

ORIGINAL ARTICLE

COMPARATIVE STUDY OF IRON STATUS IN APPARENTLY HEALTHY PREGNANT WOMEN WITH NON PREGNANT WOMEN

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Summary

Iron status in this clinical trial was represented as "Serum Iron, Total iron- binding capacity (TIBC), Unsaturated iron- binding capacity (UIBC), Transferrin saturation, Packed cell volume (PCV), Hemoglobin (Hb)", were evaluated in the blood of 98 healthy participant women, including 35 healthy non-pregnant women aged between (18-45) years as a control group and 63 healthy pregnant women aged between (15-44) years which divided into two groups depending on gestational age, the first group in the first trimester aged between (15-38) years; the second group in the third trimester aged between (21-44) years; in order to investigate the impacts of pregnancy and gestational period on iron status. The dedication of the contemporary research was to conclude the physiological changes in iron conditions in pregnant women in relation with non-pregnant women. Regarding this results that are recorded in the current research, a great significant drop in the level of the serum iron, transferrin saturation, PCV, Hb in "the first and third trimester" of pregnant women when comparison done with the control cases, while a statistical significance elevation of TIBC and UIBC level in the first and third trimester of pregnancy compared with control groups. Finally, the results of the mean value of iron status showed a meaningful difference between the first and third trimesters of pregnancy.

Key words: pregnancy; iron; haemoglobin; RBC; PCV

Introduction

Pregnancy is known as a physiological condition associated with multiple changes in metabolic, physiological, biochemical, haematological and immunological processes. If these changes are exaggerated, they can cause complications in gestation (1). Physiological alteration in pregnancy may ensue amendments in ordinary levels for many biochemical parameters, and these findings may be misapprehended as a pathological disease (2). The average period of human conception is 40 weeks, from the first day of the female last menstrual cycle (3). It is usually classified into three trimesters. The first trimester is from week 1-12 weeks. The second trimester is from 13-28 weeks. The last trimester is from 29-40 weeks and ends with delivery (4). During pregnancy, "iron deficiency and iron overload" raised the risk for adverse pregnancy outcomes (5).

Anemia, defined as low hemoglobin or hematocrit, is frequent within ladies during their childbearing life, especially if the females are impoverished, pregnant, or member of a minority group (1, 2). Prior recent, it was thought that anemia during pregnancy had minimal negative consequences (1). The correlation between anemia early in pregnancy and an added threat of preterm delivery has been proposed in recent years (2, 3). Similarly, a link between poor pregnancy consequences and high hemoglobin and iron reserves has been shown. However, the hazards and advantages of preventive iron supplements in pregnant mother who are not iron defective continue debatable (3).

Iron is a valuable element required by our body, which is important not only for the functioning of various cellular pathways, such as DNA synthesis, enzymatic function, and energy generation in the mitochondria but also important for haemoglobin production, which forms approximately sixty percent (60 %) of whole iron content in the body, that play role in transport and exchange of O₂ (6). Iron is very important for both "maternal health" as well as "fetal growth and development" (7, 8). During gestational periods, physiologic normal iron exigencies upsurge dramatically to help fetoplacental growth and mother acclimatization to gestation. To meet this increase in the demand for iron, both oral iron absorption, and the armament of iron from the storage area increased (9). Iron desires are increased by three times during pregnancy, Iron deficiency anemia can cause a weakening in the enzymes containing iron activity and reduction O₂ transport in both the fetus and the mothers, that is lead to increased risk of pregnant death, especially caused by bleeding and septicemia (10).

Iron insufficiency is a very well-known dietary inadequacy in both the developed and the developing countries. Through their fertile age, women are vulnerable of iron deficiency owing to hemorrhage during periods, with 10 % experiencing high losses (80 mL/mo). It really is believed about 50 % of women who are pregnant do not have satisfactory iron reserves (1, 3). So because iron requirement for gestation (3–4 mg/d) is significant, the likelihood of iron shortage and iron-deficiency anemia would rise with gestation. Nevertheless, the frequency of anemia and iron-deficiency anemia in postpartum women in the "United States" is unknown, although it is relatively high, particularly among the poor. Anemia rises fourfold throughout pregnancy, from first to third trimester, in limited females studied as part of prenatal dietary monitoring (3).

Materials and Methods

The study was done on 98 healthy females. Their ages ranged between (15-45) years. Informed consent has been collected from all participants who joined this study. The control group included 35 healthy non-pregnant ladies; ranging age between (18-45) years, with a mean (33) years. The second group involved in this study included 63 healthy pregnant ladies; ranging in age between (15-44) years, with a mean (28) years. A complete history was taken from each participant of both groups including name, age, gestational age, occupation, and family history. The group of pregnant women is subdivided into 2 subgroups regarding the gestational trimester. The first subgroup contains 32 healthy pregnant ladies in the "first trimester of pregnancy". The second subgroup included 31 "healthy pregnant women" in the "third trimester of pregnancy". Approximately 5 ml of venous blood specimens were withdrawn from all participants conjoined in the study by venipuncture. One millilitere of the blood sample was collected into an EDTA tube, which was used for PCV and Hb measurement. The remaining 4 ml of blood specimen was immediately transferred into the plain tubes and incubated in a water bath at (37 °C) for the whole (10 minutes) after that centrifuged at 3000 rpm for (15 minutes) to finish separation of serum specimen. The separated sample was used to determine the level of serum iron, "total iron- binding capacity (TIBC)". "Serum iron" and "total iron-binding capacity" level were estimated calorimetrically (11, 12) using the kit supplied by Randox, UK. The assumption of assay bestowed that; ascorbic acid, after dissociating iron-transferrin coupled in acid media, lowers Fe⁺³ to Fe⁺², which forms a colorful complex with Ferene. The absorbance at 600 nm is dependent on the quantity of iron in the sample. To minimize copper interaction, thiourea is incorporated into the reaction mixture.

"Total iron-binding capacity" was indomitable using a kit presented by Randox, UK. Concurring to the following techniques; after adding enough Fe⁺³ to saturate transferrin, the surplus Fe⁺³ is purged by absorption with basic magnesium carbonate powder, and the bound iron in the residue is determined after spinning.

"Transferrin saturation % (TS%)" is approximated from the following equation:

$$TS\% = \frac{\text{Serum iron}}{\text{TIBC}} * 100$$

To calculate "unsaturated iron-binding capacity (UIBC)" subtract the "serum iron concentration" from the TIBC (13). PCV was determined by the well-known "Microhematocrit method described" by "Daci and Lewis,1986" (14); when the whole blood specimen is centrifuged for maximum RBC packing, the heavier RBC sink to the bottom and the space occupied by the RBC is measured and expressed as a percentage of the total blood volume. The WBC & platelets rise above the RBC as a middle thin layer called buffy coat. The upper part is representing the plasma; any increase or decrease in the plasma volume if the body will affect the hematocrit. Haemoglobin is determined by "Drabkin colourimetric method" (15) using kit supplied by SPINREACT® (Cat. No. 7 E-17176, Spain). The principle of assay based on the reaction of hemoglobin with potassium ferricyanide to form methemoglobin, this later were then converted to cyanomethemoglobin with the aid of potassium cyanide. The darkness of color is reciprocal to the level of hemoglobin presents. The results were analyzed using an unpaired t-test, data shown as mean ± standard deviation [SD]; $P \leq 0.05$ which regarded as statistically significant (16).

Results

The results showed a significant decrease in the mean values of "serum iron, transferrin saturation", PCV and Hb in pregnant women of the first-trimester group (10.99 ± 7.65), (19.6 ± 12.5), (36.41 ± 3.25), and (12.17 ± 1.04) respectively in comparison with controls (14.19 ± 3.27), (27.26 ± 7.97), (40.60 ± 2.61), and (13.514 ± 0.875) respectively. However, there was a significant elevation in the mean value of TIBC and UIBC in the first trimester of the pregnant women group (56.73 ± 7.30) and (45.7 ± 10.5) respectively compared with the control group (53.08 ± 5.34) and (38.89 ± 7.41) respectively (see Figure 1 and 2).

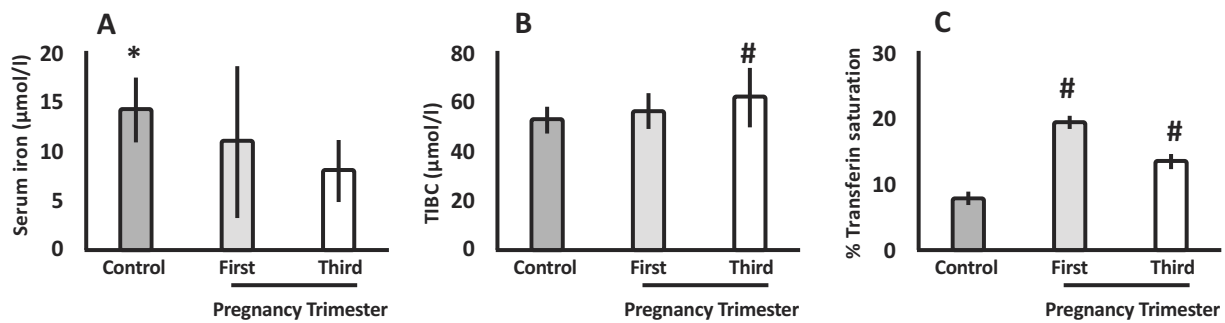


Figure 1. Iron status in pregnant compared to non-pregnant women. Data expressed as mean±SD, * $p < 0.05$ as compared to the third trimester, # $p < 0.05$ as compared to the control group. TIBC=total iron-binding capacity.

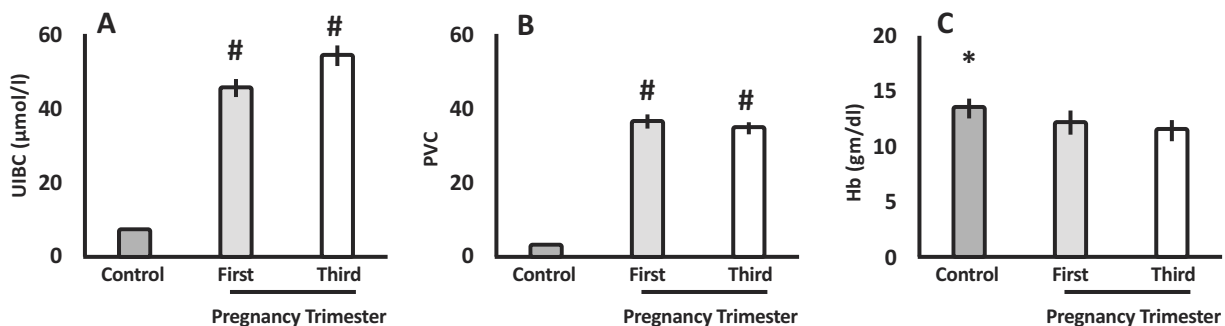


Figure 2. RBC status in pregnant versus non-pregnant women. Data expressed as mean±SD, * $p < 0.05$ as compared to the third trimester, # $p < 0.05$ as compared to the control group. UIBC=unsaturated iron-binding capacity, PCV=packed cell volume and Hb=hemoglobin.

The resemblance of the values of iron status between the non-pregnant and pregnant ladies in "the third trimester of pregnancy", there was a significant reduction in the values of serum iron, transferrin saturation, PCV and Hb

concentration in the "third trimester" of pregnant women group (8.01 ± 3.15), (13.53 ± 6.59), (34.55 ± 2.71), and (11.487 ± 0.889) respectively in comparison with the control group (14.19 ± 3.27), (27.26 ± 7.97), (40.60 ± 2.61), and (13.514 ± 0.875) respectively. However, there was a significant rise in the mean value of TIBC and UIBC in the third trimester of the pregnant women group (62.3 ± 12.0) and (54.3 ± 12.5) respectively compared with the control group (53.08 ± 5.34) and (38.89 ± 7.41) respectively (see Figure 1 and 2).

The differences in the mean values of iron status within pregnant women groups revealed and a significant reduction in mean values of iron, transferrin saturation, PCV and Hb concentration was noticed in the pregnant women group in the third-trimester group (8.01 ± 3.15), (13.53 ± 6.59), (34.55 ± 2.71), and (11.487 ± 0.889) respectively as compared with pregnant women group in the "first trimester" (10.99 ± 7.65), (19.6 ± 12.5), (36.41 ± 3.25), and (12.17 ± 1.04) respectively. While there was a significant elevation in the mean value of TIBC and UIBC in the "third trimester" of the pregnant women group (62.3 ± 12.0) and (54.3 ± 12.5) respectively in compared with the first trimester of the pregnant women group (56.73 ± 7.30) (45.7 ± 10.5) respectively.

Discussion

The results of this research confirmed low levels of serum iron, transferrin saturation, PCV, and Hb concentration of pregnant women group compared to the control non-pregnant group. Nevertheless, serum TIBC and UIBC show a significant elevation in the pregnant group compared with the control group. The findings are in agreement with a couple of studies (17, 18) conducted by Vellanki Lakshmi Narasamma, *et. al.* and Nuzhat R. *et. al.*; and has been ascribed to the normal upsurge in the iron requisites and is remarkably lofty during pregnancy, which are 3 times due to incident of mother red cell volume, the precipitous maturity of both placenta and fetus, grew basal maternal needs and bleeding during labor (10). During gestation, haemoglobin levels in pregnant are lower than the levels in non-pregnant ladies in most cases. This is due to the fluid (plasma) being eminent by about 50 % during gestation (19). The increased plasma volume will cause dilution in the red cells, making their level drop. The decrease in PCV may be due to increasing in the volume of plasma during pregnancy causing hemo-dilution, hormonal changes that eminent fluid withholding and iron deficiency (20-22). In pregnancy, a physiological hemodilution, which is mostly seen during (20-24) week of gestation, and haemoglobin differ through the trimesters (23). There is a physiological decline in hemoglobin during the second trimester. This physiological drop is caused by the higher eminent in the volume of plasma, as compared with the mass of RBC, which is a slightly upsurgues through the pregnancy period. This physiological process maybe leads to a relative hemo-dilution in blood viscosity, which facilitates the blood movement in the placenta (24).

Also, the statistical analysis of the mean values of "iron status" between the first and third trimesters of pregnant ladies, showed a significant alteration in the mean values of iron status has been seen between "the first and third trimesters of pregnancy". The findings of the current research are in agreement with Amah-Tariah FS, *et al.* (25) increases the mass of RBC, and accelerates placental and fetal growth, which results in increased physiologic iron demand to 3-7.5 mg/dl in the third trimester (26). Most of the iron transfer to the fetus occurs during the third stage of pregnancy (27).

In utero environmental influences can affect fetal growth and organogenesis, potentially affecting the offspring's long-term health (28). According to research on maternal iron deficit and neurodevelopmental outcomes, "iron status" in gestation is a critical factor (29). Nonetheless, the majority of research have only looked at the influence of iron therapy on short-term consequences (30). A major thorough study of iron therapy indicated that it had an effect on "maternal hemoglobin" but had no impact on a child health at delivery (31). A further study discovered a weak association among maternal and infant hemoglobin levels shortly after birth (32). A comprehensive evaluation of the long-term effects of "maternal iron status" on child health is currently available.

Conclusion

It concluded from the above research that pregnancy is a risk factor for the development of iron deficiency anaemia. The healthcare provider should provide enough advice and information to avoid anaemia and malnutrition protecting mother and baby from harsh complications of anaemia or iron deficiency status.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Adherence to Ethical Standards

The study was approved by the Medical Research Ethics Committee at the University of Mosul. The study approval number and date UOM/COM/MREC/2013 (3) on 01/12/2013.

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