STATUS OF TRACE ELEMENTS (IRON, ZINC AND COPPER) IN SERA OF PREGNANT WOMEN AT THIRD TRIMESTER

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ABSTRACT

Background and Objectives: Pregnancy is a biological phenomenon associated with dynamic changes in physical, mental and biochemical alterations in body. Maintaining the appropriate micronutrient levels is considered essential for developing the normal pregnancy otherwise there would be adverse pregnancy outcomes. Anemia is one of the most common public health problems in all trimesters of pregnancy where it is regarded as one of the most common causes of maternal death. The aim of this study is to evaluate the serum level of iron, zinc and copper at the third trimester of pregnancy and to ascertain the association between trace elements and hematological parameters.

Methods: This cross sectional study was conducted in January - August 2018. Study participants were divided in to two groups and each group consists of 40 pregnant women at their third trimester of pregnancy. The study group consists of women who did not take iron and folic acid supplements whereas the control group represented pregnant women who took iron and folic acid supplements (400 µg/day). Both zinc and copper were assayed using atomic absorption method whereas iron was measured manually using spectrophotometric method. Statistical analysis for all study variables was done using SPSS version 18. All variables were expressed as mean ± standard deviation (SD) and p values of 0.05 or less were considered statistically significant.

Results: Mean serum iron level was statistically significantly lower in study subjects compared with controls ($p = 0.01$). Moreover, mean serum zinc concentration displayed a highly statistically significantly lower values in study subjects compared to controls ($p < 0.0001$). However, mean serum copper level was slightly lower in study group but did not show any statistically significant differences. No significant correlation seen between iron with zinc and copper and iron with hematological variables

Conclusion: Pregnant women who did not take iron and folic acid supplementation developed maternal anemia as well as hypozincemia particularly in the third trimester. Therefore, sufficient intake of iron and zinc supplementation and trace metals rich diet during pregnancy is recommended to prevent adverse pregnancy outcomes.

KEY WORDS: Trace elements, Iron deficiency anemia and Pregnancy.

INTRODUCTION

Pregnancy may be defined as a biological phenomenon associated with dynamic changes in physical, mental and biochemical alterations in body (1,2). During the whole period of pregnancy there is an increased body demands for nutritional intake including trace elements (micronutrients), vitamins and minerals for the purpose of developing fetus (3,4). Maintaining appropriate micronutrient levels is considered essential for developing the normal pregnancy otherwise there would be adverse pregnancy outcomes (5). Zinc and copper are two important trace elements that are required by human body in minute quantities and this high demand for such elements is clearly illustrated during pregnancy (6,7). It is believed that both zinc and copper play an essential role in fetal growth and development, maintaining antioxidant homeostasis as well as orchestrating different metabolic reactions (8).

Anemia is described as one of the most common public health problems that taken place during all trimesters of pregnancy particularly in

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developing countries where it is regarded as one of the most common causes of maternal death if left untreated (9,10,11). The current study attempted to assess the serum levels of iron, zinc and copper during normal pregnancy particularly in the third trimester. Moreover, to find out if there is a significant correlation between anemia (if indicated) and other micronutrients such as zinc and copper.

MATERIALS AND METHODS

This cross sectional study was conducted in January - August 2018. A total of 80 outpatient pregnant women at the third trimester of pregnancy were recruited to Duhok Delivery Hospital in Duhok where they underwent clinical examination by a specialized gynecologist. The participants were divided in to two groups and each group consists of 40 pregnant women at their third trimester. The study group consists of women who did not take iron and folic acid supplements whereas the control group represented pregnant women who took iron and folic acid supplements (iron and folic acid supplements (400 µg/day). Case history as well as all necessary preliminary data and physical examination were taken from each recruited participant including height, weight and body mass index (BMI). Upon obtaining their consent a 5 ml of venous blood was taken from each participant for performing laboratory examination. Each blood sample was divided into two parts; whole blood which was put in EDTA tube for hematological tests and serum for performing the biochemical investigations.

The whole blood sample (EDTA tube) was used for measurement of complete blood count by automated blood cell counter (coulter machine, Roche). Serum iron levels were assayed manually by commercial kits using spectrophotometric method (Biolab, France). Both zinc and copper were assayed using atomic absorption method at the Scientific Research Center, College of Science/ University of Duhok.

Statistical analysis for all study variables was done using SPSS version 18 (Chicago, USA). All variables were expressed as mean ± standard deviation (SD). Both independent t-test and Chi square tests were used to determine the statistical significance of difference in mean between study groups, p values of 0.05 or less were considered statistically significant.

RESULTS

Study group had a mean age of 32 years and body mass index (BMI) of 38 kg/m² whereas the control subjects had the mean age of 29 years with a BMI of 36 kg/m². Concerning age and BMI variables, no statistically significant differences were detected between both groups (Table 1).

Table (1): Basic characteristics of study groups

Parameters	Study subjects (No. = 40)	Control subjects (No. = 40)	p value
Age (years)	32 ± 3.61	29 ± 3.82	> 0.05
Body Mass Index (BMI kg/m²)	38.12 ± 3.14	36.8 ± 3.42	> 0.05
No. of iron takers	0	40	NA

Regarding hematological parameters, hemoglobin (Hb) showed lower values in study subjects compared with controls but it was statistically not significant. In addition; no significant differences were seen in packed cell volume (PCV) and mean cell hemoglobin concentration (MCHC) variables between the groups (p = > 0.05). Both mean cell volume (MCV) and mean cell hemoglobin (MCH) displayed a statistically significant difference in study subjects compared to control (p = 0.02 and p = 0.03) respectively (Table 2).

Table (2): hematological parameters among study groups

Parameters	Study subjects (No. = 40)	Control subjects (No. = 40)	p value
Hb. (g/dl)	10.9 ± 3.37	12.3 ± 2.85	> 0.05
PCV (%)	33.84 ± 4.52	39.04 ± 2.18	> 0.05
MCV (fL)	78.53 ± 5.32	92.51 ± 4.63	0.02
MCH (Pg)	28.14 ± 5.62	31.25 ± 6.92	0.03
MCHC (g/dl)	32.92 ± 3.76	31.53 ± 3.84	> 0.05

Mean serum iron level was statistically significantly lower in study subjects compared with controls (p = 0.01). Moreover, mean serum zinc concentration displayed a highly statistically significantly lower value in study subjects compared to controls (p < 0.0001). However, mean serum copper levels were slightly lower in study group but did not show any statistically significant difference (Table 3).

Table (3): serum trace element levels in study groups

Parameters	Study subjects (No. = 40)	Control subjects (No. = 40)	p value
Iron (µg/dL)	69.81 ± 6.71	82.33 ± 7.64	0.01
Zinc (µg/dL)	67.24 ± 10.42	91.15 ± 10.61	< 0.0001
Copper (µg /dL)	94.86 ± 23.81	98.51 ± 19.69	> 0.05

Table 4 represents respectively the number and percentage of both study groups who have iron deficiency, zinc deficiency (hypozincemia) and copper deficiency (hypocuppremia). Based on their normal reference values, serum iron of less than (70 µg/dL) is considered deficiency and the same is applied for zinc and copper. Among study group, 26 participants (65%) had iron deficiency anemia versus 3 control subjects (7.5%). Regarding zinc deficiency, 29 subjects (72.5%) were recorded as hypozincemic vs. 2 control subjects (5%). However, no subject was considered hypocuppremic in both groups.

Table (4): Number and percentage of study participants with trace elements deficiency

Parameters	Study subjects (No. = 40)	Control subjects (No. = 40)
Number and % of individuals with Iron deficiency	26 (65 %)	3 (7.5%)
Number and % of individuals with Zinc deficiency	29 (72.5%)	2 (5%)
Number and % of individuals with Copper deficiency	0 (0%)	0 (0%)

Pearson's correlation coefficient was used to determine correlation between variables. We attempted to determine the correlation coefficient between iron with zinc and copper as well as iron with other hematological parameters (Hb, PCV, MCV, MCH and MCHC) respectively. Although there was an obvious positive correlation between serum iron with zinc and copper and iron with hematological variables, none of them showed a statistically significant correlation (Table 5).

Table (5): Pearson's correlation coefficient between iron and other variables.

Variables	*r* value	*p* value
Iron – Zinc	0.124	> 0.05
Iron – Copper	0.106	> 0.05
Iron – Hb	0.102	> 0.05
Iron – PCV	0.08	> 0.05
Iron – MCV	0.02	> 0.05
Iron – MCH	0.1	> 0.05
Iron – MCHC	0.108	> 0.05

DISCUSSION

Despite the fact that the prevalence of anemia in women during pregnancy is well documented in previous literature, we attempted to strictly emphasize on the alterations in micronutrient levels that taken place particularly during the third trimester. In addition to evaluating the serum iron levels, we had the opportunity to examine both important trace elements; zinc and iron. Based on our results, it can be clearly seen that the blood indices (MCV and MCH) of study subjects were significantly lower which provides a clue that they have hypochromic microcytic anemia. Such results are supported by previous studies indicating that the iron deficiency anemia is predominantly exist in pregnancy as a result of many factors (12) which would be explained later.

It was important to have a direct clue about the iron status of study recruits to know whether they are anemic or not. As expected, the serum iron levels were statistically significantly reduced in study subjects compared with controls and the majority of them were shown anemic. This is well documented in previous studies concluding that iron deficiency is considered one of the common manifestations that exist during pregnancy and particularly the third trimester (13). It is important to know the mechanisms underlying significant reduction of serum iron levels. Firstly, during pregnancy there is a high metabolic requirement by mother and this is represented by increased iron consumption by the developing fetus and placenta. Secondly, blood volume expansion significantly increases the iron requirement during pregnancy i.e. blood volume augments fast in pregnant women and their fetuses. The body requires a large amount of iron for the synthesis of hemoglobin. Iron deficiency can cause anemia, decreasing the capacity of carrying the oxygen by hemoglobin, resulting in chronic lack of oxygen in other tissues and fetus (14). As a result of inadequate intake of iron, iron deficiency or anemia will directly affect fetal growth and development. In addition; inadequate iron intake or a diet which express poor concentrations of iron seems to be responsible for the majority of deficiency in mothers during pregnancy (15).

Zinc which is an important micronutrient that plays an essential role in a variety of metabolic processes promoting growth and development, was also examined to clarify its role in pregnancy. Interestingly, serum zinc levels were significantly reduced in study group compared to control subjects. Although previous studies concluded that there is a significant correlation between iron and zinc deficiency, in current results we didn't record any significant correlation. These results are in concordance with previous research concluding that Hypozincemia was observed in

anemic pregnancy supplemented with weekly and daily iron and folic acid tabs respectively which provides a clear evidence of altered micronutrients levels during pregnancy (16, 17). It is important to know how zinc deficiency affects iron. It is important to clarify the possible mechanism underlying the association of zinc deficiency on iron levels. Current results support the idea that one of the effects of zinc deficiency is loss of appetite which in turns results in low diet intake especially rich in iron which subsequently leads to iron deficiency (18,19,20).

Copper was also assessed in this study to examine its possible association with iron and zinc. There was no significant differences between both groups. Although there was a trend towards a correlation between serum copper and iron levels but was statistically not significant. The possible mechanism that explain the relation between copper and iron is that copper is usually associated with ceruloplasmin which acts as a ferrioxidase which convert Fe+2 to Fe+3 and stimulate iron efflux from the liver (21, 22). In pregnancy, the metabolism of copper and iron are correlated with each other and the deficiency of one has noticeable effects on the metabolism of the other micronutrient. In pregnant women, iron deficiency results in increased liver copper levels, which is associated with increased both serum copper and ceruloplasmin activity in maternal serum (23, 24).

Despite respectable efforts have been done to conduct this study, there are possible limitations that should have been done. The sample size was small compared with the nature of this study which is due to the fact that convincing recruiters to participate in this study was challenging. Assessment of pregnancy outcomes is another essential part of the study that should have been conducted. This was due to the lack of patient's commitment and follow up after delivery in addition to unavailability of a computerized database which allow researchers to follow up their study participants. Future studies should keep such points in mind and attempt to minimize the limitations to a minimum extent.

In conclusion, based on the results of the current study, maternal anemia still remains an important issue which may be associated with zinc deficiency although the correlation was not significant. It is recommended that more education should be provided to pregnant women regarding adequate intake of iron and zinc supplementation and trace metals rich diet during pregnancy in order to prevent adverse pregnancy outcomes.

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