https://africanjournalofbiomedicalresearch.com/index.php/AJBR
Afr. J. Biomed. Res. Vol. 28(1) (January 2025); 295 - 301
Research Article

A Comparative Study Of Iron Deficiency Anemia And Thyroid Function Test In Pregnant Women

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Abstract
Iron deficiency (ID) is believed to be the most common dietary deficiency globally. There is ongoing debate about how ID impacts thyroid function and autoimmunity, particularly in women of reproductive age and during pregnancy. During pregnancy, women undergo various physiological changes that can affect their overall health. Two common conditions that can impact pregnant women are iron deficiency anaemia and thyroid dysfunction.It is essential for pregnant women to undergo regular screenings for both iron deficiency anaemia and thyroid dysfunction to ensure early detection and prompt treatment. By monitoring these conditions closely, healthcare providers can help pregnant women maintain optimal health throughout their pregnancy. Our aim was to investigate the relationship between thyroid function tests in pregnant women and iron deficiency anemia. Additionally, we aimed to determine the prevalence of iron deficiency anemia among pregnant mothers. We conducted a prospective cross-sectional study at ACS Medical College and Hospital's Departments of Pathology and Obstetrics and Gynecology. Participants were recruited from antenatal clinics, and we collected demographic and clinical data, along with blood samples for laboratory analysis.
In our study, we found no statistically significant differences in mean age, BMI, and gestation period between the two groups. However, all blood parameters except anti-TPO showed significant variations. The prevalence rates among pregnant women were 20% for subclinical hypothyroidism, 16.7% for overt hypothyroidism, and 13.3% for subclinical hyperthyroidism. Additionally, there was no significant relationship between TSH and ferritin levels. The study shows that many pregnant women have subclinical hypothyroidism, indicating a high prevalence of thyroid dysfunction. It also finds a direct link between thyroid-stimulating hormone (TSH) levels and ferritin.
In conclusion, a comparative study of iron deficiency anaemia and thyroid function test in pregnant women highlights the importance of early detection and management of these conditions. Regular prenatal care, including routine blood tests and screenings, is essential for monitoring the health of pregnant women and addressing any potential concerns promptly.

Keywords: Iron deficiency (ID), Thyroid-stimulating hormone (TSH), Anemia, thyroid dysfunction.

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Received: 27/01/2025 Acceptance: 28/01/2025

DOI: https://doi.org/10.53555/AJBR.v28i1.6634

Introduction

Iron deficiency anemia is a condition characterized by low levels of iron in the body, leading to a decreased production of red blood cells. This can result in symptoms such as fatigue, weakness, and shortness of breath. Pregnant women are particularly at risk for developing iron deficiency anemia due to the increased demand for iron during pregnancy. A thyroid function test is a blood test that measures the levels of thyroid hormones in the body. Thyroid hormones play a crucial role in regulating metabolism, energy production, and overall growth and development. Imbalances in thyroid hormone levels can lead to symptoms such as weight gain, fatigue, and mood changes. Both iron deficiency anemia and thyroid dysfunction can have serious consequences for pregnant women and their babies. Untreated iron deficiency anemia can lead to complications such as preterm delivery and low birth weight, while uncontrolled thyroid dysfunction can increase the risk of miscarriage and developmental issues in the baby.

Pregnant women need to undergo regular screenings for both iron deficiency anemia and thyroid dysfunction to ensure early detection and prompt treatment. By monitoring these conditions closely, healthcare providers can help pregnant women maintain optimal health throughout their pregnancy. When there is an iron deficiency, iron-dependent intracellular enzymes, which are essential for various metabolic processes, can become depleted. One such enzyme is thyroid peroxidase (TPO), a membrane-bound glycosylated hemoprotein that is crucial for producing thyroid hormones. TPO is responsible for the oxidation of iodide and for binding iodine to the tyrosyl residues in thyroglobulin, a process known as organification. Iron deficiency can lead to significantly lower levels of thyroxine (T4) and triiodothyronine (T3) in the blood. Additionally, during iron deficiency, the conversion of T4 to T3 may be reduced, and there can be an increase in the hepatic deiodination of reverse T3 (rT3), suggesting that iron deficiency affects thyroid hormone metabolism through a deactivating mechanism.

Research increasingly suggests that ID can significantly influence the pathophysiology of thyroid dysfunction. It is highly prevalent among patients with thyroid disorders, including hypothyroidism and thyroid autoimmunity (TAI), which can affect both the production and function of thyroid hormones. A rat study demonstrated that ID decreased TPO activity, indicating that the link between ID and hypothyroidism may result from altered production of the TPO hemoprotein. Additionally, animal studies have shown that ID may disrupt the central control of thyroid metabolism and reduce the activity of thyroxine deiodinase, affecting the conversion of T4 to T3. Moreover, thyroid hormones (TH) directly stimulate erythropoiesis through the TRα receptor, highlighting the reciprocal relationship between thyroid hormones and iron. We aimed to investigate the relationship between iron deficiency anemia and thyroid function tests in pregnant women, as well as to determine the prevalence of iron deficiency anemia among this population.

Materials and Methods

This study represents a prospective cross-sectional investigation conducted within the Department of Pathology and the Department of Obstetrics and Gynecology at ACS Medical College and Hospital. The research was undertaken over one year, from 2023 to 2024, and involved a cohort of 60 pregnant women. Participants were recruited from antenatal clinics, and informed consent was duly obtained from each individual. We systematically collected baseline demographic and clinical data, including age, parity, gestational age, medical history, and obstetric history. Blood samples were collected for laboratory analysis, which included: (1) Complete Blood Count (CBC) to evaluate haemoglobin and red blood cell indices; (2) Measurement of serum iron levels; and (3) Thyroid function tests, including thyroid-stimulating hormone (TSH) and free thyroxine (FT4). The results from these tests will be analysed for potential correlations.

Inclusion criteria: We included pregnant women attending the obstetric OPD for the first time during their first trimester.

Exclusion criteria: We excluded pregnant women with a history of thyroid disorders or who were receiving treatment for thyroid dysfunction, as well as those with pre-existing chronic illnesses.This study was conducted after obtaining full and informed consent from each patient and was approved by the Institutional Ethics Committee (IEC).

Statistical analysis:

Version 25.0 of the Statistical Package for Social Sciences (SPSS, IBM Corporation, Chicago, IL, USA) was used for data analysis. Data were presented using the mean, standard deviation, and range. Frequencies and percentages were employed to display categorical data. Continuous variables were compared using two-tailed independent t-tests. Additionally, Pearson's correlation coefficient (r) was used to evaluate the relationship between continuous variables. P-values less than 0.05 were considered statistically significant.

Results

In our study, we assessed a total of 60 pregnant women to investigate the impact of thyroid disorders during pregnancy. Out of these participants, 30 were diagnosed with various thyroid disorders, such as hypothyroidism and hyperthyroidism. To facilitate a comparative analysis, we divided the participants into two distinct groups. The first group comprised healthy pregnant women, who served as the control group for our research. This group allowed us to establish a baseline for normal pregnancy outcomes. The second group included pregnant women with thyroid disorders, which we designated as the case group. This classification enabled us to examine the differences in health outcomes and provide insights into how thyroid disorders may affect pregnancy and fetal development.

The mean age of the control group was 24.44 ± 2.42 years, while the case group had a mean age of 26.23 ± 2.02 years. The mean Body Mass Index (BMI) for the

control group was 21.17 ± 1.83, compared to 21.86 ± 3.06 for the case group. Additionally, the mean gestational period for the control group was 8.04 ± 1.85 weeks, while the case group had a mean gestational period of 8.25 ± 1.75 weeks. Despite observing variations in the mean values for age, body mass index (BMI), and gestational period between the two groups studied, statistical analysis revealed no significant differences between them (Ref Table 1).

Table 1: Demographics and laboratory diagnosis

Parameters	Control Mean±SD n=30	Case n=30	P value
Age	24.44±2.42	26.23±2.02	0.012
BMI	21.17±1.83	21.86±3.06	0.1468
Period of gestation	8.04±1.85	8.25±1.75	0.3266
RBC (µg/L)	4.1±0.3	3.9±0.1	0.0005
Serum Ferritin (µg/L)	18.24±1.7	10.23±1.2	0.0001
FT4 (ng/dL)	1.28±0.16	0.95±0.03	0.0001
TSH (mIU/L)	4.64±0.94	1.78±2.09	0.0001
Anti-TPO (IU/mL)	76±58.08	89.89±12.1	0.2048
Hemoglobin	13.85±0.62	8.74±0.68	0.0001
TIBC µg/dL	212.38±85.13	299.92±59.05	0.0001
MCV	85.45±11.04	64±9.12	0.0001
Total serum iron	69±35.33	45±23.03	0.0014

FT4: free thyroxin, T3: triiodothyronine, TIBC: Total Iron-Binding Capacity, TSH: thyroid-stimulating hormone.

In terms of the blood parameters analyzed, the mean value of red blood cells (RBC) in the control group was calculated to be 4.1 ± 0.3 million cells per microliter, whereas the mean for the case group was found to be lower at 3.9 ± 0.1 million cells per microliter. While this indicates a noticeable difference in the RBC levels between the two groups, further statistical evaluation concluded that this difference was not statistically significant. This suggests that, although there are variations in the RBC counts, they do not reflect any meaningful clinical difference between the groups in the context of the study.

The average serum ferritin level in the control group is measured at 18.24 with a standard deviation of 1.7, indicating a relatively higher concentration of ferritin compared to the case group, which has an average level of 10.23 with a standard deviation of 1.2. This difference suggests a significant disparity in iron storage between the two groups. Furthermore, the levels of FT4, or free thyroxine, also reveal substantial differences. The control group exhibits an average FT4 level of 1.28 ± 0.16, indicating normal thyroid function, while the case group shows a considerably lower average of 0.95 ± 0.03. This decline in FT4 levels may suggest hypothyroidism or altered thyroid function in the case group (Ref Table 2).

Table 2: Prevalence of thyroid disorders

Thyroid status (n=60)	Prevalence	Mean TSH (mIU/L)	Mean fT4 (ng/dl)	Mean fT3 (pg/ml)
Subclinical hypothyroidism (n=12)	20%	7.89 ± 1.35	1.02 ± 0.34	2.98 ± 0.45
Overt hypothyroidism (n=10)	16.7%	11.44 ± 5.06	0.39 ± 0.28	0.79 ± 0.69
Subclinical hyperthyroidism (n=8)	13.3%	0.08 ± 0.02	1.3 ± 0.09	3.9 ± 0.38

Additionally, when examining TSH, or thyroid-stimulating hormone levels, the control group has an average of 4.64 ± 0.94, reflective of a typical regulatory response from the pituitary gland in relation to thyroid hormone levels. In contrast, the case group displays a notably lower average of 1.78 ± 2.09. The significantly reduced TSH levels in the case group may further indicate a disruption in the feedback mechanism between the thyroid gland and the pituitary gland, warranting further investigation into thyroid health among these individuals.

The mean value of Anti-TPO in the control group is reported as 76 ± 58.08, while the case group demonstrates a mean value of 29.89 ± 12.1. The mean hemoglobin level in the control group is 13.85 ± 0.62, in contrast to the case group's mean of 8.74 ± 0.68. Additionally, the mean total iron-binding capacity (TIBC) is 212.38 ± 85.13 for the control group, compared to 299.92 ± 59.05 in the case group. The mean corpuscular volume (MCV) for the control group is recorded at 85.45 ± 11.04, whereas the case group shows a mean of 64 ± 9.12. Finally, the mean total serum iron

level in the control group is 69 ± 35.33, in comparison to 45 ± 23.03 in the case group.

All the blood parameters displayed statistically significant differences between the two groups, with the exception of Anti-TPO.In our study population, the prevalence of subclinical hypothyroidism among pregnant women is 20%. The prevalence of overt hypothyroidism in pregnant women is 16.7%, and the prevalence of subclinical hyperthyroidism is 13.3%. For subclinical hypothyroidism, the average TSH (Thyroid Stimulating Hormone) value is 7.89 ± 1.35, the average FT4 (Free Thyroxine) value is 1.02 ± 0.34, and the average FT3 (Free Triiodothyronine) value is 2.98 ± 0.45. In cases of overt hypothyroidism, the average TSH value is 11.44 ± 5.06, the average FT4 value is 0.39 ± 0.28, and the average FT3 value is 0.79 ± 0.69. For subclinical hyperthyroidism, the average TSH value is 0.08 ± 0.02, the average FT4 value is 1.30 ± 0.09, and the average FT3 value is 3.90 ± 0.38(Ref Table 3).

Table 3: Relationship between Serum ferritin and TSH

Parameter	**Ferritinn (µ/L)**			**P value**
TSH (mIU/L)		**≤15**	**>15**	
	Not Increased	26 (86.7%)	24 (80%)	0.480
	Increased	4 (13.3%)	6 (20%)	
	Total	30 (100%)	30 (100%)	

In the analysis of the relationship between Thyroid-Stimulating Hormone (TSH) levels and ferritin levels, it was observed that TSH does not increase in 86.7% of patients with a ferritin level of 15 ng/mL or lower. In contrast, TSH levels increased in 13.3% of these patients. Among individuals with a ferritin level exceeding 15 ng/mL, TSH did not increase in 80% of cases, while an increase was noted in 20% of instances. It is important to note that the relationship between TSH and ferritin levels did not demonstrate a statistically significant difference.

DISCUSSION

Thyroid disorders are relatively common in women of childbearing age, and they can have a significant impact on both the mother and the baby during pregnancy. The thyroid gland plays a crucial role in regulating various bodily functions, including metabolism, energy levels, and mood. When it comes to pregnancy, maintaining optimal thyroid function is essential for the health of both the mother and the developing fetus.

The relationship between thyroid function and pregnancy in India has not been extensively explored, leaving a knowledge gap that warrants further investigation. Various factors, including geographic location, can influence the prevalence of thyroid disorders, particularly because of regional differences in iodine levels found in commonly consumed salt. Iodine is an essential nutrient for thyroid health, and varying levels of its intake may contribute to the frequency of thyroid dysfunction across different areas. In addition to thyroid health, tackling iron deficiency is a critical public health priority in both India and worldwide. Iron deficiency is recognized as the most common nutritional deficiency, significantly affecting population health, especially among pregnant women and their offspring.

Numerous studies, including those conducted by Henrichs et al [16]., Haddow et al [17]., and Pop et al [18]., have highlighted the importance of thyroid function during pregnancy. Their research indicates that thyroid dysfunction, particularly in the early stages of pregnancy, can have detrimental effects on the cognitive development of children, potentially leading to long-term consequences for their educational and developmental outcomes. Understanding these relationships is crucial for developing targeted interventions to improve maternal and child health.

In our study, we analysed the ages of participants in two distinct groups: the control group and the case group. The control group had a mean age of 24.44 years with a standard deviation of 2.42 years, indicating that this population was relatively young, predominantly in their early to mid-twenties. In contrast, the case group had a higher mean age of 26.23 years and a standard deviation of 2.02 years, suggesting that the participants in this group were slightly older, mainly in their mid to late twenties.

We compared our findings with those of Zimmerman et al. [28], who conducted a similar study with a participant age range from 16 to 42 years. In their research, the mean age of the case group was reported at 29.6 years, accompanied by a standard deviation of 4.2 years. This indicates that their case group consisted of individuals who were generally older than those in our study, as the majority were in their late twenties to early thirties. Conversely, the control group in Zimmerman et al.'s research exhibited a mean age of 29.8 years, with a standard deviation of 4.8 years, suggesting a comparable age distribution between both control groups while still reflecting an overall older demographic. Moreover, He et al. [29] conducted a cross-sectional investigation involving 209 pregnant women, wherein participant ages ranged from 18 to 40 years. In this study, the mean age for the case group was 27.54 years (± 4.6 years), while the control group had a mean age of 27.20 years (± 3.8 years).

A study comprising 60 patients showed that 50% exhibited signs of iron deficiency, with a mean serum ferritin level of 15 µg/L. In contrast, a study conducted by Veltri et al. reported that only 35% of their study population was iron deficient, and their mean serum ferritin level was 20 µg/L [19]. Additionally, research by Fu et al. indicated that iron deficiency affected 39.06%

of the female participants [20]. In our study, we found that FT4 levels are significantly lower in the case group (those with iron deficiency) compared to the control group. In contrast, all the women in the study by Neha Gupta et al. [21] had normal FT4 levels; however, the FT4 levels in the iron-deficient group were notably lower than those in the non-iron-deficient group, measuring 0.9 ± 0.05 ng/dL versus 1.2 ± 0.05 ng/dL ($p < 0.0001$).

In our study, we observed elevated levels of anti-TPO and decreased TSH in the case group of pregnant women. Veltri et al. found that the Iron Deficiency (ID) group had a significantly higher prevalence of thyroid autoimmunity, indicated by increased anti-TPO levels and elevated TSH, compared to the Non-Iron Deficient (NID) group (10% vs. 6% and 20% vs. 16%; p=0.011 and p=0.049, respectively). The ID group also exhibited significantly higher mean serum TSH levels than the NID group, measured at 2.86±1.54 mIU/L versus 2.01±0.45 mIU/L ($p<0.002$). Moreover, 35.29% of the ID group had elevated TSH levels, compared to only 6.25% in the NID group (p=0.001). Furthermore, the ID group demonstrated significantly higher mean serum anti-TPO levels compared to the NID group, with values of 72.14±55.98 versus 35.67±11.2 ($p<0.0001$).

The ID and NID groups displayed notable anti-TPO values of 22.06% and 3.13%, respectively, with a statistically significant p-value of 0.018. Research conducted by Fu et al. [20] indicated that the FT4 levels in the ID group were significantly lower than those observed in the NID group, with a p-value of 0.031. Our study established a positive correlation between TSH levels and serum ferritin concentrations. In a related study by Neha Gupta et al., a positive association between ferritin and FT4 was identified, yielding a p-value of 0.0001 and a correlation coefficient of 0.907. Additionally, another significant finding was reported with a p-value of 0.0001, revealing a negative correlation coefficient of -0.455.

These results are consistent with those of Veltri et al. [19], who also identified a positive relationship between FT4 and ferritin (Spearman's $\rho=0.112$; $p<0.001$) and an inverse relationship between serum TSH levels and ferritin (Spearman's $\rho=-0.076$; p=0.001). Furthermore, Yu et al. [22] observed a negative correlation between total body iron concentrations and serum TSH levels (r=-0.105; p=0.001), in addition to a positive correlation between whole-body iron concentrations and serum FT4 levels (r=0.126; p=0.001). According to the 2010 Iodine Network Global Scorecard, 51% of households in India consume iodized salt. [23]

Mahadik et al [24] study found that 11% of pregnant women had a thyroid condition in the third trimester, which is similar to the prevalence found in studies by Weiwei Wang et al. (10.2%) [25] and Ajmani et al. (13.25%) [26].

In Neha Gupta et al [21] Women with subclinical hyperthyroidism, overt hypothyroidism, and subclinical hypothyroidism had mean serum TSH values of 0.07 ± 0.03 mIU/ml, 8.02 ± 1.25 mIU/ml, and 11.92 ± 5.34 mIU/ml, In our study, we found that free thyroxine (FT4) levels were significantly lower in the iron-deficient case group compared to the control group. All the women in the study by Neha Gupta et al. had normal FT4 levels, although the FT4 in the iron-deficient (ID) group was considerably lower than that in the non-iron deficient (NID) group (0.9 ± 0.05 ng/dL vs. 1.2 ± 0.05 ng/dL; $p < 0.0001$).

Our study also revealed that anti-thyroid peroxidase antibodies (anti-TPO) were elevated, and thyroid-stimulating hormone (TSH) levels were decreased in the pregnant women of the case group. Veltri et al. found that the ID group had a significantly higher prevalence of thyroid autoimmunity (indicated by elevated anti-TPO) and raised TSH levels compared to the NID group (10% vs. 6% and 20% vs. 16%; p = 0.011 and p = 0.049, respectively). The ID group exhibited significantly higher serum mean TSH levels compared to the NID group (2.86 ± 1.54 mIU/L vs. 2.01 ± 0.45 mIU/L; $p < 0.002$). Additionally, 35.29% of the ID group and 6.25% of the NID group had elevated TSH levels (p = 0.001). The study found that the ID group had significantly higher serum mean anti-TPO levels than the NID group (72.14 ± 55.98 vs. 35.67 ± 11.2; $p < 0.0001$). The prevalence of high anti-TPO levels was notable in both groups (22.06% for ID and 3.13% for NID), with a p-value of 0.018. Fu et al. reported that the FT4 levels in the ID group were significantly lower than those in the NID group (p = 0.031).

Our findings indicate a positive correlation between TSH and serum ferritin levels. Similarly, the study by Neha Gupta et al. showed a positive association between ferritin and FT4 levels, with a p-value of 0.0001 and a correlation coefficient of 0.907. There was also a significant p-value of 0.0001 with a correlation coefficient of -0.455. These results align with those of Veltri et al., who identified a positive connection between FT4 and ferritin (Spearman's $\rho = 0.112$; $p < 0.001$) and an inverse relationship between serum TSH levels and ferritin (Spearman's $\rho = -0.076$; p = 0.001). Yu et al. observed a negative correlation between total body iron concentrations and serum TSH levels (r = -0.105; p = 0.001) and a positive correlation between whole-body iron concentrations and serum FT4 levels (r = 0.126; p = 0.001).

According to the 2010 Iodine Network Global Scorecard, 51% of Indian households consume iodized salt. Mahadik et al. found that 11% of pregnant women had a thyroid condition in the third trimester, consistent with studies by Weiwei Wang et al. (10.2%) and Ajmani et al. (13.25%). In the study by Neha Gupta et al., women with subclinical hyperthyroidism, overt hypothyroidism, and subclinical hypothyroidism had mean serum TSH values of 0.07 ± 0.03 mIU/mL, 8.02 ± 1.25 mIU/mL, and 11.92 ± 5.34 mIU/mL, respectively.In our study population, the prevalence of subclinical hypothyroidism in pregnant women is 20%. The prevalence of overt hypothyroidism is 16.7%, while subclinical hyperthyroidism is present in 13.3% of the women.

For those with subclinical hypothyroidism, the mean TSH value is 7.89 ± 1.35, the mean FT4 value is 1.02 ± 0.34, and the mean FT3 value is 2.98 ± 0.45. In cases of overt hypothyroidism, the mean TSH value is 11.44 ± 5.06, the mean FT4 value is 0.39 ± 0.28, and the mean FT3 value is 0.79 ± 0.69. Women with subclinical hyperthyroidism have a mean TSH value of 0.08 ± 0.02, a mean FT4 value of 1.3 ± 0.09, and a mean FT3 value of 3.9 ± 0.38.

Additionally, the mean serum FT3 values for women with subclinical hyperthyroidism, overt hypothyroidism, and subclinical hypothyroidism were 4.1 ± 0.40 pg/ml, 1.58 ± 1.43 pg/ml, and 2.92 ± 0.454 pg/ml, respectively. The mean serum FT4 levels for these groups were 1.09 ± 0.30 ng/dl for subclinical hypothyroid women, 0.36 ± 0.24 ng/dl for overt hypothyroid women, and 1.2 ± 0.10 ng/dl for subclinical hyperthyroid women. In contrast, a 2016 Indian report stated that reference values for TSH, FT3, and FT4 during the third trimester were 0.47–5.78 (μIU/ml), 0.24–3.61 (ng/100 ml), and 0.47–5.1 (ng/100 ml), respectively. Specifically, during the third trimester, the values for TSH, FT3, and FT4 were noted as 0.47–5.78 (μIU/ml), 0.24–3.61 (ng/100 ml), and 0.47–5.1 (ng/100 ml). Our study found a statistically significant relationship between TSH and ferritin levels. Similarly, a study by Neha Gupta et al. reported a positive correlation between TSH and ferritin..

CONCLUSION

Research suggests that many pregnant women may have subclinical hypothyroidism, indicating a common issue with thyroid function. Low iron levels may also affect thyroid health, increasing TSH levels and decreasing FT4 concentrations in the first trimester. Therefore, women need to receive proper prenatal counseling and treatment for iron deficiency. Early identification of thyroid dysfunction should also be prioritized. Moreover, the first-trimester checkup should include an assessment of the iron profile, including serum ferritin levels. A recent study has highlighted a concerning trend among pregnant women, showing that a substantial proportion exhibit signs of subclinical hypothyroidism. This condition underscores a significant prevalence of thyroid dysfunction, which can have implications for both maternal and fetal health. The research indicates that low levels of iron may play a detrimental role in thyroid function. Specifically, inadequate iron can lead to an increase in thyroid-stimulating hormone (TSH) levels and a corresponding decrease in free thyroxine (FT4) concentrations during the crucial first trimester of pregnancy.

Given these findings, it is essential for healthcare providers to ensure that expectant mothers receive appropriate prenatal counselling that addresses the potential risks associated with iron deficiency. This counselling should include guidance on dietary sources of iron and the importance of supplementation if necessary. Furthermore, the early identification of any thyroid dysfunction should be prioritised in prenatal care regimens, as timely intervention can mitigate potential complications. Moreover, it is advisable that routine checkups during the first trimester incorporate a comprehensive assessment of the iron profile. This assessment should include measuring serum ferritin levels, which serve as a key indicator of iron stores in the body. By implementing these strategies, healthcare professionals can significantly improve the overall health outcomes for both mothers and their developing infants.

CONFLICTS OF INTEREST:

The authors of the study documented that there are no conflicts of interest pertaining to the publication of the paper.

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