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Elemental Status of Pregnant and Lactating Women in Bassa L.G.A of Plateau State, Nigeria

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Abstract: The present study has determined the serum levels of ten elements (sodium, potassium, magnesium, calcium, zinc, copper, iron, manganese, phosphorus and chloride) in the three trimesters of pregnancy and in lactation. Four hundred and thirty two apparently healthy pregnant, lactating and non-pregnant/non-lactating (control) women participated in the study. Atomic absorption spectrophotometric method was used for the analysis of some of the elements. The determination of inorganic phosphate was carried out by phosphomolybdic acid method, while the level of chloride was measured by the mercuric nitrate method. Our results showed that the serum sodium levels in pregnancy were significantly higher than the levels obtained in their control counterpart and in lactation ($p<0.05$). In the same vein, the levels of calcium determine from the pregnant groups were higher than that from the lactating group ($p<0.05$). On the other hand the level of zinc in the lactating group was higher than those in the rest groups ($p<0.05$). The estimated levels of iron (in all the groups) were within the literature range and there was no significant difference between them ($p<0.05$). This study has established the normal levels of ten serum elements in pregnancy and lactation for indigenes of Bassa L.G.A of Plateau state. Base-line nutritional status of this sort is helpful in guarding against mineral deficiency/overload in the course of management of antenatal and postnatal women in Bassa areas.

Key words: Serum, elements, pregnant, lactating, women

INTRODUCTION

Women are often more vulnerable to malnutrition than their male counterparts. This is particularly so in the developing countries where the larger population of the unemployed are women (Jacobs, 2000; Onimawo, 2001). Few of them who are employed have low per capita income and that in the face of worsening food crisis. The vulnerability of women to malnutrition is heightened during conditions of pregnancy and lactation, periods which are characterized by increased nutritional needs. These nutritional needs include, apart from energy and protein, the requirement for micronutrients (minerals and vitamins), without which important metabolic pathways will be undermined. Among the essential mineral elements often required are Iron (Fe) and Calcium (Ca). Others are Zinc (Zn), Copper (Cu), Magnesium (Mg), Manganese (Mn), Phosphorus (P), Potassium (K), Chlorine (Cl) and Sodium (Na), (Onimawo, 2001).

The present study has estimated serum levels of some mineral elements for the purpose of establishing the mineral status in pregnancy and lactation for women living in Bassa L.G.A of plateau state. It is hoped that the knowledge of their mineral status will be helpful in guarding against mineral deficiency/overload in the course of management, so as to ensure a better pregnancy course and a successful lactation.

MATERIALS AND METHODS

The subjects who participated in the present study were women attending antenatal, post natal and out-patient clinics in the Medical Centres in Bassa LGA of Plateau state. In the selection of subjects the procedures followed were in accordance with the ethnical standards of the institutions. Subjects were admitted into the study after obtaining their informed consent, being clinically examined and certified healthy (for the purpose of this study) by the physician. Those who showed signs of pyrexia, anaemia, diabetes, oedema, diarrhea, malaria, hypertension or suffering from sickle cell disease were excluded. A total of 500 subjects were expected to participate in the study but only 432 of them gave their full co-operation. Out of this number, 100 were in the lactating group, while 232 were in the pregnant groups (the 1st, 2nd and 3rd trimesters pregnant groups). Lastly 100 of them were the non pregnant/non lactating women which constitute the control group.

Collection of serum samples: About 5 ml of blood was obtained from each subject by peripheral venopuncture using a sterile disposable syringe and needle. The blood was gently transferred, after removing the needle (so as to avoid haemolysis), into a clean dry labeled centrifuge tube. It was allowed to clot for about 30 min at room temperature, then gently ringed and centrifuged to

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obtain the serum. Each serum sample was properly labeled and stored at -5°C till required for analysis.

Biochemical analysis: Determination of Na, K, Mg, Ca, Zn, Fe, in diluted serum were carried out by flame technique of Pye Unicam SPG and Hitachi model 150-80 polarized Zeeman automatic atomic absorption spectrophotometer. Flameless method was used for Cu, Mn and Pb.

The estimation of inorganic phosphate was by ammonium phosphomolybdic acid method (AOAC, 1980). Chloride was measured by the mercuric nitrate method as explained by Tietz (1987) with diphenylcarbazone as an indicator.

Statistical analysis: Analysis of Variance (ANOVA) was used to determine the statistical differences in the mean levels of the elements between the groups - control, 2nd and 3rd trimesters pregnant and lactating groups. The association between serum elements within group was determined by use of correlation and regression coefficient.

Computer-Makintosh performer 5200CD version 7.0 was used for the statistical analysis of the data. The statistical programme was start-view.

RESULTS

The subjects were divided into 5 groups; the control (100 subjects) the 1st trimester (32), the 2nd trimester (100), the 3rd trimester (100) and the lactating (100) groups. Their mean ages were 32.99±9.49, 22.03±3.99, 25.58±6.55, 25.33±5.73 and 24.88±5.88 in that order.

Table 1: Number of women in the normal, pregnant (1st, 2nd and 3rd trimesters) and lactating groups, with mean age in years ± SD

Groups	Sample No.	Mean age (lower-Upper values)
Normal	100	32.99±9.49 (15-47)
1st trimester	32	22.03±3.99 (15-30)
2nd trimester	100	25.58±6.55 (15-44)
3rd trimester	100	25.33±5.73 (15-40)
Lactating	100	24.88±5.88 (15-45)

The levels of mineral elements (mM) determined in the serum of the 3 pregnant groups (the 1st, 2nd and 3rd trimesters) ranged between 104.16-155.8 for Na; 2.56-4.26 for K; 0.71-2.19 for Mg; 1.67-3.09 Ca; 0.03-0.12 Zn; 0.02-0.03 Cu; 0.02-0.05 Fe; ND-0.008 Mn and 120.47-160.71 for Cl^-. Phosphorus levels were between 3.62-7.26 mg/100 ml.

In the lactating group the values ranged from 87.71-115.93, 2.23-5.09, 0.45-0.93, 1.26-2.68, 0.09-0.16, 0.002-0.06, 0.002-0.06, 0.008-0.01, 105.78-132.22 and 1.91-3.1 respectively.

The non pregnant/non-lactating control values were 98.98-144.68, 2.49-5.23, 0.64-1.80, 1.77-3.17, 0.02-0.11, 0.01-0.03, 0.014-0.06, 0.002-0.02, 2.72-5.6, 116.79-153.13 and 2.72-5.6, in the same order.

The result from ANOVA showed that there was no significant difference ($p>0.05$) between the serum Na, K, Zn and Cl^- levels in the 2nd and 3rd trimesters of pregnancy. Contrarily, a statistically significant difference ($p<0.05$) was determined between the levels of Na, Mg, Cl^- and Pb in the lactating and control groups.

DISCUSSION

This study has assessed the serum levels of 10 mineral elements in the 1st, 2nd, 3rd trimesters of pregnancy and in lactation.

Significant difference ($p<0.05$) determined between the minerals values in the pregnant, lactating and control groups confirmed the altered metabolism of some of these elements in pregnancy and lactation (Brown and Gallery, 1994).

When compared to other published work (Temple *et al*., 1996), the serum Na levels determined from the present work appeared lower. This trend could be attributed to age differences. The subjects used in the above cited reference were children. Apart from these, physiological factors (such as age and the gender differences), others such as cultural habits and dietary patterns had been recognized as factors capable of influencing studies of this nature (Tietz, 1987). However, the serum K levels determined in the present study compared favourably to those from the cited references.

Positive correlation was determined between sodium and potassium. This agreed with other previous studies (Obeinu, 1991; Sirkoski *et al*., 1988).

Significant differences were obtained between Mg levels in the lactating and pregnant groups; and in the lactating and control groups ($p<0.05$). These differences were attributed to the increased need for this element during pregnancy and lactation (Edward and Bourchier, 1991). The differences could also be attributed to the type of dietary intake. Highly processed foods are reported to contain low levels of Mg and consequently give rise to low serum levels of the element (Sojika, 1995). Major dietary sources are whole grains, nuts, seeds, cocoa and green leafy plants. When compared to other published work our determination showed that the serum Mg levels in this population of women were higher (Tietz, 1987; Sojika, 1995). This could be due to the consumption of minimally processed food stuff.

Calcium: Calcium values were comparable to literature ranges (Tietz, 1987). However, it is recognized that the seemingly normal serum calcium levels might not necessarily be interpreted as an out come of adequate calcium, intake but rather as a result of Ca metabolism during periods of low intake. This fact is supported by the result of an earlier study on their food intake, (Madukosiri *et al*., 2007). The estimated daily calcium consumption was found to be lower than the recommended literature level (Tietz, 1987).

Table 2: The mean levels (mM) of the elements in the serum of women in the control, pregnant (1st, 2nd and 3rd trimesters) and lactating groups (phosphorus values are in mg/100 ml serum)

	Groups (Means ± SD)				
Elements	Control (n = 100)	1st Trimester (n = 32)	2nd Trimester (n = 100)	3rd Trimester (n = 100)	Lactating (n = 100)
Na	121.83±22.85^{ade}	126.40±22.31	128.39±22.64^{bd}	128.24±27.56^{ce}	102.82±13.11^{abc}
K	3.86±1.37^{ab}	3.34±0.78	3.41±0.77^{a}	3.37±0.89^{b}	3.66±1.43
Mg	1.22±0.58^{ad}	1.55±0.41	1.74±0.45^{bde}	1.29±0.58^{ce}	0.69±0.24^{abc}
Ca	2.47±0.70^{a}	2.42±0.67	2.53±0.52^{be}	2.32±0.65^{ce}	1.97±0.71^{abc}
Zn	0.067±0.045^{ad}	0.040±0.012	0.043±0.018^{bd}	0.061±0.058^{c}	0.124±0.037^{abc}
Cu	0.018±0.01	0.023±0.005	0.021±0.005	0.022±0.005	0.031±0.029
Fe	0.036±0.022	0.031±0.011	0.036±0.014	0.038±0.015	0.032±0.030
Mn	0.010±0.008	ND	ND	0.006±0.002	0.010±0.002
Pb	0.004±0.002^{a}	0.005±0.003	0.005±0.002^{b}	0.004±0.002^{c}	0.001±0.0004^{abc}
P	4.16±1.44^{ad}	5.03±0.86	6.51±0.75^{bde}	4.90±1.28^{ce}	2.55±0.64^{abc}
Cl	134.96±18.17^{ad}	139.22±14.87	140.59±20.12^{bd}	137.36±16.07^{c}	119.002±13.22^{abc}

Figures with the same superscripts on the horizontal row are significant (p<0.005). (ND - Not Detected)

Table 3: Correlation coefficient® determined between the elements in the serum of pregnant (2nd and 3rd, trimesters) and lactating women from Bassa LGA

	Groups			
Elements	Normal	2nd Trimester	3rd Trimester	Lactating
Na and K	0.19 (p>0.05)	0.16 (p>0.05)	0.27 (p<0.05)	0.37 (p<0.05)
P and Ca	0.46 (p<0.05)	-	0.57 (p<0.05)	0.55 (p<0.05)
P and Mg	0.81 (p<0.05)	0	-	-
Ca and Mg	0.34 (p<0.05)	0.15 (p>0.05)	0.75 (p>0.05)	0.53 (p<0.05)
Fe and Zn	0.14 (p>0.05)	0	0	0
Fe and Cu	0	0	0.10 (p>0.05)	0
Fe and Pb	0	0	0	0
Zn and Pb	-0.23 (p<0.05)	0	-	-
Zn and Cu	0	0	0.21 (p<0.05)	0

Phosphorus: The serum phosphorus levels in the pregnant group were significantly higher (p<0.05) than those of the control and lactating groups. Phosphorus is involved in the intermediary metabolism of carbohydrates and is a component of other physiologically important substances such as organic phosphate esters, phospholipids, nucleic acids and nucleotides. Thus, the observed increase in serum phosphorus level is linked to an increase in material metabolism during pregnancy.

Iron: There was no significant difference determined between the serum iron levels in the subject groups (p>0.05). Our values were higher than those determined by Iiouno and Uchendu (1988), but were within the range given by Tietz (1987). Again, this does not suggest the absence of anaemia. Apart from the usual causes, anaemia could also arise from ingestion of high levels of nitrates (in drinking water) and pollutants such as Pb (in foods) (Menge *et al*., 1998; Gupta *et al*., 1999). Heavy metals such as Pb can cause anaemia by inhibiting important enzymes in the pathway of heam biosynthesis. Lead (Pb) can inhibit d-aminolevulinic acid (ALA) dehydratase in heam biosynthesis. Lead (Pb) can also inhibit the action of ferrochelatase, the enzyme catalyzing the incorporation of ferrous iron into protopaphyrin IX. All our subject groups showed elevated serum Lead (Pb) levels which were above the recommended literature level (Sirkoski *et al*., 1988). We attributed this to the mining activities in the study area. Plateau state is one of the major mining areas in the country and it could be possible that the poor disposal of industrial waste is having its toll on the bioaccumulation of this element in the food plants grown in the area, from where they get into the body when contaminated foods are consumed. We had earlier on reported a high prevalence of anaemia among this population (Madukosiri and Adoga, 2002), which lead to our postulation that the aetiology of anaemia might not be unconnected with the level of the toxicant, Pb, in their blood. On the other hand the significantly lower (p<0.05) Pb level in the serum of the lactating women was attributed to maternal loss through the breast milk (Gulson *et al*., 1998).

The values of the other elements Cu, Zn and Mn were comparable to the literature values and there was no significant difference (p>0.05) between the mean levels in the various groups.

Conclusion and recommendations: This study has provided reference values for the ten serum elements in the three trimesters of pregnancy and in lactation within the age group 15-47 years.

Although serum Ca levels are within the normal range given in the literature, there is cause for further

investigation as the prevailing situation may be the outcome of calcium metabolism mediated through the action of parathyroid hormone during low intake. We therefore recommend calcium supplementation throughout pregnancy and lactation periods, for women living in Bassa LGA of Plateau state.

Also this study has established normal iron levels among pregnant and lactating women in Bassa LGA. The earlier reported anaemia in this population of women is unlikely to be due to low iron status, rather low iron utilization may be an underlying factor. The etiology may not be unconnected with the level of Pb in the sera which consequently can antagonize iron metabolism. Therefore, iron supplementation should not be the ultimate step towards solving the problem of anaemia in this environment. Otherwise, we may be heading to indiscriminate iron supplementation with subsequent iron overload and its metabolic consequences. Effort should be directed towards developing strategies and methods to reduce the level of Lead (Pb) in the environment and in the food stuff. In the short run intake of vitamin C- containing foods such as rose hips and citrus fruits are recommended to protect the body against Pb poisoning (Paavo and Airola, 1970). Lastly, this study has shown that magnesium intake is adequate and need no supplementation. The intake of minimally processed food is encouraged.

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