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Laboratory Evalation of Iron Deficiency Animia in Pregnant Women in Diyala –Iraq

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Abstract: ***Anemia has multiple and varied causes, some of which known as Iron Deficiency Anemia (IDA) especially for women during the pregnancy period. The aims this study are determination of serum Iron and (Mn, Mg, Ca, Na and k) levels in a pregnant women's suffering from IDA,study the correlation of these metals to IDA . Seventy-five women with mean age 27.6years, 25pregnant women with normal pregnancy condition and suffering from IDA as a comparative group of pregnancy. Serum iron level decreased in pregnant mother with IDA of pregnancy. Serum copper level was increased in healthy pregnant women compared with healthy non-pregnant group. Reduction in serum level of magnesium, manganese, calcium, and potassium of pregnant women with IDA. The findings indicated that the levels of the elements studied were affected (increase or reduction) by the state of IDA in pregnant woman, especially copper. Therefore, these elements could be used as laboratory markers for assessment of IDA during the pregnancy period.***

Keywords: Iron Deficiency , trace elements ,Anemia, pregnancy,Iraq

1. Introduction

Iron(Fe),Magnesium(Mg),Manganese(Mn),Calcium(Ca),Sodium(Na),andPotassium(K).although present in minute amounts in the body,are essential nutrients.Even after identification, shortcomings of the methods available for their analysis together with a failure to recognize their importance led to their designation as the trace elements Concentrations of minerals must usually maintained within quite narrow limits if the functional and structural integrity of the tissue is to be maintained .Ingestion of diet that are that are deficient, imbalances, or excessively high in trace minerals may induce changes in the form or concentration of the particular trace minerals in body tissues and fluids, so that it falls below or rises develop, physiological functions may be adversely affected, and structural disorders may arise.They perform functions indispensable to maintenance of live,growth and reproduction.An inadequate intake of trace minerals impairs cellular and physiological function, causes illness and many interfere with vital functions, toxicity and imbalances require the body to metabolically compensate for the nutrient deviation[(1)].Trace minerals are necessary for normal pregnancy.Anemia of pregnancy is extremely common in developing countries. Most common type of anemia in pregnancy is thought to be due to iron deficiency. Abnormal trace mineral concentration in woman has been associated with a number of maternal complications during pregnancy.These include anorexia,a tonic bleeding, missed abortion and pica[(2)].In no one of the studies available so far, especially in Iraq. have the values of serum iron, copper,magnesium, manganese, calcium, sodium and potassium in pregnant anemic woman been determined, compared with their values during normal pregnancy[(3)].Mechanisms, which are ensure optimal body distribution of a system of homeostatic regulation for that elements, and include absorption,storage, and excretion. Although many details of trace elements absorption processes are still unknown but rate of absorption of a trace elements decreases with its increasing concentration in the trace intestinal lumen[(4)].An overabundance of one trace element can interfere with the metabolic utilization of another element present in-normal or marginal concentrations[(5)].Alternatively. The effect of a toxic trace element may be ameliorated by another "protective" trace element[(6)].The addition of large amounts of zinc to a diet interferes with the intestinal copper absorption system.Resulting in copper deficiency in spite of an otherwise adequate copper intake. Hence, copper deficiency, in trace, is known to provoke iron deficiency and anemia[(7)].Hemoglobin has many important function in the body.Its major role in oxygen transport to the tissues and CO_2 transport back to the lunges. It is also one of the major buffering systems of the body.and as a pair of polypeptide chains each chain has a heme attached near center, therefore, molecular hemoglobin has four heme groups and carries four O_2 molecules (HbO_2)[(8)].The heme consists of an organic part and an iron atom.The organic part, protoporphyrin, is made up of four pyrrole rings.The four pyrroles are linked by methane bridges to form a tetrapyrrole ring. Four methyl, two vinyl, and two propionate side chains are attached.The iron atom in heme binds to the four nitrogen in the center of the protoporphyrin ring. The iron can form two additional bonds, one on either side of the heme plane.Onlyferrohemoglobin, the +2 oxadation state, can bind oxygenthe α and β Subunits of hemoglobin have the same structural design as myoglobin while fetuses have their pwn kind of hemoglobin, called hemoglobin F(α_2,γ_2),)which differ from adult hemoglobin A(α_2,β_2)[(9)].An important property of hemoglobin F is that it has a higher oxygen affinity under physiological conditions than does hemoglobin A. the higher oxygen affinity of fetal blood was knowen for many years.[(10)].Iron metabolism: the total iron content of the adult is approximately 55 mg/kg body weight, or about 4 gm in a 70 kg man.(JAMA1968).recommended daily intake of iron is10-20mg for females[(11,12)].Pregnancy is another physiological state affecting the bioavailability of iron, which increases roughly parallel to the increase in iron requirements the pH levels is crucial in any attempt to stimulate gastrointestinal of food iron[(13)].There are many factors that enhance iron absorption such as cellular protein red meat, sugars, and ascorbic acid.Vitamin C aids in the transfer of iron form Ferritin[(14,15)].Factors that inhibit iron absorption include calcium, which diminished the absorption of ferrous and ferric iron(an individual consuming a high calcium diet could develop iron deficiency anaemia[(16)].They also include

certain complexing agents such as oxalate, phytat ,phosphoprotien and fibers[17].Taannins in tea and polyphenol compounds in coffee[18]. In woman the mean monthly menstrual loss of iron is about 16mg and the average is 0.5mg/day. It can be higher in those with menorrhagia that becomes iron-deficient.During pregnancy the mean extra daily loss to the fetus and placenta is about1.5mg[19].The interactions between trace minerals, immunology, and disease resistance are extremely complex. From the more basic molecular immune research it is clear that trace minerals play an important role in the immune response.There are many factors that could affect a body's response to trace minerals supplementation such as the duration and concentration of trace minerals supplementation, physiological status of a body(pregnant) the absence or present of dietary antagonists, environmental factors,and the stress on trace mineral metabolism. Their presence was long overlooked and it has only been in recent years that analytical techniques capable of measuring such trace levels were developed. This elements perform functions indispensable to maintenance of life,growth and reproduction[20].

Aim of Study

The purpose of this study It is hoped that this information will add to the general knowledge of the metabolism of Iron in woman and thereby help in the eventual evolution of the role Iron and other elements alone or may play in disease. To determine if there is any significant difference in the hematological and elements profile in blood of pregnant woman.

2. Materials and Methods

1. Materails and Subject:
This study was conducted the period from the 1st of Feb.2014 till the end of June 2014, the study group consisted 75 woman. It was decided to carry out the study in Al-Ebtehal commercial laboratory in Baquba city/Diyala governorant.The subjects comprised three groups:

Group I (Non-pregnant control): this group consisted of 25 healthy non pregnant volunteer's woman all in the childbearing age, with a mean±SD age, and range of 27.6 yrs.Full history and complete examination evaluated them. None of them had clinical or laboratory evidence of a disease that would affect the parameters to be measured.

Group II (pregnant control):this group consisted of 25 healthy normal pregnant females, with no adverse medical or obstetric history, which did not require any medication.

GroupIIIP-IDA(pregnant woman with Iron Deficiency Anemia**):**25 pregnant women suffering from iron deficiency anemia were chosen. Woman suffering from other types of anemia were excluded from this study.None of the patients were on any medication or trace elements supplementation;thepatient was diagnosed depending on their clinical history,hemoglobin concentration was<11gm/dl and decreased serum iron levels below the normal value. The duration of pregnancy was assessed to the nearest complete month.

Blood Samples

About 5 ml of venous blood was drawn the cubital vein by using disposable needles and syringes. In all the cases, blood sample were collected between10-11a-m**.**Approximately two hours after the latest meal to avoid diurnal variation. Blood sample was put in a clean dry plain tube and was allowed to clot at 37^0C for 25 minutes before centrifugation. The serum obtained was used for estimation of serum iron, and other minerals Concentrations in serum (Cu,Mg,Mn,Na,Ca and Na). The unheparinized blood samples were centrifuged at 3000rpm for 15 minutes. The clear serum was transferred to clean plastic tubes by disposable syringes. The tubes were topped by plastic stoppers and stored at-20^0Ctill the time of analysis. Serum iron levels(SIC),serum Cupper Conc.(SCuC),Serum Magnesium levels(SMgC),Serum Manganese Conc.(SMnC), Serum Sodium Conc.(SNaC),Serum Potassium Conc.(SkC),Serum calcium Conc.(SCaC).Were estimated using a Kits of Iron, Cupper,Magnesium, Manganese, Sodium, Potassium,Calcium were purchased from Biolab company(Spanish).HemoglobinLevels(HbL) was measured by using cyanomethaemoglobinometry.The Level of Hb was estimated after accurate dilution of blood in a solution that converts Hb to cyanommethaemoglobin,which is then quantitated specrophotometrically,It was expressed in gm/100ml(gm/dl)l.

Statistical Analysis t-test (unpaired) was used to examine the significance of the difference in the mean of the parameter between two groups. Person correlation coefficient(r)was used to test the relation between two variables within the same group.

3. Results

Group I(Non- pregnant controls)
The levels of serum Iron, Cupper, Magnesium, Manganese, Calcium, Sodium, Potassium, and Hemoglobin have been studied. The mean values, standard deviation of the mean of all parameters investigated in this group are shown in(Table I).

Group II(pregnant controls)
During pregnancy some parameters have been studied in order to detect anemia: hemoglobin, iron in the serum, concentration of pregnant women (group II) have been measured (Table1).

SIC:The normal range of SIC is(8.95-30.43) μ mol/l[21].In the present study, mean value of 25 normal non pregnant controls is 18.01 ±6.21(Table1). In the SIC is significantly lowered than in group I. And the Deference is statistically significant(P<0.001)(Table3).In-group II as a whole regardless of the periods of gestation, SICis significantly lower than that in group I (P<0.001)(Table3).**HbL:**Hemoglobin, haematocrit, and mean corpuscular haemoglobin concentration were evaluated. The hemoglobin was decreased from 129.5±10.3 in group 1 to 111.9±7.15 in group II as a whole group (Table1).A paralleled variation in HbL in group II were found, the difference was also significant(P<0.001).Generally, HbL in group II as a whole was statistically lower compared with that in group

I(P<0.001)(Table3).In group II a significant positive correlation was found between HbL and SMgC, SKC and a significant negative correlation with group I (P<0.05) (Table3).**SCuC**:It is well known that the normal range of SCuC is(18.53–47.41 μ mol/l)[21].In the present study, in group I the mean was24.3±4.97 μ mol/l(Table1).Whereas in group II as a whole was 28.00±4.97 μ mol/l.(Table1).The means of SCuC were 25.265 μ mol/l corresponding to the group II.SCuC is significantly lower in group II there were no significant differences compared with that in group I,(Table1).In the pregnant control group as a whole, SCuC was higher than that in the group I(Table 2),but The difference is not significant.

SMnC: The normal range of SMnC is(0.091 μ mol/l)[21].In non pregnant controls group I, SMnC was found to be 0.103±0.01(Table 1).Whereas in the pregnant women group II as a whole group, the mean of SMnC was 0.1004±0.01.A significant changes were observed in the SMnC of the two groups.**SNaC**:The normal ranges for serum Na reported are about 134-159 mmol/l[21]: In group I was 137.4±7.06 mmole/l(Table 1),whereas in group II as a whole the mean was140.47±13.75mmol/l(Table2).Means of SNaC were 138.043±14.073.In group I SNaC is slightly lower than that in group II as a whole group,but the difference is not significant(Table3).A significant positive correlation was found between SNaC and(SIC,SCuC and SMgC)in groupII(p<0.01).**SKC**:A compromise of the reported normal ranges of SKC is (3.5-5.3mmol/l)[21].in the present study: In group I was 4.10±0.8 mmol/l(Table1).whereas in group II as a whole the mean was 4.07±1.17mmol/l(Table1).Means of SKC were 4.213±1.111.very high significant positive correlation between SKC and (SIC, HbL,SCaC and a very high negative correlation between SKC and (SCuC, SNaC, and Age)was also found(P<0.001)(Table3),**SCaC**:The normal range of SCaC is(2.1-2.6mmol/l)[21].In the present study:IngroupI the mean was 2.21±0.33mol/L(Table1,2)whereas in groupII as a whole the mean was 1.77±0.53mmol/L(Table1).Means of SCaC were1.884±0.58 corresponding to the of groupII.IngroupII as a whole,regardless of the periods of gestation,SCaC.Is significantly lower than in groupI(P<0.001)(Table 3).Acomparison of groupII shows that SCaC was lower in groupI.

3Group III(P-IDA)

In the present study, the concentrations of serum iron, copper, magnesium, manganese, sodium, potassium, calcium, and hemoglobin have been studied.The mean values, standard deviation of the mean of all parameters investigated in this group are shown in(Table 2).

SIC: In group I the mean was 9.60±0.321mol/L,SIC is significantly lower, in the groupIII (P-IDA) than in the corresponding of the pregnant control group, (P<0.001).In group III (P-IDA) as a whole, SIC is significantly lower, compared with group II(P<0.001) (Table 4).

HbL: HbL of group III(P-IDA),the mean was 8.79±10.6mol/L (Table1,2)are significantly lower than those in corresponding in group II(p<0.001),(Table2).In group III(P-IDA)as whole regardless of the periods of gestation HbL are significantly lower than in groupII(p<0.01).(Table 4).A comparison between the groupIII(P-IDA),shows that HbL is higher, and difference is significant(p<0.005).

SCuC: In group III the mean was 33.01±0.33mol/L(Table2) SCuC is significantly higher in the group III (P-IDA) Compared with the corresponding in group II(p<0.01).(Table 2).Also in group III(P-IDA) as a whole regardless of the periods of pregnancy,SCuC is significantly higher compared with those in group II(P<0.001)(Table 4).

SMgC:SMgC is significant lower, of group III (P-IDA) than in the corresponding of the pregnant control group,(P<0.001),SMgC is significantly lower, compared with groupII as awhole (p<0.001)(Table4).**SMnC:** SMnC is lower than in the group III(P-IDA) than in the corresponding of the pregnant control group but it is no significant .In group III as a whole group, SMnC is lower,compared with group II as a whole and also it is no significant(Table 2).A highly significant positive correlation was found between SMnC and SNaC(p<0.001).while a significant negative correlation was found between SMnC and SCuC(p<0.005),a significant positive correlation between SMnC, Age of pregnant women and a significant negative correlation between SMnC and HbL was observed (Table 4),**SNaC:**SNaC in group III(P-IDA) is higher than its level in the corresponding of group II(p<0.01)respectively(Tables 4).Also it is higher in group III as a whole compared with group II as a whole group(p<0.001)(Table 4**),SKC:**SKC in group III is lower than its level in the corresponding of group II(p<0.01),(Tables 4).Also comparison of group III shows that SKC is lower ,it is significant with(p<0.05),A significant negative correlation was found in the group III between SKC and SMgC and(p<0.05),and a significant positive correlation between SKC and HbL(p<0.05)(Table4).In thegroupIII(P-IDA)a significant negative correlation was found between SKC and the Age of pregnant women(Table 4).

SCaC: SCaC is lower, in the groupIII(P-IDA)than in corresponding of the pregnant control group and it is significant(P<0.001)(Tabl4).In groupIII as a whole group,SCaC is significantly lower, compared with groupII as a whole(P<0.01).(Tabl4) .A comparison between .A significant negative correlation between SCaC and SIC,in the groupIII was found(p<0.01)(Table 4).A significant positive correlation between SCaC and(SCuC,SKC)and a significant negative correlation between SCaC was found of groupIII(p<0.01)(Table 4).

Table 1: Comparison of all measured parameters between non- pregnant control (group I) and pregnant control (group II) as whole groups, (Data presented as Mean ± SD).

Parameters		*Non-pregnant control (n=25)*	*Pregnant control (n=25)*
SIC	**(μ mol/L)**	18.01±6.33	12.1±4.86***
HbC	**(g/L)**	129.5±10.3	111.9 ±7.15***
SCuC	**(μ mol/L)**	24.8±4.97	28.01±4.97
SMgC	**(mmol/L)**	0.90±0.03	0.89±0.05**
SMnC	**(μ mol/L)**	0.103±0.01	0.100 ±0.01***
SNaC	**(mmol/L)**	137.1±1.06	150.47±13.75
SKC	**(mmol/L)**	4.10±0.8	3.20±1.17

SCaC	**(mmol/L)**	2.21±0.33	1.73±0.53***

* : Signigicant Difference P <0.05 ** : Signigicant Difference P < 0.005 *** : Signigicant Difference P < 0.001

Table 2: Comparison of all measured parameters between pregnant control (group II) and P-IDA (group III) as whole groups,(Data presented as Mean ± SD)

Parameters		*Pregnant Control (n=25)*	*Pregnant -IDA (n=25)*
SIL	**(μ mol/L)**	12.1±4.86	9.60±3.21***
HbL	**(g/L)**	111.9 ±7.15	80.79 ±10.6***
SCuC	**(μ mol/L)**	28.01 ±4.97	33.00±13.82***
SMgC	**(mmol/L)**	0.89±0.05	0.80±0.21***
SMnC	**(μ mol/L)**	0.100 ±0.01	0.097 ±0.01
SNaC	**(mmol/L)**	150.47 ±13.75	150.03 ±13.94***
SKC	**(mmol/L)**	3.20±1.17	3.20 ±0.99***
SCaC	**(mmol/L)**	1.73±0.53	1.73 ±0.44*

* : Signigicant Difference P <0.05 ** : Signigicant Difference P < 0.005 *** : Signigicant Difference P < 0.001

Table3: Correlation coefficient matrix and significant levels for all parameters in pregnant controls.

Parameters	SIC	HbL	SCuC	SMgC	SMnC	SNaC	SKC	SCaC	Age
SIC	1.0	0.05**	0.12*	NS	0.18*	NS	NS	NS	0.29**
HbL		1.0	0.097***	NS	NS	0.15***	0.46*	NS	NS
ScuC			1.0	0.03*	0.28***	NS	NS	NS	0.18*
SMgC				1.0	NS	NS	NS	0.009***	NS
SMnC					1.0	NS	0.25*	NS	NS
SNaC						1.0	0.13	NS	NS
SKC							1.0	NS	NS
SCaC								1.0	NS
Age									1.0

NS:Non Significant *,Significant Differamce P< 0.05 ** ,Significant Differamce P< 0.005 ***, Significant Differamce P< 0.001

Table 4: Correlation coefficient matrix and significant levels for all parameters in P-IDA.

Parameters	*SIC*	*HbC*	*SCuC*	*SMgC*	*SMnC*	*SNaC*	*SKC*	*SCaC*	*Age*
SIC	1.0	0.27*	NS	-0.274*	NS	NS	NS	-0.25*	NS
HbL		1.0	NS	NS	NS	NS	0.5*	NS	NS
SCuC			1.0	NS	-0.5**	NS	NS	NS	NS
SMgC				1.0	NS	NS	-0.5*	NS	NS
SMnC					1.0	0.73***	NS	NS	NS
SNaC						1.0	NS	NS	NS
SKC							1.0	NS	NS
SCaC								1.0	NS
Age									1.0

NS:Non Significant *,Significant Differamce P< 0.05 ** ,Significant Differamce P< 0.005 ***, Significant Differamce P< 0.001

4. Discussion

Serum Iron Conc.(SIC)In Group I(Non-Pregnant Controls)

In the present study, mean value for SIC of 25 woman normal non-pregnant controls, shows lower values than those observed in the other reports. [22].These differences may be attributed to the fact that these parameters are subject to many variables, which may introduce substantial differences into these results. These parameters are influenced by many physiological states, such as diurnal variation, the techniques used for their determination in addition to the type of food intake in different geographical areas and socio-economical status of the people.

SIC in Group II(Pregnant Controls): In the present study there is a gradual decrease in the S1C the pregnant controls. The greatest changes occur very clear. These finding agree with the results observed by many other investigators [23].Also a slight gradual decrease in S1C during pregnancy reaching its lowest values. These findings are consistent with results found by other investigators. Also a gradual decrease in the SIC at the pregnant controls compared with that in the non-pregnant controls is observed. This too, agreement with previous studies[24].The present study shows that of pregnant controls, there is a difference in SIC compared with that in-group I(non-pregnant controls),but this difference is statistically non-significant.This difference may be attributed to the fact that the mother has sufficient iron reserves at the beginning of pregnancy[25]besides the iron demands during of pregnancy are actually lower than they are prior to pregnancy. A more marked decrease in the SIChas been found during thepregnant.This is mainly due to the expansion of blood volume and hemoglobin mass which normally begins at the beginning of the 2nd trimester and progresses almost linearly up to term. Also fetal demands for iron increases progressively. These finding confirm those made by other researchers**.** Other studies showed that elemental iron requirement increased from1.5 to 2mg/day up to 5to7mg/day with progresses of pregnant period. About half of this iron is needed for the increased maternal blood volume; the remainder is used for fetal and placental growth or is lost during the normal heightened excretion that is associated with pregnancy [26]**.**The erythroid activity starts early in pregnancy and may exhaust the iron stores before fetal demands for iron can be met .Another factor, which also affects the SIC,is that fetoplacental demand

deposition of iron increases markedly during the 3rd trimester [27].

SIC in GroupIII(P-IDA):Its consequent anemia are recognized as the most common specific nutrient deficiency in the world including Iraq[28].It is estimated that about2.15 billion people are iron deficient(WHO,1991),and41.5% of the women were found to be anemic Hb<11gm\dl[29],While on the basis of Hb<12 gm\dl,37%of the women were considered anemic.About 90% of all anemic cases are due to lack of iron, affecting mostly the developing world where nearly 1/3 of the population is iron deficient.Roughly,47% of non pregnant women and 60% of pregnant women are anemic worldwide[30],in the industrial world as a whole anemia prevalence during pregnancy oscillates between 9 and 14% for the same age-sex categories although the poor among these societies are more affected[26].ID defined as an insufficient supply of iron to the cells of the body after iron reserves have been exhausted, since this is a late manifestation of chronic ID[36].In the present study a lower SIC is found compared to their values in pregnant controls with haemodilution that occurs naturally. These observations agree with the previous studies.Alsoa marked progressive decrease in SIC during of this group has been observed, which is consistent with the finding of other investigators. This progressive decline in the SIC in P-IDA is attributed to the fact that the maternal and fetal demand for iron especially during of pregnancy are increased, mainly due to the expansion of blood volume which is physiological haematological adaptation which occurs during pregnancy[31].

HbL In-Group I: In the present study the non-pregnant control females exhibited mean values for HbL which are consistent with values reported in other developing countries[32].

HbL In-Group II:A study of 25 pregnant normal controls shows a minor decline in HbL in this group than in non-pregnant controls which accords with the observations made by other researchers[33]. Changes in HbL during group II were statistically non-significant,Over the past two decades considerable information has accumulated about anemia during pregnancy. The most interest in the context of anemia is the progressively falling level of HbL a particularly during the of pregnancy. During the course of pregnant controls several physiological adaptations normally take place[34].One of these is haematological adaptation, that during pregnancy blood volume beings to increase slowly early in the 1st trimester because of the expansion of the plasma volume and a reduction in circulating red cell mass which is reflected by low HbL[35]the increase in plasma volume is disproportionately greater than the increase in red cell mass which increased progressively throughout pregnancy, a physiologic dilution occurs which normally result in an absolute drop of 3 to 5% HbL during normal pregnancy.This is a normal "physiological or dilution anemia"of pregnancy, occurring in all women regardless of their previous iron nutrition[36].These cannot be thought as haematologic disorders but rather as disturbances in the regulation of the plasma volume. This type of anemia is also called relative anemia, which is characterized by normal total red cell mass[37] .The increase in the plasma volume is mainly hormonal because both oestrogens and aldosterone are greatly increased in the pregnancy. Also during pregnancy the bone marrow becomes increasingly active especially during the 3rd trimester and produces an excess of red blood cells,It has been found that the red blood cells are rich in both iron and zinc[36].

HbL In-GroupIII: In the present study there is a severe progressive decline of HbL of the P-IDA compared with that in pregnant controls which is in accordance with results observed by previous workers[31].The lowest values are found in the this group(P-IDA)compared to the pregnant control group and non-pregnant group.In the present study the superimposition of ferropenic anemia on the adaptive hematological changes results, as would be expected, in a limitation of red cell mass expansion and a more profound diminution of all hematological parameters when ID appears.In (1994),Viteri obtained similar results. The effect of haemodilution becomes more severe if the pregnant women have low iron stores[37].

Serum Copper Conc.(SCuC) in GroupI: In the non-pregnant women of childbearing age, the mean value for the SCuC varies from one report to another. In the present work the non-pregnant healthy, normal menstruating women in childbearing age exhibited a mean SCuC of 146.27±5.88 µg/100ml, which confirms the values reported by some investigators [40], these differences in the SCuC may be attributed to the different techniques used as well as to the social and nutritional status, and to the time of blood collection, since SCuC has a diurnal variation with peak levels in the morning[41].

SCuC in GroupII(pregnant controls):The healthy pregnant control in the present study showed a significant increase in SCuC compared to non-pregnant control. This is in agreement with previous studies[42].The exact mechanism responsible for the increase in the SCuC in pregnant controls is not clearly understood. One of the main possibilities for hypercupreamia during gestation is the increase in the production of hormones by the placenta particularly oestrogens[43].So raised SCuC might therefore, copper accumulation caused by a failure of biliary excretion of excess copper. In the present study, a significant negative correlation is found between SCuC and HbL in the pregnant controls. So hypercupraemia may be due to decreased HbL in the whole blood[44].Copper has a catalytic action on the synthesis of haemoglobin and in the production of the erythrocytes. Because of its biocatalytic properties on the cell, it also plays an important role in the processes of growing, It has been postulated that copper is essential for the red blood cells or the release of erythrocyte from bonemarrow. Copper is also an essentail factor for the synthesis of haemoglobin but it is not included in the structure of the haemoglobine molecule. This means that copper is of great importance in the defensive reactions of organism by producing specific antibody. Finally the physiological stress of pregnancy causes a marked elevation of the blood copper content [45].

(SCuC)in Group III(P-IDA): In the present study the SCuC in p-IDA is markedly elevated compared with the pregnant controls of the same gestational period. Also pregnant women with IDA show a progressive elevation in SCuC in this grop .Certain biochemical and haematological changes in blood occur in IDA and the interpretation of

such changes should attract the attention of biochemists and haematologists in particular as well as researchers atlarge. It is well known that plasma proteins including Caeruloplasmin play a significant role in a number of disease processes. Abnormal values of these different protein fractions could either be a cause or the effect of a disease.on different protein fractions have upset many time-honourd concepts and have brought to the forefront a number of aspects of diseases in medicine which were in the dark till recently. The changes in Caeruloplasmin and copper values may be related to a complicated mechanism regarding the role of copper and caeruloplasmin in iron metabolism[46].

Serum Magnesium Conc.(SMgC)in Group I: The normal value for SMgC in the non-pregnant healthy women varies from one report to another[47].In the present study the control non-pregnant women of childbearing age exhibited SMgC with a mean of 2.38±0.03 mg/dL. This agrees with the values reported from other developing countries[48].However, the mean value for SMgC in this study is higher than the mean values in the literatures from western countries[49].This may be attributed to dietary habits prevailing in these countries as well as to the social and nutritional status and to the time of blood collection as well as to different techniques used.

SMgC in Group II(pregnant controls): In the present work, a progressive reduction in maternal SMgC with increasing gestational age is observed compared to non-pregnant control group, which confirm the observations of other workers [49].A decline in SMgC begins early in pregnancy and the greatest decrease is observed in the pregnancy, but the difference is not significant.Several physiological factors may contribute to the decrease in SMgC during pregnancy. The results of the present study reveal a negative correlation between Mg and Cu.A negative correlation was observed between birth weight and Mg levels in maternal[50].The results of this study show a significant positive correlation between SMgC-SIC,SKC,HbL,while a significant negative correlation between SMgC- SCuC, SMnC and SNaC was observed. The role of Magnesium in biological processes has not yet been clearly established; the exact mechanism responsible for the decrease in SMgC in pregnant controls is not clearly understood.This is essential for the continuation of the pregnancy [51].

SMgCin group III(P- IDA): In the present study, it is found that SMgC severely declines in the P- IDA compared with the pregnant controls of the same gestational period. Also pregnant women with IDA show a progressive decrease in SMgC in this group. In the present study a significant direct relationship is found between SMgC and SKC in the P-IDA. The cause of the gradual fall in SMgC found in this study must be sought among several possible mechanisms, gradual haemodilution or plasma volume expansion normally occurs as a normal physiological adaptation during pregnancy.

Serum Manganese Conc.(SMnC) in GroupI: In the present study the non- pregnant control exhibited a mean SMnC of(0.577±0.02)mg/dL which confirms the normal values reported by some investigatorThis is the first time such a finding has been made and to the best of my knowledge,it has not been previously reported,but these results could be compared more favorably with the values in other developing countries than with the values of western countries, this may be attributed to dietary habits prevailing in these countries. Many Asians including Iraqi's continue to eat their traditional diets based on cereal, pulse, nuts grains, coffee and tea. In addition to food, Mn toxicity in humans is confined to industrial exposure[52].

SMnC in group II:The healthy pregnant controls in the present study showed a minor decline in SMnC in the group II than in non- pregnant controls. there is a slight decrease in the SMnC in contrast with the non- pregnant controls. The decrease was continues throughout the gestation. Mn is essential for lipid and carbohydrate metabolism, bone and tissue formation, and reproductive processes. It appears to be closely linked to iron absorption in the gastrointestinal tract, with excretion occurring mainly through the bile [53].

SMnC In-Group III(P- IDA):In the present work, it is found that SMnC severely declines in the P- IDA compared with the pregnant controls as a whole groups, and the different is significant. Also pregnant women with IDA show a progressive reduction in SMnC with the significant lowest value at thegroup. In the present study, A highly significant negative correlation is found between SMnC–SCuC,SCu/Zn ratio and SNaC at the P-IDA. A highly significant negative correlation is found between SMnC at the P-IDA.

Serum Sodium Conc.(SNaC) in group I: The normal value for SNaC in the non-pregnant healthy women varies from one report to another[258].In the present study the control non- pregnant women of childbearing age exhibited SNaC with a mean of 399.71±3.17mg/dl which inconsistent with other reports from abroad.Some of these investigators observed SNaC as Low as 155mg/dl[54].However, the mean SNaC in this study is consistent with reports from other developing countries[55]These differences in the SNaC may be attributed to the different techniques used as well as to the social and nutritional status and to the time of blood collection. However, the mean value for SNaC in this study is higher than the mean values in the literatures from western countries,but these results could be compared more favorably with the values reported in other developing countries as Iran,Egypt,andKuwait,thishypernatemia may be attributed to dietary habits prevailing in these countries.

SNaC in group II(pregnant controls): The healthy pregnant controls in the present study showed an increase in SNaC compared to non- pregnantcontrols. But this elevation is not significant.The rise in SNaC was continues through the gestation [56].Results of this study show that"among pregnant control group, the maternal SNaC is more than that of non- pregnant control women.A significant positive correlation between SNaC-SIC and SMgC,a highly significant positive correlation between SNaC-SCuC and Cu/Zn ratio is observed at this group in the present study. The exact mechanism responsible for the increase in the SNaC in pregnant controls can be related to Renin. Renin is a proteolytic enzyme secreted by the juxta glomerular apparatus, Its secretion is stimulated by decreased blood pressure in the afferent arterioles in the kidney.It also increases the blood pressure, turning off the reninangiotensin

stimulus by a feedback mechanism[56].Dietary deficiency of Mg^{2+}results in loss of cellular $K^{+}$and gain of cellular Na^{+} and calcium cations [57.58].

SNaC in GroupIII(P-IDA): In the present study the SNaC in P-IDA is markedly elevated compared with the pregnant controls of the same gestational period. In the present study, a highly significant direct relationship is found between SNaC and SMnC in the P-IDA, while a significant negative relationship is found between SNaC and SZnC at the this group, and a highly significant direct relationship is found between SNaC SCuC in the P-IDA.

Serum potassium Conc.(SKC) in group I: In the present work, the normal value for SKC in the non–pregnant 14.88±0.73mg/dl,which confirms the values reported by some investigators[59].but is inconsistent with other reports from abroad.These differences in the SKC may be attributed to the social and nutritional status and to dietary habits prevailing in Iraq & other countries. In addition to food, other factors may cause differences in the SKC such as the source of water supply,geographical location and socioeconomic and racial status, and temperature[60].a progressive reduction in maternal SKC with increasing gestational age is observed compared to non- pregnant control group, which confirm the observations of other workers[61]

SNaC in Group II: In the present work**.** A decline in SNaC begins early in pregnant and the greatest decrease is observed in pregnancy. Several physiological factors may contribute to the decrease in SKC during pregnancy. One of such factors may be the increase in SKC. In the present study a significant direct relationship is found between SKC and HbL.A significant inverse relationship is found between SKC and SCuC in the of normal pregnancy.SKC showed a progressive decline while SNaC showed elevation with increasing gestational age.This agrees with the findings of previous workers[62]**,**In the Group II, a highly significant positive correlation is found between SKC,SIC,HbL and SCaC, while a highly significant negative correlation is found between SKC-SCuC and SnaC. The most important of these is kidney function. There is no renal threshold for potassium; therefore, the 80 to 200mmol consumed daily may be effectively excreted by the distal tubules [21].

SKC in Group III(P-IDA):In the present work, it is found that SKC severely declines in the P-IDA.One of these consequences of this hypokalemia is hypernatremia. It is known that there is an inverse relationship between SKC and SNaC[62]In the present study, the SKC is markedly declines compared with pregnant controls of the same gestational period. Also pregnant with IDA show a progressive reduction in SKC.

Serum Calcium Conc.(SCaC) in Group 1(Non pregnant Controls): The normal value for SCaC in the non- pregnant healthy women varies from one report to another**.** In the present study the control women of childbearing age exhibited SCaC with a mean7.56±0.44mg/dL.The mean value for SCaC in this study is lower than the mean values in the literatures[63].But these results could be compared more favorably with the values reported in other developing countries. This calcium deficiency may be attributed to dietary habit prevailing in these countries. Many Asians including Iraqi's continue to eat either traditional diet based on cereal and pulse.This kind of diet with its low minerals (including calcium).

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