Maternal thyroid status and its relation to ferritin and vitamin B12 in Saudi pregnant women

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Background
Thyroid dysfunction is a worldwide phenomenon in women, and the prevalence increases during pregnancy, with hypothyroidism being the most common.
In most developing countries, nutritional deficiencies of nearly all essential nutrients, including iron, vitamin B12, and folic acid, are common in pregnant women. Thyroid disorders and nutritional deficiencies especially of iron and vitamin B12 cause a number of maternofetal complications.
Objectives
To assess thyroid status in pregnant Saudi women and explore its relation to ferritin and vitamin B12.
Patients and methods
This was a cross-sectional study conducted at antenatal clinics of the Northern Area Armed Forces Hospital, KSA, enrolling 254 Saudi women: 180 pregnant [classified according to gestational age into group A (first trimester) and group B (second trimester)], and 74 age-matched healthy nonpregnant women, as control group (group C). After a detailed obstetrical and medical history, and clinical assessment, participants were subjected to laboratory investigations in the form of thyroid function by measuring thyroid-stimulating hormone (TSH) and free thyroxin, hemoglobin (HB), serum ferritin, and vitamin B12 levels.
Results
TSH level was lower in pregnant than nonpregnant women. Subclinical hypothyroidism (35.5%) was the most common thyroid disorder followed by overt hypothyroidism (10%) and hypothyroxinemia (2.2%) in pregnant women. HB and vitamin B12 levels were significantly lower in first and second trimesters of pregnancy when compared with controls (P=0.001). Serum free thyroxin correlated positively with HB and ferritin, whereas TSH correlated negatively with HB and ferritin.
Conclusion
High prevalence of hypothyroidism in pregnant females and its association with iron and vitamin B12 deficiencies highlight the urgent need for thyroid status to be detected and to evaluate nutritional deficiencies in such group, so as to start early treatment promptly and to prevent the adverse effects of the disorder to both mother and fetus to achieve normal pregnancy outcome.

Keywords:
ferritin, pregnancy, thyroid, vitamin B12

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Introduction

The prevalence of thyroid disorder in pregnancy is approximately 2–5%, with hypothyroidism being more common, approximately 6.47–14.32% [1]. During the initial phase of gestation, the fetus is solely dependent on thyroid hormones from mother until its own thyroid gland is developed. Inadequate supply of thyroid hormones at this stage can cause fetal brain damage, miscarriage, or premature growth of fetus [2].

In pregnant women, the gland increases 10% in size in iodine-replete countries and by 20–40% in areas of iodine deficiency. Production of thyroxin (T4) and triiodothyronine (T3) increases by 50%, along with a 50% increase in the daily iodine requirement. This is owing to estrogen induces a rise in serum thyroid-binding globulin, whereas the placenta releases several thyroid stimulatory factors in excess like human chorionic gonadotropin (HCG) [3]. During the first trimester, HCG induces a transient increase in free thyroxin (FT4) levels, which is mirrored by a lowering thyroid-stimulating hormone (TSH) concentrations. Following this period, or second trimester, serum FT4 concentrations decrease ~10–15% and serum TSH

values steadily return to normal [4], whereas others stated that serum FT3 and FT4 levels decrease gradually from the first to the last 3 months of pregnancy, and TSH level increases gradually during the whole pregnancy, and these physiological changes may result in hypothyroidism [5].

In our clinical practice, we have noticed TSH elevated rapidly along with the decrease of hemoglobin (HB) and serum ferritin levels in pregnant women. A few clinical studies have indicated that iron deficiency affects thyroid function during pregnancy. Yu *et al*. [6] found that iron deficiency is an independent risk factor for isolated hypothyroxinemia during the first trimester of pregnancy with appropriate iodine intake in China. Zimmermann *et al*. [7] provided data suggesting that poor maternal iron status predicts higher TSH and lower FT4 during pregnancy in areas of borderline iodine deficiency.

Vitamin B12 maintains normal folate metabolism, which is essential for cell multiplication during pregnancy. Vitamin B12 deficiency is emerging as a growing public health problem, and an increasing number of studies have shown that deficiency is commonly seen in pregnancy [8]. Vitamin B12 status during pregnancy is critical as maternal vitamin B12 deficiency can affect the pregnancy outcome for both mother and the offspring. For women who want to get pregnant, a vitamin B12 deficiency means an increased risk of developing intrauterine growth retardation, preeclampsia, and preterm labor [9]. Deficiency of vitamin B12 is highly prevalent among hypothyroid patients. Vitamin B12 deficiency worsens hypothyroidism. Unfortunately, both deficiencies can go unnoticed, and they can be difficult to diagnose [10].

So, the present study was aimed to assess thyroid status in pregnant women in the first and second trimesters and explore its relation to ferritin and vitamin B12.

Patients and methods

Study design

In this cross-sectional study, 180 Saudi pregnant women in their first trimester or second trimester were recruited from antenatal clinics of the Northern Area Armed Forces Hospital, KSA, in the period from January 2018 to April 2018. Participants were subdivided into two groups: group A had pregnant women in the first trimester (1–13 week), and group B included pregnant women in the second trimester (14–27 week). Another 74 age-matched healthy nonpregnant Saudi women served as controls (group C). The sample size was based on the number of patients who met the inclusion criteria during the study period.

The criteria for selecting the pregnant individuals in the sample included the following:

(1) Pregnant in the first or second trimester with a viable normal fetus.
(2) Coming for routine obstetric evaluation and did not start any supplementation before.
(3) Singleton pregnancy.

Exclusion criteria for studied groups were as follows:

(1) Multiple pregnancies.
(2) History of thyroid disease or any other chronic illnesses, renal disorders, diabetic, etc.
(3) On any supplementation 6 months before the study.

After informed consent, all participants were subjected to the following:

(1) History taking, including sociodemographic and medical information.
(2) Complete physical examination including abdominal ultrasound to pregnant women to confirm gestational age and normality of pregnancy.
(3) At their first antenatal visit as part of routine laboratory workup, all the participants were subjected to the following laboratory investigations:
    (a) Thyroid function by measuring TSH and FT4.
    (b) HB and serum ferritin.
    (c) Vitamin B12 level.

Blood was collected after 8–10 h of fasting by venipuncture from all participants. TSH, FT4, HB, serum ferritin, and vitamin B12 measurements were performed using the chemiluminescence assay (Cobas 6000 analyzer e601 module; Roche Diagnostics, Munchen, Germany). The normal range according to the manufacturer for TSH and FT4 was 0.27–4.20 μIU/ml and 12–20 pmol/l, respectively. The detection sensitivity was 0.005 μIU/ml for TSH and 0.3 pmol/l for FT4. The normal range for ferritin kit was 13–150 ng/ml, for HB was 12–15.5 g/dl, and for vitamin B12 was 153–710 pmol/l.

Thyroid status and definitions

According to the guidelines of the American Thyroid Association for the diagnosis and management of thyroid disease during pregnancy [11] and according

to the currently available report that included normal pregnant participants from the Gulf region [12], the normal range for FT4 during pregnancy was 10.5–22.3 pmol/l. Thyroid disorders during pregnancy were classified into the following:

(1) Hypothyroidism was considered when TSH was more than 2.5 μIU/ml, and the level of FT4 defined the type, as either primary (FT4 <10.5 pmol/l) or subclinical (FT4 ≥10.5 pmol/l).
(2) Hyperthyroidism was considered for TSH less than or equal to 0.03 μIU/ml and/or FT4 more than 22.3 pmol/l.
(3) Hypothyroxinemia was define by the presence of low FT4 (≤10.5 pmol/l) with normal serum TSH levels (≤2.5 μIU/ml).
(4) Euthyroid was defined by normal TSH (2.5≥TSH >0.3 μIU/ml) and normal FT4 (10.5≤FT4 ≤22.3 pmol/l) level.

For the nonpregnant (control group),

(1) Hypothyroidism was considered when TSH was more than 4.2 μIU/ml, and the level of FT4 defined the type as either primary (FT4 <10 pmol/l) or subclinical (FT4 ≥10 pmol/l).
(2) Hyperthyroidism was considered for TSH less than or equal to 0.1 μIU/ml and/or FT4 more than 23 pmol/l.
(3) Hypothyroxinemia was define by the presence of low FT4 (≤10 pmol/l) with normal serum TSH levels (≤4.2 μIU/ml).
(4) Euthyroid was defined by normal TSH (4.2 ≥TSH >0.3 μIU/ml) and normal FT4 (10.5≤FT4 ≤23 pmol/l) level.

Statistical analysis

Software (SPSS, version 20.0 for Windows; SPSS Inc., Chicago, Illinois) was used for the univariate, bivariate, and stratified analyses of the data. Qualitative variables were analyzed by constructing contingency tables with Fisher exact test, when conditions for the former were not met. Analysis of variance (*F* test) and Kruskal–Wallis test were used for multiple comparisons of quantitative variables of parametric and nonparametric type.

Correlations among variables were studied by using the Pearson coefficient (*r*). Differences were considered significant at *P* value less than or equal to 0.05 and nonsignificant at 0.05.

Results

A total of 254 women participated in the study, and 180 (70.8%) of them were pregnant. According to their gestational age, they were classified into two groups: group A included 104 (40.9%) women in the first trimester (1–13 week), and group B included 76 (29.9%) women in the second trimester (14–27 week). Moreover, 74 (29.2%) age-matched healthy nonpregnant Saudi women served as controls (group C). The mean age of group A was 30.6±6.6 years, the mean age of group B was 28.8±6.9 years, and the mean age of group C was 33.1±9.9 year, with statistical significant difference between group C in relation to groups A and B (*P*=0.004). Regarding body mass index (BMI=weight (kg)/height (m^2)), there was a statistically significant difference between group C in relation to groups A and B (*P*=0.013) (Table 1).

Table 1 The characteristics of the study patients

	Group A [*N*=104 (40.9%)]	Group B [*N*=76 (29.9%)]	Group C [*N*=74 (29.2%)]	*F* test	*P*
Age (years) (mean±SD)	30.6±6.6	28.8±6.9	33.1±9.9[ab]	5.7	0.004**
BMI (kg/m^2) (mean±SD)	27.7±6.3	28.1±5.4	30.4±6.6[ab]	4.45	0.013*

[ab]Significance compared with groups A and B. **P* value for differences between groups. ***Significance *P*-value ≤ 0.01.

Compared with group C, groups A and B pregnant women exhibited nonsignificant lower TSH levels (2.76±2.88 vs. 2.57±1.44 and 2.59±1.11 mIU/l, *P*=0.25). The TSH levels were similar in groups A and B pregnant women (2.57±1.44 and 2.59±1.11 mIU). Significant differences were observed in FT4 levels among the studied groups. Compared with group A, FT4 levels were significantly lower in groups B and C (14.77±2.13 vs. 12.94±1.89 and 13.56±2.89 pmol/l, *P*=0.001). Compared with group C, pregnant women in groups A and B showed remarkable low vitamin B12 levels (425.46±158.85 vs. 192.60±76.2 and 165.05 ±74.9 pmol/l, *P*=0.001). Significant differences in HB existed among the studied groups. Compared with group C, pregnant women in groups A and B had lower HB concentration (12.66±1.53 vs. 12.23±1.2 and 11.53±1.33 g/dl, *P*=0.01). HB concentration was lower in group B than group A (11.53±1.33 and 12.23 ±1.2 g/dl, respectively). Although serum ferritin level was higher in group C (nonpregnant: 31.27±33.02) in relation to its level in pregnant groups (27.23±17.03 for group A and 24.64±19.71 for group B), no significant differences were found in serum ferritin level among the studied groups (*P*=0.33) (Table 2 and Fig. 1).

Following the guidelines of the American Thyroid Association for the diagnosis and management of thyroid disease during pregnancy [11] and according to the currently available report that included normal

pregnant participants from the Gulf region [12] to assess the thyroid status among the studied groups, we found euthyroidism was much more prevalent in nonpregnant (83.3%) than in pregnant women (53.8 and 50% for groups A and B, respectively), whereas hypothyroidism (overt and subclinical) was more prevalent in pregnant women (9.6 and 34.6%, respectively, for group A and 10.5 and 36.8%, respectively, for group B). On the contrary, there was no hyperthyroidism in pregnant women, and it was present in only 2.7% of the nonpregnant women. On the contrary, hypothyroxinemia had the same prevalence (2%) in pregnant women in groups A and B, and it was absent in group C. However, there was significant statistical difference regarding thyroid status among the studied groups (P=0.001) (Table 3).

Correlation analysis of TSH with HB, ferritin, and vitamin B12 levels in different studied groups revealed that in group A there were nonsignificant negative correlations between TSH level and HB as well as ferritin levels (r=−0.17 and −0.07, P=0.09 and 0.51, respectively), but there was a highly significant positive correlation between TSH and vitamin B12 levels (r=0.25, P=0.011). In group B, TSH level was negatively correlated with HB, ferritin, and vitamin B12 levels, which was significant for HB and vitamin

Table 2 Comparison between the studied groups regarding thyroid-stimulating hormone, free thyroxin, hemoglobin, ferritin, and vitamin B12

	Group A	Group B	Group C	*F* test	*P*
TSH (mean ±SD)	2.57 ±1.44	2.59 ±1.11	2.76±2.88	χ^2=2.79	0.25
FT4 (mean ±SD)	14.77 ±2.13	12.94 ±1.89[a]	13.56 ±2.89[a]	χ^2=14.74	<0.001**
B12 (mean ±SD)	192.60 ±76.2	165.05 ±74.9	425.46 ±158.85[ab]	χ^2=139.0	<0.001**
Ferritin (mean ±SD)	27.23 ±17.03	24.64 ±19.71	31.27 ±33.02	χ^2=2.22	0.33
HB (mean ±SD)	12.23 ±1.2	11.53 ±1.33$	12.66 ±1.53[ab]	χ^2=13.57	<0.01**

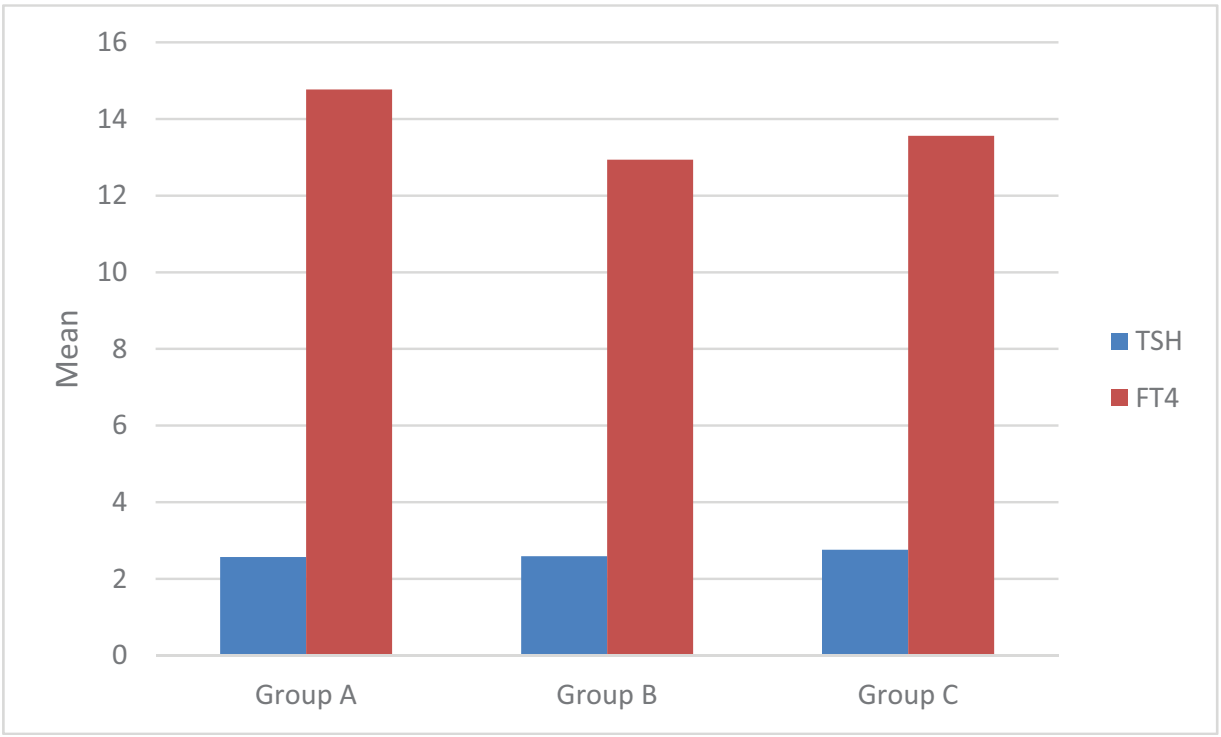
FT4, free thyroxin; HB, hemoglobin; TSH, thyroid-stimulating hormone. [a]Significance compared with group A. [b]Significance compared with group B. [ab]Significance compared with groups A and B. **Significance *P*-value ≤ 0.01.

Table 3 Thyroid status among the studied groups

	Group A	Group B	Group C	FET	*P*
Euthyroid	56 (53.8)	38 (50.0)	62 (83.8)	30.09	<0.001**
Hypothyroidism	10 (9.6)	8 (10.5)	2 (2.7)		
Subclinical hypothyroidism	36 (34.6)	28 (36.8)	8 (10.8)		
Hyperthyroidism	0 (0.0)	0 (0.0)	2 (2.7)		
Hypothyroxinemia	2 (1.9)	2 (1.9)	0 (0.0)		

FET, Fisher exact test. **Significance *P*-value ≤ 0.01.

Figure 1



Mean TSH and FT4 among the studied groups.

Table 4 Correlation of hemoglobin, ferritin, and vitamin B12 with thyroid-stimulating hormone in different studied groups

TSH	Group A		Group B		Group C	
	r	*P*	*r*	*P*	*r*	*P*
HB	–0.17	0.09	–0.44	<0.001**	–0.43	<0.001**
Ferritin	–0.07	0.51	–0.23	0.044*	–0.08	0.49
Vitamin B12	0.25	0.011*	–0.20	0.08	–0.05	0.66

HB, hemoglobin; TSH, thyroid-stimulating hormone. *Significance *P*-value ≤ 0.05. **Significance *P*-value ≤ 0.01.

Table 5 Correlation of hemoglobin, ferritin, and vitamin B12 with free thyroxin in different studied groups

FT4	Group A		Group B		Group C	
	r	*P*	*r*	*P*	*r*	*P*
HB	0.27	0.006**	0.15	0.20	0.28	0.017*
Ferritin	0.10	0.29	0.32	0.005**	–0.16	0.18
Vitamin B12	–0.11	0.26	0.04	0.71	0.15	0.20

FT4, free thyroxin; HB, hemoglobin. *Significance *P*-value ≤ 0.05. **Significance *P*-value ≤ 0.01.

B12 and nonsignificant for ferritin (r=–0.44, –0.23, and –0.20, respectively, and P=0.001, 0.044, and 0.08, respectively). Moreover, in group C, TSH was negatively correlated with HB, ferritin, and vitamin B12 levels, which was significant for HB and nonsignificant for ferritin and vitamin B12 (r=–0.43, –0.08, and –0.05, respectively and P=0.001, 0.49, and 0.66, respectively). However, on analysis of correlation of FT4 with HB, ferritin, and vitamin B12 levels in different studied groups, we found that in group A there were positive correlations between FT4 level and HB as well as ferritin levels, which was significant for HB and nonsignificant for ferritin (r=0.27 and 0.1, P=0.006 and 0.29, respectively), but there was nonsignificant negative correlation between FT4 and vitamin B12 levels (r=–0.11, P=0.26). In group B, FT4 was positively correlated with HB, ferritin, and vitamin B12 levels, which was only significant with ferritin (r=0.15, 0.32, and 0.04, respectively, and P=0.2, 0.005, and 0.71, respectively). In group C, there were positive correlations between FT4 level and HB as well as vitamin B12 levels, which was significant for HB and nonsignificant for vitamin B12 (r=0.28 and 0.15, P=0.017 and 0.2, respectively), but there was a nonsignificant negative correlation between FT4 and ferritin levels (r=–0.16, P=0.18) (Tables 4 and 5).

Discussion

Thyroid dysfunction is a worldwide phenomenon in women, and the prevalence increases during pregnancy [13]. In most developing countries, nutritional deficiencies of nearly all essential nutrients, including iron, vitamin B12, and folic acid, are common in pregnant women. Thyroid disorders and nutritional deficiencies especially of iron and vitamin B12 cause a number of maternofetal complications including the decreased ability of mother to cope up with bleeding that occurs during delivery, low birth weight of fetus, growth retardation, and increased perinatal mortality [14]. There are only a few reports on the prevalence of pregnancy-related thyroid disorders in the Saudi context. Therefore, this study was conducted to assess thyroid status in pregnant Saudi women and its relation to ferritin and vitamin B12.

In this study, we found nonsignificant lower TSH levels in first and second trimesters of pregnancy when compared with controls, which was in agreement with Zha *et al.* [5] who explored the range for thyroid hormones in normal pregnant Chinese and reported that TSH was significantly lower in pregnant than controls. However, it was in contrast with the study of Baghel *et al.* [15] who studied thyroid status in Indian pregnant women in the first trimester and found significantly elevated TSH level in pregnant than nonpregnant, as well as with the study of Abdelhafiz *et al.* [16], who studied thyroid functions in Sudanese women in mid and late pregnancy, and also found significant elevation in TSH level in pregnant than nonpregnant women. In our study, the mean TSH level was nearly similar in first and second trimesters at 2.57±1.44 and 2.59±1.11 mIU, respectively, which was slightly lower than mean TSH level in the study of Chandrasekhara *et al.* [17] who studied thyroid disease in pregnant Indian women and found mean TSH level of first trimester to be 2.78 ±2.33 mIU and in second trimester to be 2.82±1.64 mIU.

In our study, we found that serum FT4 levels in pregnant women decreased significantly from the first to the second trimester, and it is significantly higher in the first trimester of the case group than in the control group. This is in accordance with the study of Zha *et al.* [5] who declared that serum FT4 levels in pregnant women decreased gradually from the first to the last three months. Our results were in contrast with the results of Baghel *et al.* [15] who found FT4 level was significantly lower in first trimester pregnant women than controls.

The present study showed thyroid abnormalities in 16.2% among the nonpregnant participants, and the most common thyroid disorders were subclinical hypothyroidism (10.8%), followed by overt hypothyroidism and hyperthyroidism, having the same prevalence (2.7%). There were positive

correlations of FT4 with HB, whereas TSH correlated negatively with HB and ferritin. These findings were in accordance with the study of Refaat [18] who studied the prevalence and characteristics of anemia associated with thyroid disorders in nonpregnant Saudi women and found that thyroid disorders represent 19.6% of the study population, with subclinical hypothyroidism (59.3%) being the most prevalent followed by overt hypothyroidism (32.2%) and hyperthyroidism (8.4%), with also positive correlations of FT4 with HB and negative correlation of TSH with HB and ferritin. This was also in accordance with the study of Hasanato *et al*. [19] who studied the incidence of thyroid diseases in Saudi adult women in Riyadh and documented that hypothyroidism (15.5%) is much more prevalent than hyperthyroidism (3%) in their studied group, and with the study of Al Eidan *et al*. [20] who found that subclinical hypothyroidism (10.7%) is more prevalent than subclinical hyperthyroidism (1.7%) in women participating in their study.

Our results documented thyroid abnormalities in 46.2% and 50% of pregnant females in first and second trimesters, respectively, and the most common thyroid disorder was subclinical hypothyroidism followed by overt hypothyroidism and hypothyroxinemia. Furthermore, serum FT4 correlated positively with HB and ferritin, whereas TSH correlated negatively with HB and ferritin. This was in agreement with Refaat [13] who studied the prevalence of pregnancy-induced thyroid dysfunction and the characteristics of the associated anemia in primigravida Saudi women during the first trimester in Mekkah, and with the study of Hussein [21] who study the prevalence of thyroid dysfunction among Saudi women in early pregnancy at King Abdulaziz University Hospital in Jeddah, who reported that hypothyroidism (40.3%) (occult and overt) was the commonest thyroid dysfunction in first trimester in their studied group. The study by Shaheen and Hasan [14], who explore the prevalence of anemia and its effects on thyroid function in pregnant Indian women, also found that thyroid abnormalities represent 50% of their studied group (anemic and nonanemic) with subclinical hypothyroidism being the most prevalent; when the prevalence of thyroid disorder was compared among the pregnant women who were anemic and nonanemic, the prevalence rate was much higher in pregnant anemic women, suggesting strong association between hypothyroidism and iron deficiency. Our results were also coincident with the study of Ahmed *et al*. [22] who compared the universal and targeted screening for thyroid dysfunction in pregnant Egyptian women and found that hypothyroidism is the most common dysfunction (55.9%) with subclinical hypothyroidism representing 42.8% and overt hypothyroidism representing 13% in their studied group (low and high risk), with similar prevalences in first, second, and third trimesters.

Lower TSH level in pregnant than nonpregnant women, together with high FT4 level in the first trimester than in the second trimester as well as that in the first trimester of controls, and the increased prevalence of hypothyroidism (being the commonest disorder) in our study was owing to the physiological and hormonal changes occurring in normal pregnancy that alter thyroid function. The increased glomerular filtration rate that occurs in pregnancy can lead to increased losses of urinary iodine, resulting in iodine deficiency and eventually maternal goiter. Thyroid function tests change during pregnancy owing to the influence of two main hormones: HCG and estrogen. The high circulating HCG levels in the first trimester may result in a slightly low TSH. When this occurs, the TSH will be slightly decreased in the first trimester. Estrogen increases the amount of thyroid hormone-binding proteins in the serum, which increases the total thyroid hormone levels in the blood as more than 99% of the thyroid hormones in the blood are bound to these proteins. In summary, pregnancy-induced stress on the thyroid can lead to hypothyroidism.

Moreover, we found significantly lower levels of HB and vitamin B12 levels in first and second trimesters of pregnancy when compared with controls. Moreover, ferritin was nonsignificantly lower in pregnant than nonpregnant women, which was in accordance with the study of Baghel *et al*. [15] who reported that vitamin B12 and iron were significantly lower in the first trimester of pregnancy than in nonpregnant. In our study we had noticed that vitamin B12 was positively correlated with TSH in the first trimester and negatively correlated with TSH in the second trimester, which was different from the study of Bashetti *et al*. [10] who studied the association of vitamin B12 and folic acid with thyroid hormones in pregnant Indian women with hypothyroidism and found TSH was correlated negatively with vitamin B12 in first and second trimesters, but these might be owing to that all participants in their study were hypothyroid. However, vitamin B12 is very essential in all stages of life, and its demand increases during pregnancy, fetal development, and infant growth states, owing to the dependency of the fetus on maternal vitamin B12 for proper development and growth.

The first trimester pregnancies without any supplementation more likely reflect the preconceptional status. Our results emphasize that iron and B12 deficiencies were common problem in this geographical region. These pregnant women will probably develop iron and B12 deficiency anemia with the progression of pregnancy. Screening in the preconceptional period or early pregnancy seems valuable for the detection and treatment.

Conclusion

In conclusion, we studied maternal thyroid status in first and second trimesters in pregnant women in Northern Area, KSA, and its relation to ferritin and vitamin B12. We observed a lower TSH level in pregnant than nonpregnant. We found that subclinical hypothyroidism was the most common thyroid disorder followed by overt hypothyroidism and hypothyroxinemia. In addition, we showed lower levels of HB, ferritin, and vitamin B12 in first and second trimester of pregnancy when compared with controls. Serum FT4 correlated positively with HB and ferritin, whereas TSH correlated negatively with HB and ferritin. So, these results highlight the urgent need for thyroid status to be detected early and treatment started promptly. Therefore, screening pregnant women for maternal thyroid dysfunction as early as possible should be considered, particularly in a country like Saudi Arabia.

More researches are needed to be conducted so that a clear link associated with thyroid function and iron status can be ruled out to prevent the adverse effects of the disorder to both mother and fetus, so as to achieve normal pregnancy outcome. Moreover, we recommend further detailed, multicenter studies to understand the association between vitamin B12, and thyroid profile. So, early diagnosis of these deficiencies will be useful for starting of supplements to avoid unwanted effects in pregnancy.

Study limitation

However, our study has a few limitations. First, we did not investigate autoimmune thyroid disease as a cause of thyroid disorder. Second, the study should be extended to the population in iodine-deficient or excessive area. Further research is needed to determine the role of maternal thyroid dysfunction with iron and vitamin B12 deficiency in fetal development. Lastly, our study was conducted in one center, so would be better to have a multicenter study.

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Conflicts of interest

There are no conflicts of interest.

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