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Original Article

Correlation between TSH, Prolactin, LH, FSH, Estrogen, and Progesterone in Women with Infertility

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Abstract

Background: Hormonal imbalances play a pivotal role in female infertility, affecting various endocrine pathways that warrant comprehensive evaluation.

Objective: To analyze correlations between thyroid-stimulating hormone (TSH), prolactin, luteinizing hormone (LH), follicle-stimulating hormone (FSH), estrogen, and progesterone in women with infertility.

Methods: This retrospective observational study was conducted at the Department of Obstetrics and Gynecology of Prakash institute of Medical Sciences, India, between January 2024 and December 2024. Medical records of 140 women (90 with primary infertility and 50 with secondary infertility) aged 19–45 years were analyzed over a one-year period. Hormonal profiles including TSH, prolactin, LH, FSH, estrogen, and progesterone were analyzed. Statistical analyses were performed using the SPSS 23.0 software and a p-value of less than 0.05 was considered statistically significant.

Results: Women with primary infertility were younger and had a shorter duration since marriage compared to those with secondary infertility ($p<0.001$). Irregular menstrual cycles were significantly more common in primary infertility cases ($p=0.002$). Thyroid dysfunction was seen in 25% of cases, with hypothyroidism as the most common thyroid function abnormality (14.9%). A strong positive correlation was found between TSH and prolactin levels ($r=0.821$, $p<0.05$), whereas a significant negative correlation was present between TSH and LH ($r=-0.73$, $p<0.05$) and FSH ($r=-0.41$, $p<0.05$). Correlations between TSH and estrogen or progesterone was not found to be statistically significant ($P>0.05$).

Conclusion: TSH levels significantly correlate with prolactin, LH, and FSH levels in women with infertility. These findings underscore the importance of comprehensive endocrine evaluation of women with infertility to optimize diagnosis and management strategies.

Keywords: Hormonal imbalance, infertility, prolactin, thyroid-stimulating hormone

Introduction

Infertility is usually defined as failure to conceive even after 12 months of regular and unprotected sexual intercourse. It is a significant global health issue that affects approximately 8–12% of the couples worldwide.[1] The burden of infertility is significant in developing countries where infertility not only is a medical issue but also has serious social and psychological consequences. In India the prevalence of infertility is estimated to be around 10–14%, with variations based on socio-demographic

factors. Since female infertility accounts for approximately 40-50% of all infertility cases it is important to have an in-depth understanding of the etiological factors and underlying mechanisms involved in female's infertility.[2]

Female infertility is multifactorial and its causes ranges from anatomical, genetic, environmental, and lifestyle factors to endocrine and metabolic dysfunctions. Structural abnormalities (tubal blockage, congenital uterine anomalies and uterine fibroids) can interfere with fertilization and implantation.[3] Genetic disorders (chromosomal abnormalities and mutations affecting ovarian function) can lead to primary ovarian insufficiency. Lifestyle factors such as obesity, stress, smoking and exposure to environmental toxins also affect fertility in women. However, one of the most common yet underdiagnosed causes of infertility in women is hormonal imbalances particularly involving thyroid hormones, gonadotropins, and prolactin.[4] Thyroid dysfunction can result in altered sex hormone-binding globulin (SHBG) levels, abnormal follicular development and luteal phase defects.[5]

Follicle-stimulating hormone (FSH) and luteinizing hormone (LH) are key gonadotropins that are known to regulate follicular maturation and ovulation. Disturbances in their secretion can lead to ovulatory dysfunction which is a leading cause of infertility in women.[6] Elevated FSH levels is suggestive of diminished ovarian reserve. Altered LH secretion patterns are commonly seen in polycystic ovary syndrome (PCOS) which is a major cause of anovulatory cycles leading to infertility. Prolactin is involved in the regulation of the HPO axis. Hyperprolactinemia is known to suppress gonadotropin-releasing hormone (GnRH) secretion thereby causing decreased FSH and LH levels resulting in anovulation and menstrual irregularities.[7]

The relationship between thyroid hormones, FSH, LH and prolactin is complex. Thyroid dysfunction can significantly affect the secretion of gonadotropins as well as prolactin.[8] In women with hypothyroidism elevated thyrotropin-releasing hormone (TRH) levels stimulate prolactin secretion which in turn inhibits FSH and LH release. All these hormonal changes impair follicular development and ovulation. Hyperthyroidism has been associated with suppressed TSH and alterations in gonadotropin dynamics causing menstrual disturbances and infertility. Additionally, estrogen metabolism and SHBG levels are influenced by thyroid hormones further affecting reproductive hormone levels.[9]

Despite growing interest in the hormonal mechanisms underlying infertility, few studies have systematically explored the correlations between thyroid hormones, prolactin, FSH, LH, estrogen, and progesterone in women with infertility. A better understanding of these hormonal interactions can lead to improved clinical outcomes in affected women.

Methods

This retrospective observational study was conducted in the Department of Obstetrics and Gynecology of Prakash institute of medical sciences, India. The study period extended over one year, from January 2024 to December 2024. In this study medical records of total 140 women diagnosed with infertility were analyzed. These cases were categorized into two groups based on the type of infertility: primary infertility (n=90) and secondary infertility (n=50). All women included in the study were aged between 19 and 45 years. Since the study was retrospective and observational no ethical issues were involved and hence no ethical committee clearance was required. Patients' data was anonymized prior to analysis to maintain confidentiality. The study adhered to institutional norms regarding the use of medical records for research.

The minimum sample size was determined to be 120 cases based on previous pilot studies evaluating thyroid and other hormonal profiles among infertile women. Aiming for a statistical power of 90% and a 95% confidence interval. Therefore, 140 infertile women were included in this study to ensure adequate statistical power.

Data were collected retrospectively from patient records and included demographic details, menstrual history, obstetric history, medication use, and addiction history. Women with known male factor infertility were excluded, as were those taking medications known to interfere with thyroid function (e.g., amiodarone, phenytoin, lithium). Women diagnosed with tubal factor infertility, congenital uterine anomalies, large fibroids or history of thyroid disease and significant psychiatric illnesses were also excluded from the study. Patients in whom complete hormonal profile (Thyroid-Stimulating Hormone (TSH), Serum Follicle-Stimulating Hormone (FSH), Serum Luteinizing Hormone (LH), Serum

Prolactin, Serum Free Triiodothyronine (FT3), and Serum Free Thyroxine (FT4) and prolactin) was available for review were included and those with incomplete hormonal profile were excluded from study. Data about various hormonal levels was collected from hospital records. It was made sure to only include those patients whose fasting venous blood samples were drawn during the early follicular phase (between days 3 to 5) of the menstrual cycle.

Hormonal measurements were performed using the chemiluminescence immunoassay (CLIA) method, as documented in the hospital records. Reference ranges for each hormone were noted according to standard laboratory guidelines. Based on available thyroid function test results and corresponding clinical features noted in the records participants were retrospectively classified into categories including euthyroid, subclinical hypothyroidism, clinical hypothyroidism, subclinical hyperthyroidism, and clinical hyperthyroidism.

Statistical analysis was performed using SPSS version 23.0. Descriptive statistics were used to summarize demographic and clinical variables. Comparative and correlational analyses were conducted to assess associations between TSH, FSH, LH, prolactin, and infertility type. A p-value <0.05 was considered statistically significant.

Results

The analysis of demographic and clinical characteristics between primary and secondary infertility cases revealed statistically significant differences. Women with primary infertility were predominantly younger, with nearly half (47.78%) in the 18–25 years age group, whereas secondary infertility was more common in the 26–30

Table 1 Comparison of Age, Duration Since Marriage, and History of Menstrual Irregularity Between Primary and Secondary Infertility Groups

Parameters		Primary Infertility (n=90)		Secondary Infertility (n=50)		p-value
		Number of cases	%	Number of cases	%	
Age Group (years)	18–25	43	47.78	8	16	p<0.001*
	26–30	22	24.44	21	42	
	31–35	11	12.22	13	26	
	36–45	14	15.56	8	16	
	Total	90	100	50	100	
	Mean Age	24.12 +/- 5.4 years		29.32 +/- 7.68 years		
Duration Since Marriage	1-3 years	38	42.22	0	0	p<0.001*
	4-6 years	31	34.44	6	6.67	
	7-10 years	11	12.22	30	33.33	
	> 10 years	10	11.11	15	16.67	
	Total	90	100.0	50	100	
	Mean	4.94 ± 3.12 years		9.20 ± 2.16 years		
History Of Irregular Menstrual Cycles	Yes	52	58.75	15	32.50	0.002*
	No	38	41.25	35	67.50	
	Total	90	100	50	100	

*Statistically significant (p<0.05)

Table 2 Thyroid Function Test Results in Studied Cases

Hormonal Parameters	Euthyroid (n=105)	Hyperthyroid (n=15)	Hypothyroid (n=20)
FT3 (pg/mL)	2.28 ± 0.48	3.9 ± 0.76	1.12 ± 0.56
FT4 (ng/dL)	8.10 ± 2.50	16.20 ± 3.40	3.20 ± 1.25
TSH (mIU/L)	2.85 ± 1.50	0.18 ± 0.06	9.25 ± 1.10

Table 3 TSH, Prolactin, FSH,LH, Estrogen and Progesterone in Studied Cases

Variables	Mean	Standard Deviation
TSH (mIU/L)	4.09	0.88
Prolactin (ng/mL)	43.90	19.85
FSH (mIU/L)	3.82	1.72
LH (mIU/L)	12.05	10.58
Estrogen (ng/mL)	82.40	44.60
Progesterone (ng/mL)	14.10	4.55

years group (42.00%). The mean age was significantly lower in primary infertility cases (24.12 ± 5.4 years) as compared to secondary infertility cases (29.32±7.68 years) ($p<0.001$). The mean duration since marriage was significantly longer in secondary infertility cases (9.20 ± 2.16 years) as compared to primary infertility cases (4.94 ± 3.12 years) ($p<0.001$). Additionally, a history of irregular menstrual cycles was more prevalent among women with primary infertility (58.75%) than those with secondary infertility (32.50%), and this difference was statistically significant ($p=0.002$) (Table 1).

The analysis of hormonal parameters among studied cases showed significant differences in thyroid function markers. 105 (75%) patients were euthyroid whereas 15 (10.71%) cases were found to be hyperthyroid whereas hypothyroidism was seen in 20 (14.9%) cases. As expected TSH levels were markedly reduced in hyperthyroid women (0.18 ± 0.06 mIU/L) and significantly elevated in hypothyroid cases (9.25 ± 1.10 mIU/L) compared to euthyroid women (2.85 ± 1.50 mIU/L) (Table 2).

The analysis of various hormones in studied cases showed that the mean TSH and prolactin levels were 4.09 ± 0.88 mIU/L and 43.90 ± 19.85 ng/mL respectively. FSH levels averaged 3.82 ± 1.72 mIU/mL, while LH showed mean of 12.05 ± 10.58 mIU/mL. Estrogen and progesterone levels were 82.40 ± 44.60 pg/mL and 14.10 ± 4.55 ng/mL respectively (Table 3).

The analysis of the correlation between TSH and various reproductive hormones showed significant associations with prolactin, LH and FSH. A strong positive correlation was found between TSH and prolactin (Spearman's correlation coefficient =0.82143, $p<0.05$). On the other hand, TSH exhibited a significant negative correlation with LH (-0.73, $p<0.05$) and FSH (-0.41,

Table 4 Correlation of TSH with Prolactin, LH, FSH, Estrogen, and Progesterone

Hormones	Spearman's Correlation Coefficient	p-value
Prolactin (ng/mL)	0.82143	<0.05*
LH (mIU/L)	- 0.73	<0.05*
FSH (mIU/L)	-0.41	<0.05*
Estrogen (ng/mL)	- 0.201	>0.05
Progesterone (ng/mL)	-0.174	>0.05

p<0.05). However, the correlations between TSH and estrogen (-0.201, p>0.05) as well as progesterone (-0.174, p>0.05) were not statistically significant (Table 4).

Discussion

The current study evaluated the correlation between thyroid-stimulating hormone (TSH) and various reproductive hormones (prolactin, luteinizing hormone (LH), follicle-stimulating hormone (FSH), estrogen, and progesterone) in women presenting with primary as well as secondary infertility. In this study out of 120 studied cases 105 (75%) patients were euthyroid. Hypothyroidism and hyperthyroidism were seen in 20 (14.9%) and 15 (10.71%) cases respectively. In a similar study Keerthana a *et al* reported hypothyroidism in 23.5% and hyperprolactinemia in 31% women presenting with infertility.[10] There was a significant positive correlation between TSH and prolactin levels in women presenting with infertility whereas negative correlations were found between TSH and LH, as well as between TSH and FSH. However, no significant correlations were observed between TSH and estrogen as well as progesterone.

Various previously done studies have reported elevated prolactin levels in hypothyroid patients to be secondary to increased thyrotropin-releasing hormone (TRH) stimulation. Fupare *et al* conducted a study to correlate thyroid hormones with FSH, LH and prolactin in infertility in the reproductive age group women.[11] For this purpose, the authors undertook a study comprising 120 women (80 were of primary infertility and 40 of secondary infertility) with infertility. The study found that Prolactin and TSH were positively correlated with each other. They were also negatively correlated with LH, FSH & T3 in infertile groups. The incidence of hypothyroidism in women with hyperprolactinemia was 25.5%. The mean serum prolactin concentration in the infertile cases with normal thyroid function was significantly higher (p<0.001) than the control group with normal thyroid function. The infertile women with hypothyroidism were found to have higher prolactin levels than the other three groups (the controls and the infertile subjects with euthyroid and hyperthyroidism) (p<0.001).The findings of this study reinforces the hypothesis that elevated TRH levels stimulate prolactin secretion consequently affecting reproductive function. Furthermore, Valvekar *et al*.[12] demonstrated a significant association between hypothyroidism-induced hyperprolactinemia and ovulatory dysfunction suggesting that routine screening for thyroid dysfunction could be beneficial in managing infertility.

This study found that there was a negative correlation of TSH and with LH and FSH. This reflects impaired gonadotropin release with increasing TSH levels. This inverse relationship may be secondary consequence of hyperprolactinemia as elevated prolactin suppresses gonadotropin-releasing hormone (GnRH) secretion thereby reducing LH and FSH levels.[13] Similar findings were reported by Sharma *et al*[14] who conducted a study of 150 infertile women. Serum LH, FSH, and estradiol were measured in all cases. The authors found a significant positive correlation between TSH and prolactin (p-value <0.05), whereas TSH showed a significant negative correlation with FSH and LH (p-value <0.05). There was an insignificant negative correlation between TSH and estrogen (D2) and progesterone (D21). The findings of this study confirmed the inhibitory effects of elevated prolactin secondary to hypothyroidism as reported by Sharma *et al*.[14] Similar negative correlation of TSH with FSH and LH has also been reported by the authors such as Conforti *et al*.[15] and Li *et al*.[16]

Interestingly, this study identified an insignificant correlation between TSH levels and estrogen and progesterone levels. This observation aligns with the study of Sharma S *et al* who demonstrated that direct correlations between TSH levels and estrogen or progesterone were relatively weak and inconsistent.[14] This inconsistent correlation of TSH with estrogen and progesterone may be due to multiple physiological mechanisms that override the isolated effects of TSH fluctuations.

This study also found substantial variability in hormone levels among infertile women notably elevated prolactin and LH concentrations. These variations underscore the importance of personalized diagnostic evaluations for management of women presenting with infertility. The elevated prolactin levels observed corroborate studies by Dhabe *et al*. who also reported prolactin's significant role in infertility.[17] In their study the authors found that Serum prolactin and hCG levels in infertile females were 33.96±11.46 ng/mL and 86.38±12.45 IU/L respectively . These values were statistically significantly high (p<0.05) as compared to prolactin and hCG levels in healthy controls. Similar higher

prolactin levels in cases of infertility have also been reported by the authors such as Lancu *et al*.[18] and Maiter *et al*.[19]

Given the substantial associations identified in this study, routine thyroid function screening, including TSH and prolactin assessments, appears indicated in infertile women. Recommendations by the American Thyroid Association also advocate evaluating thyroid status in infertility workups, supporting the clinical utility of findings of this study.[20]

Limitations of this study include its retrospective design and potential selection bias. Future prospective studies with larger sample size would enhance understanding of these hormonal interactions and further improve the understanding with respect to clinical management of infertility.

In conclusion, this study found a significant correlation between TSH and reproductive hormones in infertile women. A strong positive correlation existed between TSH and prolactin and negative correlation was found between TSH and LH/FSH. These findings suggest that even subclinical thyroid dysfunction may contribute to infertility, particularly through prolactin-mediated suppression of gonadotropins. Comprehensive endocrine evaluation should be considered essential in the diagnostic approach to female infertility.

References

1. Vander Borght M, Wyns C. Fertility and infertility: definition and epidemiology. Clin Biochem. 2018;62:2–10. doi: 10.1016/j.clinbiochem.2018.03.012.
2. Carson SA, Kallen AN. Diagnosis and management of infertility: a review. JAMA. 2021;326(1):65–76. doi: 10.1001/jama.2021.4788.
3. Vlahos NF, Theodoridis TD, Partsinevelos GA. Myomas and Adenomyosis: Impact on Reproductive Outcome. Biomed Res Int. 2017;2017:5926470. doi: 10.1155/2017/5926470.
4. Hanson B, Johnstone E, Dorais J, Silver B, Peterson CM, Hotaling J. Female infertility, infertility-associated diagnoses, and comorbidities: a review. J Assist Reprod Genet. 2017;34(2):167–77. doi:10.1007/s10815-016-0836-8
5. Ukibe NR, Ukibe SN, Emelumadu OF, Onyenekwe CC, Ahaneku JE, *et al*. Impact of thyroid function abnormalities on reproductive hormones during menstrual cycle in premenopausal HIV infected females at NAUTH, Nnewi, Nigeria. PLoS One. 2017;12(7):e0176361. doi:10.1371/journal.pone.0176361
6. Kofinas JD, Elias RT. Follicle-stimulating hormone/luteinizing hormone ratio as an independent predictor of response to controlled ovarian stimulation. Womens Health (Lond). 2014;10(5):505–9. doi:10.2217/whe.14.31
7. Hoskova K, Kayton Bryant N, Chen ME, Nachtigall LB, Lippincott MF, *et al*. Kisspeptin overcomes GnRH neuronal suppression secondary to hyperprolactinemia in humans [published correction appears in J Clin Endocrinol Metab. 2022;107(8):e3543. doi: 10.1210/clinem/dgac302.]. J Clin Endocrinol Metab. 2022;107(8):e3515–25. doi:10.1210/clinem/dgac166
8. Brown EDL, Obeng-Gyasi B, Hall JE, Shekhar S. The thyroid hormone axis and female reproduction. Int J Mol Sci. 2023;24(12):9815. doi:10.3390/ijms24129815
9. Yoshimura M, Hershman JM. Thyrotropic action of human chorionic gonadotropin. Thyroid. 1995;5(5):425–34. doi:10.1089/thy.1995.5.425
10. Keerthanaa SR, Hiremath PB. Analytical study of thyroid and prolactin hormone levels in infertile women with menstrual irregularities. International J Reproduction, Contraception, Obstetrics and Gynecology. 2020;9(4):1328–34. https://doi.org/10.18203/2320-1770.ijrcog20201025
11. Fupare S, Gadhiya BM, Jambhulkar RK, Tale A. Correlation of thyroid hormones with FSH, LH and prolactin in infertility in the reproductive age group women. Int J Clin Biochem Res. 2015;2(4):216–22. doi: 10.5958/2394-6377.2015.00005.2
12. Valvekar U, Lakshmi S, Kumar AN. Hypothyroidism and hyperprolactinemia showed positive correlation in women with primary and secondary infertility. Int J Reprod Contracept Obstet Gynecol 2016;5:2079–83. doi: http://dx.doi.org/10.18203/2320-1770.ijrcog20161866

13. Pratama G, Wiweko B, Asmarinah, Widyahening IS, Andraini T, Bayuaji H, *et al*. Mechanism of elevated LH/FSH ratio in lean PCOS revisited: a path analysis. Sci Rep. 2024;14(1):8229. doi:10.1038/s41598-024-58064-0
14. Sharma S, Meena KL, Tabiyad A, Bhardwaj MK, Jaiswal A, Mehta M. Correlation between prolactin, thyroid, LH, FSH, estradiol and progesterone in the infertile women. Int J Reprod Contracept Obstet Gynecol 2023;12:1017–22. doi: https://dx.doi.org/10.18203/2320-1770.ijrcog20230805
15. Conforti A, Di Girolamo R, Guida M, Alviggi C, Casarini L. Pharmacogenomic of LH and its receptor: are we ready for clinical practice?. Reprod Biol Endocrinol. 2025;23(Suppl 1):29. doi:10.1186/s12958-025-01359-2
16. Li J, Yu J, Huang Y, *et al*. The impact of thyroid autoimmunity on pregnancy outcomes in women with unexplained infertility undergoing intrauterine insemination: a retrospective single-center cohort study and meta-analysis. Front Endocrinol (Lausanne). 2024;15:1359210. doi:10.3389/fendo.2024.1359210
17. Navali N, Gassemzadeh A, Farzadi L, Abdollahi S, Nouri M, Hamdi K, *et al*. Intrauterine administration of hCG immediately after oocyte retrieval and the outcome of ICSI: a randomized controlled trial. Hum Reprod. 2016;31(11):2520–6. doi:10.1093/humrep/dew236
18. Iancu ME, Albu AI, Albu DN. Prolactin relationship with fertility and in vitro fertilization outcomes-a review of the literature. Pharmaceuticals (Basel). 2023;16(1):122. doi:10.3390/ph16010122
19. Maiter D. Mild hyperprolactinemia in a couple: What impact on fertility?. Ann Endocrinol (Paris). 2022;83(3):164–7. doi:10.1016/j.ando.2022.04.002
20. Alexander EK, Pearce EN, Brent GA, Brown RS, Chen H, Dosiou C, *et al*. 2017 Guidelines of the American Thyroid Association for the Diagnosis and Management of Thyroid Disease During Pregnancy and the Postpartum [published correction appears in Thyroid. 2017;27(9):1212. doi: 10.1089/thy.2016.0457.correx.]. Thyroid. 2017;27(3):315–89. doi:10.1089/thy.2016.0457