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Original Research Article

Study of Serum Hepcidin and Thyroid Hormone in Anemic Pregnant Women in Indore Region

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Abstract:

Background: Gestation, or pregnancy, involves three trimesters where a fertilized egg develops into a fetus. Early pregnancy is marked by symptoms such as missed periods, nausea, vomiting, hunger and fatigue. Significant health concerns arise during this period, notably anemia, particularly iron deficiency anemia, which affects around 60% of pregnant women in regions like Madhya Pradesh, India. Hypothyroidism also poses risks, as maternal thyroid hormones are crucial for fetal development. Understanding these conditions underscores the necessity for targeted healthcare interventions to ensure maternal and fetal well-being throughout pregnancy.

Aim & Objective: To study serum hepcidin and thyroid hormones in anemic pregnant women. Compare between Cases and Controls all these parameters & examine their correlation.

Materials and Method: Total 300 subjects were studied which were divided into two groups of 150 of anemic pregnant women as cases and 150 non-anemic pregnant women as controls. Healthy controls after defining proper inclusion and exclusion criteria. Thyroids hormone was estimated on C.L.I.A. a while Hepcidin was estimated by ELISA.

Results: Anemic pregnant women had significantly lower serum Hepcidin and thyroid hormone levels compared to non-anemic pregnant women as controls, (all $P < 0.05$). No significant correlations were found between serum Hepcidin and thyroid hormones in the anemic pregnant women.

Conclusion: Our study highlights that anemia in pregnant women is linked to lower serum hepcidin and thyroid hormone levels, which may negatively impact maternal and fetal health. Routine screening and nutritional support are essential for optimizing outcomes in region.

Keyword: T3, T4, TSH, Hepcidin.

Introduction

Gestation, another name for pregnancy, is the period of time during which one or more children grow inside a woman. Multiple pregnancies, like twin pregnancies, result in multiple offspring. There are usually three trimesters in a pregnancy. During the first trimester, which lasts from week one to week twelve, the sperm fertilizes the egg, a process known as conception.

After fertilization, the egg passes via the fallopian tube and enters the uterus, where it develops into the embryo and placenta during the second trimester, which lasts from weeks 13 to 28. Movement of the fetus may be felt around the middle of the second trimester. More than 90% of newborns can survive outside the uterus at 28 weeks if they receive good medical care. Between 29 and 40 weeks is the third trimester. [1] Missed periods, sore breasts, nausea, vomiting, hunger, fatigue, morning sickness, constipation, pelvic girdle discomfort, and frequent urination are some of the characteristics of early pregnancy. [2] Anemia in pregnancy is a significant public health concern, particularly in developing regions like Madhya Pradesh, India. According to the National Family Health Survey (NFHS-5) conducted in 2019-2020, the prevalence of anemia among pregnant women in Madhya Pradesh was reported to be alarmingly high, with approximately 60% of pregnant women affected. This statistic underscores the urgent need for targeted interventions to address this issue. [3]

IDA is the outcome of iron deficiency, which is frequently observed during pregnancy. This disorder has a major effect on the health of both the mother and the fetus. It can also result in issues like premature birth and intrauterine growth retardation. 2.36 billion People are thought to be impacted worldwide, and it is a persistent issue in India as well. [4] Iron deficiency is a disorder caused by a

prolonged loss of iron reserves. Inadequate nutritional intake, malabsorption syndromes, and hemorrhage are some of its causes. In order to meet the increasing fetoplacental unit's increased need, the mother must maintain adequate amounts of iron throughout the pregnancy. [5] Thyroid hormone production is decreased in hypothyroidism, a common endocrine condition. It is a widespread illness that varies in incidence between nations. Biochemically speaking, it is typified by a decrease in blood T3 and T4 levels, which raises the concentration of serum thyroid stimulating hormone (TSH). [6] Due to its incapacity to make iodothyronines prior to ten weeks of gestation, the fetus depends heavily on the levels of maternal thyroid hormones, particularly during the first trimester. Iodothyronine shortage may potentially impair the fetus's neurodevelopment during this time. [7] During pregnancy and the postpartum phase, thyroid problems are common. [8] Among women of reproductive age, thyroid disease is the second most prevalent endocrine ailment, after diabetes. Although the majority of these problems are curable, improper evaluation and management may have negative effects on both the mother and the fetus. [9] Hepcidin is a 25 amino acid peptide that is mostly made in the liver and is essential for controlling iron levels. It is the primary coordinator of systemic iron homeostasis, balancing iron acquisition with iron utilization and storage. It primarily works through the hepcidin-ferroportin interaction, a single molecular pathway. Thus, low transferrin saturation and a reduced iron supply to the growing erythroblast result from the loss of ferroportin from the cell surface, which also stops iron from entering plasma. [10-12] conversely, a decrease in hepcidin expression results in an increase in ferroportin on the cell surface, which raises iron absorption. The identification of hepcidin and a greater knowledge of how it regulates and inhibits the flow of iron may someday help physicians assess a patient's iron status more accurately and help treat chronic illness anemia more successfully. [13]

Material and Method

The study was conducted in department of Biochemistry with collaboration Gynecology department in Index Medical College and Research Centre, Indore between the patients of anemic pregnant women & non anemic pregnant women attending the OPD (outpatient department) of Gynecology department. Ethical clearances were obtained from the Institutional Ethical Committee and written informed consent was taken, before carrying out the study

Sample Size

This study was consisted of 150 cases of anemic pregnant women (Group I) and 150 Non – anemic pregnant women (Group II) to the Department of Biochemistry with collaboration Gynecology department of Index Medical College and research center, Indore (MP).

The pregnant women were considered as anemic in following meant – (Level of Hb gm/dL)

- 9-11 gm/dL – mild anemic
- 7-8 gm/dL – moderate anemic
- Less than 7 – severe anemic [14]

Inclusion Criteria

(A hemoglobin (Hb) 11g/dL or hematocrit of <33% can be considered for diagnosis of anemia in pregnancy. Severe anemia in pregnancy (Hb < 7g/dL) requires urgent medical treatment and Hb < 4 g/dL is an emergency carrying a risk of congestive cardiac failure, sepsis and death.)

- Patient with anemia during pregnancy
- 1-3rd trimester pregnant women
- Age group between 18 to 40 years [14]

Exclusion Criteria

- The patient with anemia before pregnancy
- Thyroid disorder, iron deficient, previous history of anemia, renal disease,
- heart disease and liver disease
- cholesterol lowering patients
- Malnourished women who are taking antithyroid drugs. [15]

Statistics Analysis

Descriptive statistics (mean, standard deviation, range) were calculated for serum hepcidin and thyroid hormones (T3, T4 and TSH) in anemic and non-anemic pregnant women.

Independent t-tests compared means between two groups in cases & controls, identifying significant differences. Pearson correlation coefficients assessed relationships between thyroid hormone levels and hepcidin, revealing potential correlations that enhance understanding of biochemical interactions in pregnancy.

Quantitative data was entered into a secure, password-protected database using the latest version of SPSS Statistics 29. (NS: $p>0.05$; Not Significant; *$p<0.05$; Significant; **$p<0.001$; Highly Significant; r = Pearson Correlation Coefficient)

Result

Table 1: Comparison of serum Hepcidin and Thyroid hormone (serum T3, serum T4 and serum TSH) in group-1 (Anemic Pregnant Women as a Cases) and group-2 (Non-Anemic Pregnant Women as a Controls)

S. No	Parameter	Anemic pregnant women (Mean ±SD)	Non-Anemic pregnant women (Mean ±SD)	P-value
1	Serum Hepcidin(ng/ml)	4.05±4.14	17.98±9.16	
2	T3 (ng/dl)	95.14±16.79	118.32±24.37	
3	T4 (µg/dl)	6.09±1.13	9.08±1.48	
4	TSH (µIU/ml)	2.02±0.99	3.71±1.21	<0.05

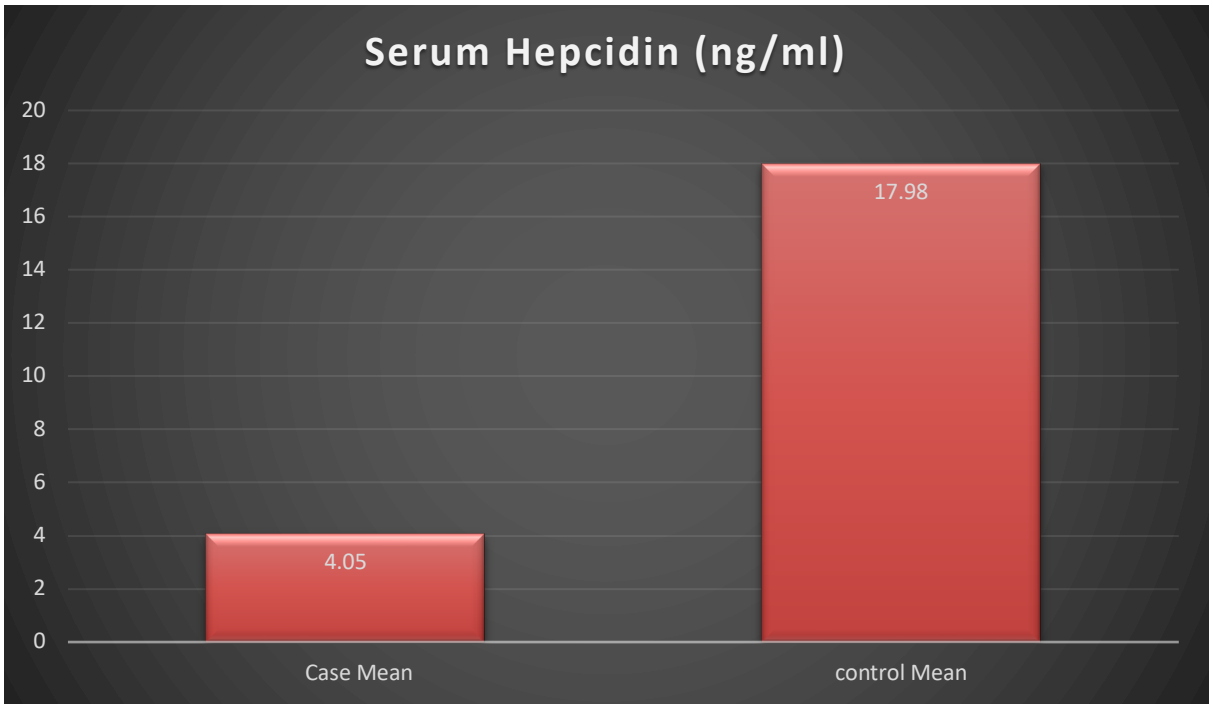
In this study was found that anemic pregnant women significantly reduced levels of serum Hepcidin in anemic pregnant women as compared to controls, indicating a potential physiological response to iron deficiency and Thyroid hormones (serum T3, serum T4 and serum TSH) also was significantly lower in the anemic pregnant women as compared to controls, suggesting potential metabolic implications and dysregulation.

This finding highlights the complex interplay between thyroid function and anemia during pregnancy.

Table 2: The Pearson Correlation result between serum Hepcidin and Thyroid hormone (serum T3, serum T4 and serum TSH) biochemical parameters in the cases group (Anemic Pregnant Women).

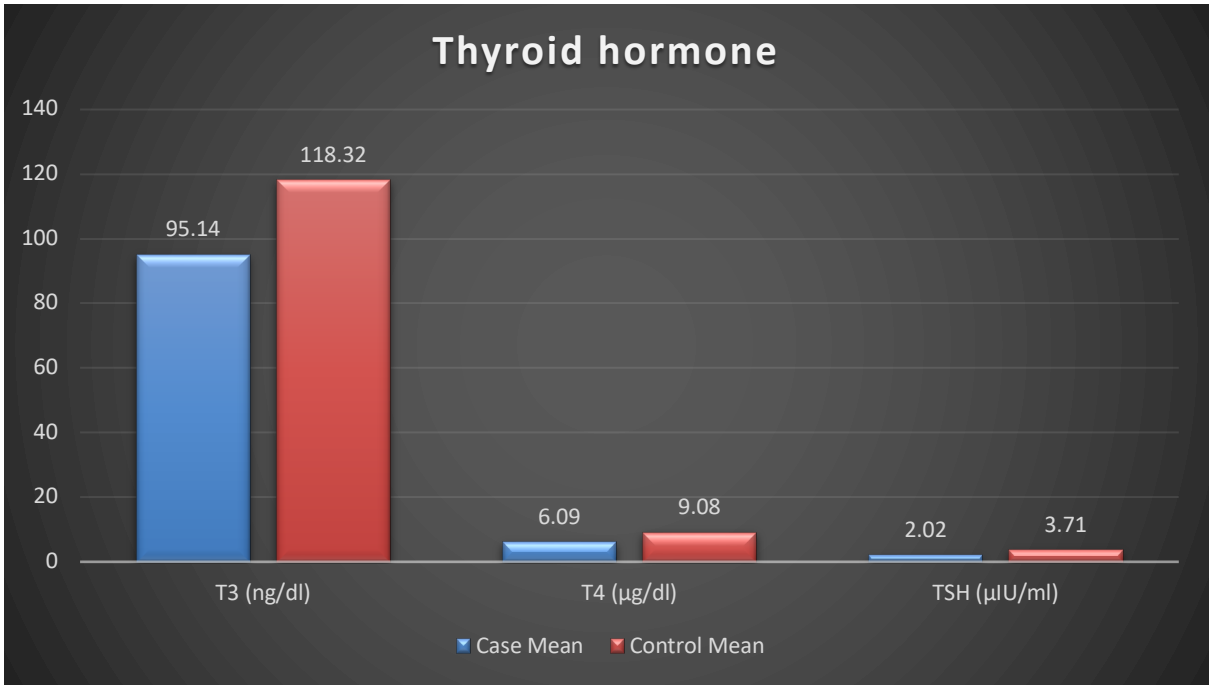
Variable 1	Variable 2	Correlation Coefficient	P- Value	Significant (p<0.05)?
Hepcidin	T3	-0.021	0.801	No Significant
Hepcidin	T4	0.024	0.770	
Hepcidin	TSH	0.012	0.888	

In this study was found the correlation analysis showed not statistically significant relationships between thyroid hormones (serum T3, serum T4 and serum TSH) and serum Hepcidin.



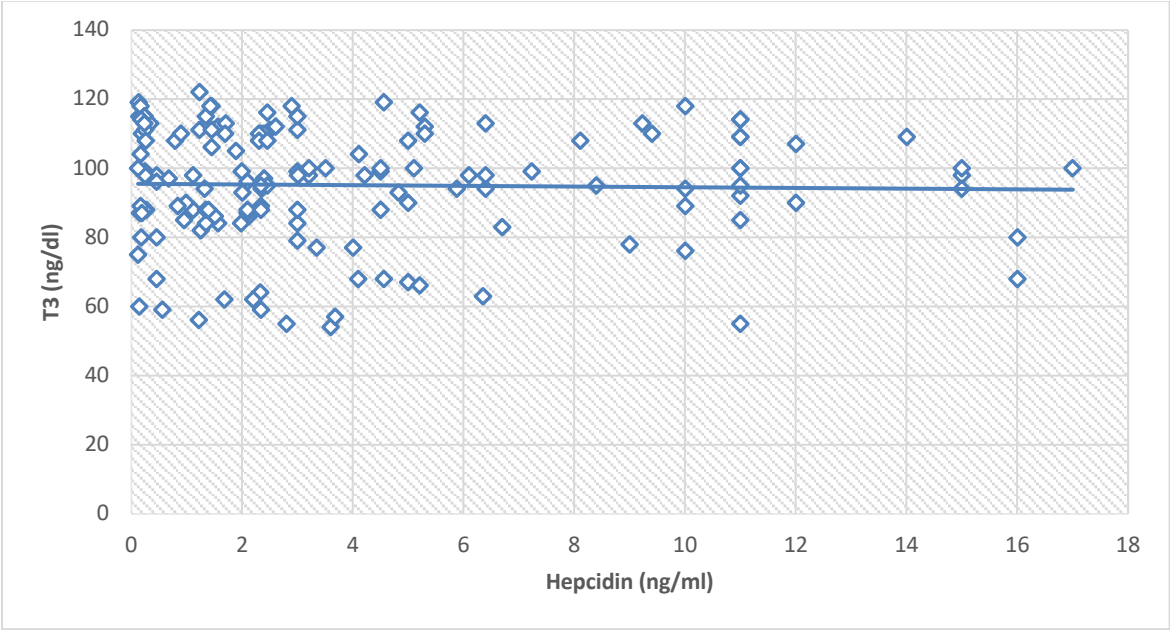
Graph 1: The mean value of serum Hepcidin among group-1 (Anemic Pregnant Women as a Cases) and group-2 (Non-Anemic Pregnant Women as a Controls).

Graph 1: Represents the mean value of serum Hepcidin in cases and controls were 4.05 and 17.98 respectively. In present study we observed that the mean value was statistically decrease and p value was statistically significant (P = <0.05) as compared to the controls.



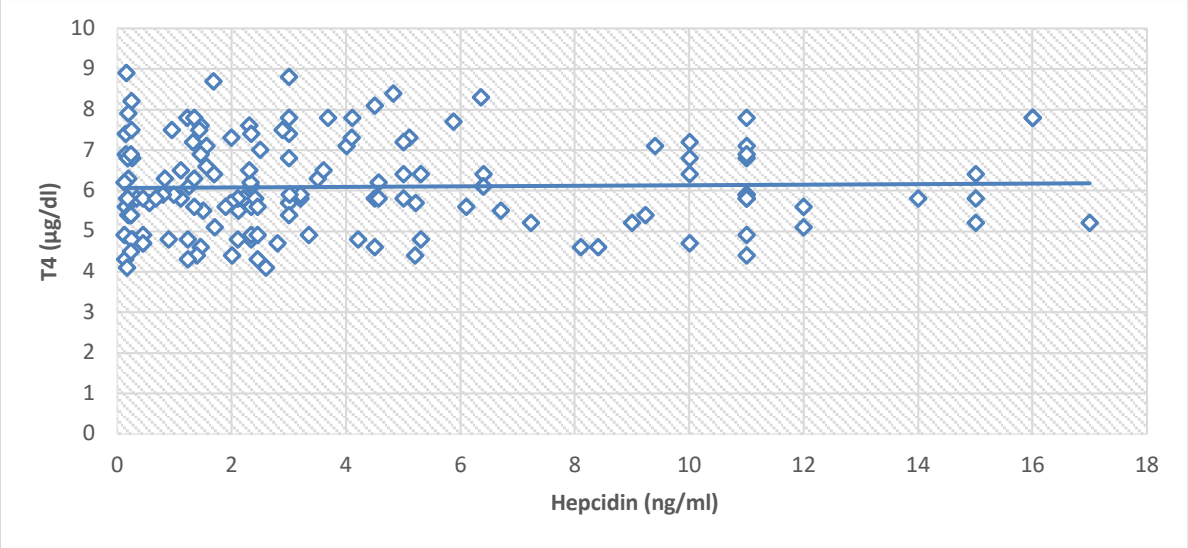
Graph 2: The mean value of serum Thyroid Hormone (T3, T4, and TSH) among group-1 (Anemic Pregnant Women as a Cases) and group-2 (Non-Anemic Pregnant Women as a Controls).

Graph 2: Represents the mean value of serum Thyroid hormone (T3, T4 and TSH) in cases were 95.14, 6.09, & 2.02 and Controls were 118.32, 9.08 & 3.71 respectively. In present study we observed that the mean value of thyroid hormone (T3, T4 and TSH) was statistically decrease and p value was statistically significant (P = <0.05) as compared to the controls.



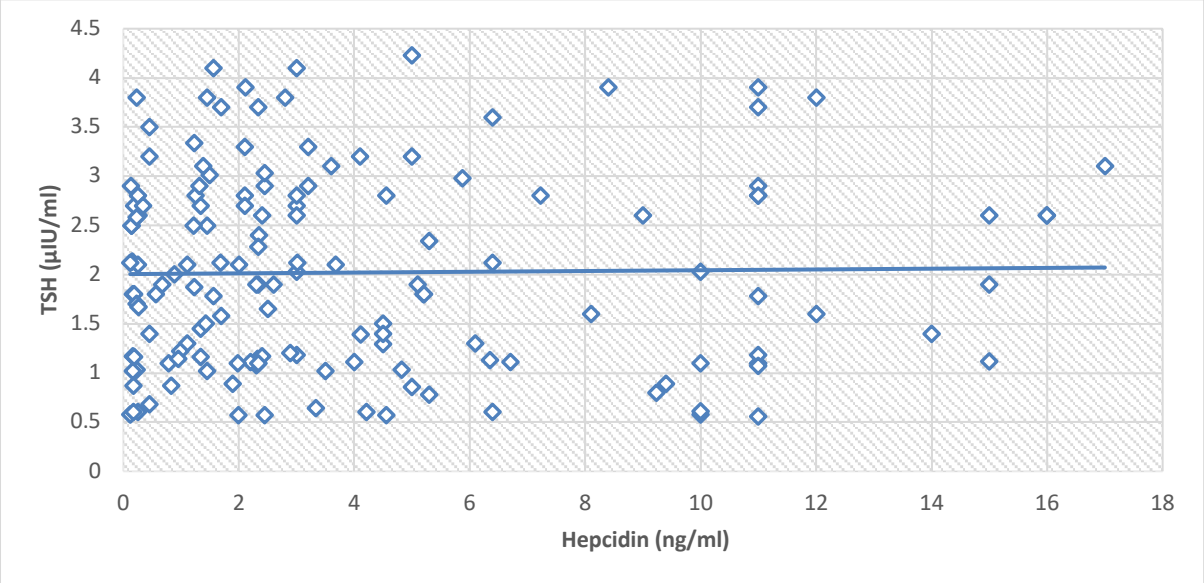
Graph 3: Scatter graph of correlation between serum Hepcidin and serumT3 in the cases group (Anemic Pregnant Women).

Graph 3: Represented Correlation (r-value) between serum Hepcidin and serum T3 was found to be Negative correlation (r = -0.021) and it was not statistically significant (P = 0.801).



Graph 4: Scatter graph of correlation between serum Hepcidin and serumT4 in the cases group (Anemic Pregnant Women).

Graph 4: Represented Correlation (r-value) between serum Hepcidin and serum T4 was found to be Positive correlation (r= 0.024) and it was not statistically significant (P = 0.770).



Graph 5: Scatter graph of correlation between serum Hepcidin and serum TSH in the cases group (Anemic Pregnant Women).

Graph 5: Represented Correlation (r-value) between serum Hepcidin and serum TSH was found to be Positive correlation (r= 0.012) and it was not statistically significant (P = 0.888).

Discussion

We observed that the mean value of serum hepcidin level in anemic pregnant women was significantly lower (4.05 ± 4.14 ng/ml) as compared to non-anemic pregnant women (17.98 ± 9.16 ng/ml), with a P-value of 0.05. Hepcidin is a key regulator of iron homeostasis, controlling iron absorption and distribution. Lower hepcidin levels in anemic pregnant women may suggest an adaptive response to iron deficiency, as lower hepcidin levels facilitate increased intestinal iron absorption. This finding is consistent with previous studies showing that iron-deficient individuals tend to have lower hepcidin levels to enhance iron availability for erythropoiesis. we observed that the mean value of serum T3 levels in anemic pregnant women (95.14 ± 16.79 ng/dl) was significantly lower compared to the non-anemic pregnant women (118.32 ± 24.37 ng/dl), with a P-value < 0.05. This suggests that anemia during pregnancy may be associated with reduced thyroid hormone production or altered thyroid function. Thyroid hormones like T3 play a critical role in metabolic processes, and reduced T3 levels could

potentially contribute to the metabolic changes observed in anemia. The mean value of serum T4 levels was also significantly lower in anemic pregnant women (6.09 ± 1.13 µg/dl) compared to non-anemic pregnant women (9.08 ± 1.48 µg/dl), with a P-value < 0.05. The reduction in T4 levels in anemic women could indicate impaired thyroid function, possibly due to the altered nutritional and physiological status during pregnancy. Since T4 is the precursor to T3, lower T4 levels could further influence overall thyroid hormone balance. The mean value of serum TSH levels was also significantly lower in anemic pregnant women (2.02 ± 0.99 µIU/ml) compared to non-anemic pregnant women (3.71 ± 1.21 µIU/ml), with a P-value < 0.05. Lower TSH in anemic pregnant women might reflect a compensatory mechanism for the reduced levels of T3 and T4, or it may indicate a subclinical form of hypothyroidism, where the thyroid gland is not functioning optimally despite normal TSH levels. This could point to a dysfunction in the hypothalamic-pituitary-thyroid axis, which is vital for maintaining thyroid hormone homeostasis. In our study was found the correlation between Hepcidin and T3 was r-value= -0.021 & (p = 0.801), indicating almost no relationship, not significant in cases. The correlation between Hepcidin and T4 was r-value= 0.024 & (p = 0.770) showing almost no relationship, not significant in cases. The correlation between Hepcidin and TSH was r-value= 0.012 & (p = 0.888), indicating almost no relationship, not significant in cases. Alnabaheen I et al. (2021) found in their study the mean level of serum Hepcidin in cases was (2.6±4 ng/ml) as compared to controls (7.5±7.3 ng/ml) and the difference was statistically significant lower (P < 0.001). The mean value of serum iron was lower in cases (63.2±25.3 µg/dl) as compared to controls (77.7±22.9 µg/dl) respectively and the difference was also statistically significant (P = 0.005). [13]

In our study we observed that the mean value of serum hepcidin level in anemic pregnant women was significantly lower (4.05 ± 4.14 ng/ml) as compared to non-anemic pregnant women (17.98 ± 9.16 ng/ml), with a P-value of 0.05. Present study was also correlate with above study. Priyadarshini A et al (2024) found in their study the mean level of T3 was significantly lower in anemic pregnant women (96.88 ± 19.24) as compared to non-anemic pregnant women (128.12 ± 26.39), with a p-value of 0.0, showing a significant difference. The mean T4 level is lower in anemic pregnant women (7.888 ± 2.28) as compared to non-anemic pregnant women (9.224 ± 1.84), with a p-value of 0.027, which is statistically significant. The mean level of TSH was lower in Anemic pregnant women (1.954 ± 0.997) as compared to non-anemic pregnant women (3.2692 ± 1.2783), with a highly significant p-value of 0.00018. [6] In our study we observed that the mean value of serum T3 levels in anemic pregnant women (95.14 ± 16.79 ng/dl) was significantly lower compared to the non-anemic pregnant women (118.32 ± 24.37 ng/dl), with a P-value < 0.05. The mean value of serum T4 levels was also significantly lower in anemic pregnant women (6.09 ± 1.13 µg/dl) compared to non-anemic pregnant women (9.08 ± 1.48 µg/dl), with a P-value < 0.05. The mean value of serum TSH levels was also significantly lower in anemic pregnant women (2.02 ± 0.99 µIU/ml) compared to non-anemic pregnant women (3.71 ± 1.21 µIU/ml), with a P-value < 0.05. Present study was also correlate with above study.

Conclusion

Our study demonstrates that anemia in pregnant women is associated with significantly lower levels of serum hepcidin, T3, T4, and TSH compared to non-anemic counterparts. These alterations may adversely affect maternal and fetal health due to disrupted iron metabolism and thyroid function, which are crucial for pregnancy outcomes. Clinically, it highlights the need for regular screening and management of anemia and thyroid function in pregnant women to mitigate potential risks.

We recommend that healthcare providers implement routine laboratory assessments of serum hepcidin and thyroid hormones for pregnant women, particularly those diagnosed with anemia. Furthermore, nutritional support, including iron and iodine supplementation, should be considered to optimize maternal health and enhance developmental outcomes for the fetus.

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