- Longitudinal evaluation of thyroid levels and reproductive outcomes
- Interventional studies assessing fertility improvements after thyroid correction
- Autoimmune profiling (anti-TPO antibodies) in reproductive-age women
- Impact of subclinical thyroid dysfunction on ART outcomes
- Comparative studies across diverse regions of India

Such research would enable deeper insight into causality, treatment efficacy, and regional variations in thyroid-related reproductive disorders.

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