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Original Research Article

STUDY OF IRON DEFICIENCY IN CORRELATION WITH THYROID HORMONE STATUS AMONG PREGNANT WOMEN

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Abstract

Background: Iron deficiency anemia is the common health problem among pregnant women. Iron is required for the normal function of the thyroid gland. Thyroid peroxidase an iron containing enzyme is essential for initial two steps of thyroid hormone synthesis. During iron deficiency synthesis of thyroid hormones is impaired by altering the activity of Thyroid peroxidase enzyme. Serum ferritin is an iron storage form and the altered level of serum ferritin have been reported in individuals with thyroid disease. Thus, iron deficiency results in sub clinical and overt hypothyroidism in pregnant women. Regular antenatal checkups and blood examination with iron and folic acid supplementation reduce the prevalence of anemia. By detecting and treating the subclinical and overt hypothyroidism we can decrease the maternal and fetal morbidity and mortality during pregnancy. **Materials and Methods:** The present study includes 100 pregnant women who are attending the antenatal clinic, GGH, Kakinada for antenatal checkup during 1st. and 2nd Trimester. Main source of data for study is pregnant women who are attending the antenatal clinic, GGH, Kakinada for antenatal checkup. Data was entered to in Microsoft Excel and the data analyzed by using Epidata software. Descriptive statistics like mean, percentage, standard deviation, and chi square test , t test were used. P value <0.05 was considered as statistically significant. **Result:** Age Group 18-20 years 6 cases and 7 controls followed by 21–23-year age group are 17 cases and 18 controls, in age Group 24-26 there are 15 cases and 14 controls and age Group 27-30 there are 12 cases and 11 controls. Hb (Hemoglobin) cases have a mean value of 8.608, while control have a mean value of 11.696. Serum Ferritin cases have a mean value of 8.118, and controls have a mean value of 32.8. Thyroid Profile such as T3 cases have a mean value of 1.353, and control have a mean value of 1.3182. T4 cases have a mean value of 12.786, and control have a mean value of 13.7662. TSH: Cases have a mean value of 3.5142, and control have a mean value of 1.7656. **Conclusion:** Understanding the complex interplay between iron deficiency and thyroid hormone status among pregnant women is crucial for optimizing maternal and fetal outcomes. It involves appreciating the dual roles of iron in thyroid hormone metabolism and thyroid hormones in iron metabolism. Comprehensive prenatal care should address both iron status and thyroid function to promote healthy pregnancies and reduce the risk of adverse outcomes associated with deficiencies in either nutrient.

INTRODUCTION

Iron deficiency anemia is the common health problem among pregnant women. According to WHO, 35 - 75% of pregnant women in developing countries are anemic.[1] Iron is required for the normal function of the thyroid gland.[2] Thyroid peroxidase an iron containing enzyme is essential for initial two steps of thyroid hormone synthesis. During iron deficiency synthesis of thyroid hormones is impaired by altering the activity of Thyroid peroxidase enzyme. Serum ferritin is an iron storage form and the altered level of serum ferritin have been reported in individuals with thyroid disease. Thus, iron deficiency results in sub clinical and overt hypothyroidism in pregnant women. There are few studies reporting the prevalence of hypothyroidism during pregnancy in India is ranging from 4.8-11%.[3]

Hypothyroidism during pregnancy has an adverse effect on both mother and child.[4] These may include miscarriage, premature delivery and increased risk of neurodevelopmental dysplasia, autism in child.[5] Changes in serum ferritin levels reflects thyroid hormones levels.[6] Previous studies showed the positive correlation between serum ferritin and thyroid hormones.[7]

Thyroid hormones play crucial roles in human development, especially in the early stage of brain development, when the central nervous system is highly sensitive to thyroid hormones.[8] In addition, hyperthyroidism causes tachycardia, anxiety, tremor of the extremities, and weight loss, while hypothyroidism causes dry skin, developmental retardation, and cretinism.[9] For the fetus, hypothyroidism also increases the risk of premature birth and threatened miscarriage.[10]

Previous study has shown that ID may be a risk factor of thyroid disorder during the pregnancy.[10] Although iron status is not the only factor affecting thyroid function, it might have a significant complementary effect.[11] The effect of ID on thyroid hormone may be related to the change in the thyroid peroxidase (TPO) activity or the reduction of transformation of thyroxine (T4) to triiodothyronine (T3) by affecting the activity of thyroxine deiodinase.[12]

Regular antenatal checkups and blood examination with iron and folic acid supplementation reduce the prevalence of anemia. By detecting and treating the subclinical and overt hypothyroidism we can decrease the maternal and fetal morbidity and mortality during pregnancy.

Aim of the study: The aim of the present study is to access the Iron deficiency as a risk factor for thyroid disorders in pregnant women.

Objectives of the study:

1. To estimate evaluate the levels of serum ferritin, Hb%, T3, T4, TSH in Pregnant women
2. To correlate the values of serum ferritin, Hb%, T3, T4, TSH in Pregnant women

MATERIALS AND METHODS

This is a Case-control study conducted among 100 pregnant women who are attending the antenatal clinic, GGH, Kakinada for antenatal checkup during 1st and 2nd Trimester from March 2024 to July 2024.

Cases: 50 Pregnant women with Iron deficiency.

Hb % - Bellow 11 gm%, Serum ferritin bellow 11 ng/ml.

Controls: Pregnant women without iron deficiency.

Hb % - above 11 gm%, Serum ferritin above 11 ng/ml.

Inclusion criteria

Pregnant women coming for antenatal checkup during 1st. and 2nd Trimester.

Exclusion criteria

- Pregnant women with condition like
- Acute illness,
- Recent history of blood transfusion,
- Renal and hepatic failure,
- History of thyroidectomy,
- History of radioactive iodine therapy,
- Using drugs known to cause hypothyroidism.

Methods:

Serum ferritin, T3, T4, TSH was measured by Chemiluminiscent immuno assay. (Access 2 analyser) in the clinical Biochemistry laboratory at GGH, Kakinada. Hb% analysed in HORIBA ABX MICROS 60 analyser in clinical pathology at GGH, Kakinada.

Biochemical parameters:

Normal range of total T3 is 0.87 – 1.78 ng/ml

Normal range of total T4 is 4.82 – 15.65 µg/dl

Normal range of total TSH: 1st Trimester – 0.05-3.70 µIU/ml and 2nd Trimester – 0.31-4.35 µIU/ml.

Normal range of Serum Ferritin in female is 11- 306 ng/ml

According to ATA guidelines the TSH upper limit in pregnancy is 4.0 µIU/ml.

We have taken 4.5 µIU/ml as cutoff for diagnosis of hypothyroidism in different trimesters10.

Total T3, T4 within normal range and TSH >4.5 µIU/ml are considered as subclinical hypothyroidism.

Statistical Analysis

Data was entered to in Microsoft Excel and the data analyzed by using Epidata software. Descriptive statistics like mean, percentage, standard deviation, and chi square test, t test were used. P value <0.05 was considered as statistically significant.

RESULTS

In [Table 1], Age Group 18-20 years 6 cases and 7 controls followed by 21–23-year age group are 17 cases and 18 controls, in age Group 24-26 there are 15 cases and 14 controls and age Group 27-30 there are 12 cases and 11 controls.

In [Table 2], Hb (Hemoglobin) cases have a mean value of 8.608, while control have a mean value of

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11.696. Serum Ferritin cases have a mean value of 8.118, and controls have a mean value of 32.8.

In [Table 3], Thyroid Profile such as T3 cases have a mean value of 1.353, and control have a mean value of 1.3182. T4 cases have a mean value of 12.786, and control have a mean value of 13.7662. TSH: Cases have a mean value of 3.5142, and control have a mean value of 1.7656.

Applying regression analysis between TSH and Hb level, there was a positive correlation between these two factors in cases. r2 value was found to be 0.2871. This was statistically significant with a P value of less than 0.005 [Figure 1].

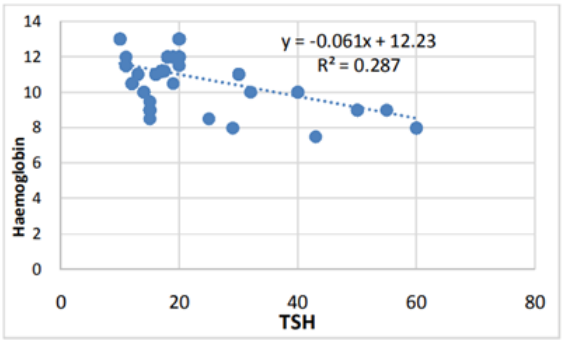

Figure 1: Correlation between TSH and Hb in cases

Table 1: Distribution of Age Group between Case and Control.

Age Group (Years)	Case	Control
18-20	6	7
21-23	17	18
24-26	15	14
27-30	12	11
Total	50	50

Table 2: Distribution of Biochemical parameters between Case and Control

	Case (Mean)	Control (Mean)	p-value
Hb	8.608	11.696	0.004
S. Ferritin	8.118	32.8	0.001

Table 3: Distribution of Thyroid profile between Case and Control

	Case (Mean)	Control (Mean)	p-value
T3	1.353	1.3182	0.093
T4	12.786	13.7662	0.152
TSH	3.5142	1.7656	0.001

DISCUSSION

Iron deficiency is the most common nutritional disorder worldwide as well as in India, and its prevention is a public health goal. Studies by Pop et al. have observed that thyroid dysfunction during early pregnancy has detrimental effects on the neuropsychological development of the offspring.[13]

In this study, Hb (Hemoglobin) cases have a mean value of 8.608, while control have a mean value of 11.696. Our results were nearly similar to a study done by He et al,[14] showed the mean and SD of Hb were 11.40 ± 1.09 g/L in case group and 12.9 ± 2.05 in control group. Another study done by Bivolarska et al,[15] which was a cross-sectional study involved 128 pregnant women the mean and SD of Hb level 11.49 ± 1.79 g/L. Correlation between Iron deficiency and hypothyroidism is likely due to impaired thyroperoxidase (TPO) hemoprotein biosynthesis, as shown in a rat study in which Iron deficiency reduced TPO activity.[15] Furthermore, animal studies have shown that ID can interfere with thyroxine deiodinase activity by reducing the conversion of thyroxine (T4) to triiodothyronine (T3) and with the regulation of thyroid metabolism at the central level.[16] Moreover, the interaction between thyroid hormones and iron is bidirectional since, through the TRα receptor, TH directly stimulates erythropoiesis.

In current study Serum Ferritin cases have a mean value of 8.118, and controls have a mean value of 32.8. In a study conducted by Veltri et al., the mean serum ferritin was 20 µ/L, and only 35% of the study population was found to be iron deficient.[17] Similarly, Fu et al. found that only 39.06% of the females studied were iron deficient.[18] Low s. ferritin during pregnancy was mainly due to the increased iron requirement and plasma volume expansion. A study done by Teng et al,[19] which was a cross-sectional; that study involved 723 pregnant women in the second and third trimester of pregnancy which was nearly similar to our study. The mean and SD of s. ferritin was 14.26 ± 9.29 µg/L in case group and 26.16 ± 8.4 µg/L in control group.

In this study, thyroid Profile such as T3 cases have a mean value of 1.353, and control have a mean value of 1.3182. T4 cases have a mean value of 12.786, and control have a mean value of 13.7662. TSH: Cases have a mean value of 3.5142, and control have a mean value of 1.7656.

Growing researches suggests that iron deficiency with or without anemia impairs thyroid metabolism by decreasing plasma T3 and T4, reducing peripheral conversation of T4 to T3 and increasing TSH concentration.[20] Iron deficiency anemia affects thyroid metabolism by inducing alteration in common hypothalamo pituitary thyroid axis, reducing T3 binding to hepatic nuclear receptor or through anemia and lower O2 transport. Iron

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deficiency anemia impairs the hepatic T4-5 deiodinase, an enzyme which converts T4-T3 on thyroid peroxidase responsible for thyroid hormone synthesis.[21] Hypothyroidism can cause a variety of anemic disorders. Iron deficiency anemia can result from impaired intestinal iron absorption related to thyroid hormone deficiency on gastric achlorhydria.

CONCLUSION

Understanding the complex interplay between iron deficiency and thyroid hormone status among pregnant women is crucial for optimizing maternal and fetal outcomes. It involves appreciating the dual roles of iron in thyroid hormone metabolism and thyroid hormones in iron metabolism. Comprehensive prenatal care should address both iron status and thyroid function to promote healthy pregnancies and reduce the risk of adverse outcomes associated with deficiencies in either nutrient.

REFERENCES

1. Sharma JB, Shankar M. Anemia in pregnancy. J Int Med sci Acad. 2010;23(4): 253-260
2. Zimmermann MB and Kohrle J. The impact of Iron and selenium deficiencies on iodine and thyroid metabolism: Biochemistry and Relevance to public health. N Eng J Med 45: 92-102.
3. Nambiar V, Jatap VS, Sarathi V, Lila AR, Kamalanathan S, Bandgar TR, et al.Prevalence and impact of thyroid disorders on maternal outcome in Asian- Indian pregnant women. J Thyroid Res 2011;2011:429097.
4. Sahu MT, Das V, Mittal S, Agarval A, Sahu M. Overt and subclinical thyroid dysfunction among Indian pregnant women and its effect on maternal and fetal outcome. Arch Gynecol Obstet 2010;281: 215-20.
5. Stagnaro-Green A, Abalovich M, Alexander E, Azizi F, Mestman J, Negro, et al. Guidelines of the American Thyroid Association for the diognosis and management of thyroid disease during pregnancy and postpartum. Thyroid 2011;21:1081-125
6. Ghassabian A, Bongers-Schokking JJ, de Rijke YB, van Mil N, Jaddoe VW, de Muick Keizer-Schrama SM, et al . Maternal thyroid autoimmunity during pregnancy and the risk of attention deficit/hyperactivity problems in children: The generation R study. Thyroid2012;22:178-86
7. Manisto T, Vaarssmaki M, Pouta A, Hartikainen AL, Ruokonen A, Surcel HM, et al. Perinatal outcome of children born to mothers with thyroid dysfunction or antibodies: A prospective population-based cohort study. J Clin Endocrinal Metab 2009;94:772-9
8. Takamastu J, Majima M, Miki K, Kuma K, Mozai T. Serum ferritin as a marker of thyroid hormone action on periferal tissues. J calin Endocrinal Metabol 1985;61 (4):672-6
9. Akhter S, Nahar ZU, Parvin S, Alam A, Sharmin S, Arslan MI. Thyroid status in patients with low serum ferritin level. Bangladesh J Biochem 2012;5(1):5-11.
10. Reh a, Grifo J, Danoff A. What is normal TSH level? Effects of stricter TSH thresholds on pregnancy outcomes after in vitro fertilization. Fertile Steril 2010;94:2920-2
11. Arlappa N, Laxmaiah A, Balakrishna N, et al.: Micronutrient deficiency disorders among the rural children of West Bengal, India. Ann Hum Biol. 2011, 38:281-9. 10.3109/03014460.2010.536572 2.
12. Ge GM, Leung MT, Man KK, et al.: Maternal thyroid dysfunction during pregnancy and the risk of adverse outcomes in the offspring: a systematic review and meta-analysis. J Clin Endocrinol Metab. 2020, 105:10.1210/clinem/dgaa555 4.
13. Beard JL, Borel MJ, Derr J: Impaired thermoregulation and thyroid function in iron-deficiency anemia . Am J Clin Nutr. 1990, 52:813-9. 10.1093/ajcn/52.5.813 .
14. Yu X, Shan Z, Li C, et al.: Iron deficiency, an independent risk factor for isolated hypothyroxinemia in pregnant and nonpregnant women of childbearing age in China. J Clin Endocrinol Metab. 2015, 100:1594- 601.
15. Pavord S, Myers B, Robinson S, Allard S, Strong J, Oppenheimer C: UK guidelines on the management of iron deficiency in pregnancy. Br J Haematol. 2012, 156:588-600. 10.1111/j.1365-2141.2011.09012.x.
16. Stagnaro-Green A, Abalovich M, Alexander E, et al.: Guidelines of the American Thyroid Association for the diagnosis and management of thyroid disease during pregnancy and postpartum. Thyroid. 2011, 21:1081- 125. 10.1089/thy.2011.0087.
17. Veltri F, Decaillet S, Kleynen P, et al.: Prevalence of thyroid autoimmunity and dysfunction in women with iron deficiency during early pregnancy: is it altered?. Eur J Endocrinol. 2016, 175:191-9. 10.1530/EJE-16- 0288.
18. Henrichs J, Bongers-Schokking JJ, Schenk JJ, et al.: Maternal thyroid function during early pregnancy and cognitive functioning in early childhood: the generation R study. J Clin Endocrinol Metab. 2010, 95:4227-34. 10.1210/jc.2010-0415.
19. Haddow JE, Palomaki GE, Allan WC, et al.: Maternal thyroid deficiency during pregnancy and subsequent neuropsychological development of the child. N Engl J Med. 1999, 341:549-55. 10.1056/NEJM19990819341080.
20. Pop VJ, Brouwers EP, Vader HL, Vulsma T, van Baar AL, de Vijlder JJ: Maternal hypothyroxinaemia during early pregnancy and subsequent child development: a 3-year follow-up study. Clin Endocrinol (Oxf). 2003, 59:282-8. 10.1046/j.1365-2265.2003.01822.x.
21. Fu J, Yang A, Zhao J, Zhu Y, Gu Y, Xu Y, Chen D: The relationship between iron level and thyroid function during the first trimester of pregnancy: a cross-sectional study in Wuxi, China. J Trace Elem Med Biol. 2017, 43:148-52. 10.1016/j.jtemb.2017.01.004.

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