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Anaemia and Some Micronutrient Levels among Pregnant Women of African Descent in Sokoto North Western, Nigeria.

Ibrahim, A.B.*¹, Ibrahim, K.K.¹, Yakubu, H.M.¹, Erhabor, O.¹, Udomah, P.F.¹, Yakubu, A.¹, Buhari, H.A.¹, Ahmed, H.M.¹, Abubakar, S.² and Onuigwe, F.U.¹

Department of Hematology, School of Medical Laboratory Sciences, Usmanu Danfodiyo University, Sokoto¹, Women and Children Hospital, Gombe State, Nigeria².

Author for Correspondence: aliyubagudo1@gmail.com/+234-706-276-6659.*

Abstract:

Anaemia in pregnancy is a serious public health issue worldwide which pose a great impact on the health of the foetus and the mother. Serum levels of copper, zinc, and manganese during pregnancy are known to have effects on pregnant women and their neonates. Blood samples were collected from 150 healthy pregnant women aged 17-45 years and 100 age- matched, non-pregnant women were monitored as controls. This was a cross sectional study aimed to determining packed cell volume and some micronutrient levels among pregnant women attending antenatal care (ANC) in Specialist Hospital Sokoto, Nigeria. Packed cell volume (PCV) was determined using standard manual method. Serum levels of copper, zinc, and manganese were analyzed by atomic absorption spectrophotometric methods. The prevalence of anaemia observed among the study subjects was 12 (8%) and non-anaemic was 138 (92%). The result indicated that the serum levels of copper, zinc and were significantly lower in pregnant women compared to their corresponding values in non-pregnant control ($p=0.0001$) respectively, whereas the level of serum manganese was significantly increased in pregnant women compared to the control ($p=0.0122$). The micronutrient levels among pregnant women were compared based on trimester. In the third trimester, the mean serum level of zinc was significantly decreased in pregnant women group than the other trimesters and control group. The mean serum levels of copper and manganese were significantly reduced among pregnant women in the first trimesters compared to the second and third trimester as well as the non-pregnant controls. In conclusion, the serum levels of copper, zinc, manganese were adequate

in the study subjects of healthy pregnant women. The anaemia observed in some of the pregnant women included in this study had no significant consequences on the pregnancy. This study advocates for targeted micronutrient supplementation for pregnant women in the area. Laboratory parameters for the diagnosis of anaemia and micronutrients should be included in antenatal care plan for pregnant women in the area to improve their health condition.

Key: *Pregnant women, Zinc, Copper, Manganese, PCV and Sokoto.*

Introduction

There are changes in the maternal circulatory system during pregnancy. Blood flow through the placenta and maternal cardiac output increases during pregnancy. About 625 milliliters of blood flow through the maternal circulation of the placenta each minute during the last month of pregnancy (Guyton and Halls, 2011). Pregnancy places extreme stresses on the haematological system and understanding of the physiological changes that results is obligatory in order to interpret any needs for therapeutic intervention (Hoffbrand, 2006).

Normal human pregnancy lasts approximately 40 weeks, as measured from the first day of the last normal menstrual period "LNMP". The anticipated date of an infant's birth is commonly referred to as the expected date of delivery (EDD). When talking with patients, physicians customarily divide pregnancy in to three times intervals called trimesters each of which is slightly longer than 13 weeks. By convention, the first trimester, 0 to 13 weeks, begins of the first day of the last menses. Rapid foetal growth

occurs during the 13 to 26 weeks of second trimester (Carl *et al.*, 2008).

By the end of the second trimester, the foetus weighs approximately 700g and is 30cm long; many foetal organs begin to mature. The 26 to 40 weeks of the third trimester is the period in which foetal organ completes their prenatal maturation. During these trimesters, the growth rate decelerates at the end of the third trimester; the foetus weighs approximately 3200g and is about 50cm long. Term is the interval from 37 to 42 weeks. Normal labour, rhythmic uterine contractions and birth occur during this period (Carl *et al.*, 2008).

The word haematocrit means to separate (which underscores the mechanism of the test because the plasma and blood cells are separated by centrifugation). The haematocrit test is part of complete blood count (CBC). This test indirectly measures the red blood cells (RBC) mass. The results are expressed as the percentage by volume of the packed red blood cell in whole blood (PCV). It is an important measurement in the determination of anaemia or polycythemia. (Fischbach, 2009).

Haemoglobin concentration below 10.0g/dl or packed cell volume (PCV) of less than 30.0% is regarded as anaemia during pregnancy (WHO, 2004). Anaemia in pregnancy is an important public health problem worldwide. WHO estimates that more than half of pregnant women in the World have a haemoglobin level indicative of anaemia (< 11.0g/dl), the prevalence may however be as high as 56 or 61% in developing countries. Women often become anaemic during pregnancy because the demand for iron and other vitamins is increased due to physiological burden of pregnancy. The inability to meet the required level for these substances either as a result of dietary deficiencies or infection give rise to anaemia (Idowu, *et al.*, 2005). In pregnancy, anaemia has a significant impact on the health of the foetus as well as that of the mother. About 20% of maternal deaths in Africa have been attributed to anaemia (Harrison, 1975). Foetuses are at risk of preterm deliveries, low birth weights, morbidity and perinatal mortality due to the impairment of oxygen delivery to placenta and foetus. The management and control of anaemia in pregnancy

is enhanced by the availability of local prevalence statistics, which is however not adequately provided in Nigeria.

Micronutrients and trace elements have an important influence on the health of both mother and foetus. Deficiency of micronutrients during pregnancy may give rise to complications such as anaemia and hypertension, as well as impairing foetal function, development and growth (Allen, 2005). A recent meta-analysis evaluating the effects of antenatal multi micronutrient supplementation on pregnancy outcomes has revealed a significant reduced risk of low birth weight and improved birth weight in comparison to iron/folic acid supplementation only. It should be noted that the majority of included studies were in low- or middle-income countries (Shah, 2009). Nutrient needs during life stages of pregnancy and lactation are increased relative to women who are not pregnant or lactating. In fact, energy requirement increased by an estimated 300kcal/day during pregnancy and 500kcal/day in lactation (Katz, 2008).

Pregnancy is associated with increased nutritional needs due to physiological changes of the woman and the metabolic demands of the embryo/foetus. Proper maternal nutrition during pregnancy is thus imperative for the health of both the woman and the offspring. Maternal malnutrition in pregnancy has been associated with adverse outcomes, including increase risk of maternal and infant mortality as well as low birth weight of newborn (<2,500grams) a measure that account for preterm birth and intrauterine growth restriction of foetus (Kramer 2003; Kramer 1987). During pregnancy micronutrient deficiencies are also a form of under nutrition. Multiple micronutrient deficiencies commonly co-exist in pregnant women, especially in less developed nations (Christian, 2010).

Materials and Methods

Study Area

The study area is Sokoto State Specialist Hospital located in Sokoto metropolis. It is committed to the provision of continually improving quality health care services to the entire State. The metropolitan city of Sokoto lies between longitude 11

Table 1: Prevalence of Anaemia among pregnant women in Sokoto

Study subjects	N	Percentage (%)
Anaemic	12	8
Non-anaemic	138	92
Total	150	100

Keys

N- Observation

% - Percentage

Table 2: Variation of Anaemia across different trimesters among study subjects

Duration of pregnancy	N	Percentage (%)
First trimester	5	41.7
Second trimester	3	25.0
Third trimester	4	33.3
Total	12	100

Keys

N- Observation

% - Percentage

Table 3: Mean±SD of Serum levels of Copper, Manganese and Zinc among study subjects

Parameters	Control (n=100)	Test (n=150)	U	Z- score	p-value
	Mean±SD	Mean±SD			
Copper (µmol/l)	14.15±3.27	11.67±3.83	4677.00	-5.261	0.0001
Zinc (µg/dl)	4.20±1.84	2.89±1.39	3666.00	-6.624	0.0001
Manganese(nmol/l)	12.89±4.95	14.75±5.46	6109.00	-2.676	0.0122

Keys

Values are presented as Mean Standard Deviation.

U=Mann-Whitney test value

Table 4: Summary statistics (including KW statistic) for serum levels of copper at different trimesters and control

Copper (µmol/l)					
Group	N	Sum of Ranks	Mean Ranks	KWS	p-value
Group 1	100	15373	153.73	69.196	0.0001
Group 2	48	2581.5	53.781		
Group 3	62	7950.0	128.23		
Group 4	40	5470.5	136.76		

Keys: KWS=Kruskal-Wallis Statistics, n=observations, group1=control, group 2=first trimester, group 3=second trimester, group 4=third trimester

Table 5: Summary statistics (including KW statistic) for serum levels of zinc at different trimesters and control

Zinc (µg/dl)					
Group	N	Sum of Ranks	Mean Ranks	KWS	p-value
Group 1	100	16384	163.84	51.829	0.0001
Group 2	48	4894.5	101.97		
Group 3	62	6426.0	103.65		
Group 4	40	3670.5	91.763		

Keys: KWS=Kruskal-Wallis Statistics, n=observations, group 1=control, group 2=first trimester, group 3=second trimester, group 4=third trimester.

Table 6: Summary statistics (including KW statistic) for serum levels of manganese at different trimesters and control

Manganese(nmol/l)					
Group	N	Sum of Ranks	Mean Ranks	KWS	p-value
Group 1	100	11159	111.59	22.833	0.0001
Group 2	48	5713.0	119.02		
Group 3	62	7680.0	123.87		
Group 4	40	6823.0	170.58		

Keys: KWS=Kruskal-Wallis Statistics, n=observations, group 1=control, group 2=first trimester, group 3=second trimester, group 4=third trimester

Table 7: Dunn's Multiple Comparison Tests for micronutrients at different trimesters and controls

Comparison	Parameter					
	Cu²⁺(µmol)		Mn²⁺(nmol)		Zinc (nmol/l)	
	MRD	p-value	MRD	p-value	MRD	p-value
Group 1 vs. Group 2	99.95	< 0.001	-7.431	> 0.05	61.871	<0.001
Group 1 vs. Group 3	25.40	> 0.05	-12.281	> 0.05	60.195	<0.001
Group 1 vs. Group 4	16.97	> 0.05	-58.985	< 0.001	72.078	<0.001
Group 2 vs. Group 3	-74.445	< 0.001	-4.850	> 0.05	-1.676	>0.05
Group 2 vs. Group 4	-82.981	< 0.001	-51.554	< 0.01	10.206	>0.05
Group 3 vs. Group 4	-8.537	> 0.05	-46.704	< 0.01	11.883	>0.05

Discussion

In this study, 150 consenting pregnant women attending Antenatal Clinic at Specialist Hospital Sokoto, and 100 non-pregnant women were analyzed for PCV, some micronutrients (Zinc, Copper and Manganese). WHO criteria of defining anaemia in pregnancy as Hb <10.0 g/dl and Packed Cell Volume (PCV) less than 30% (WHO, 2004). This study reported an overall prevalence of anaemia of 8% among our cohort of pregnant women attending ANC in Specialist Hospital Sokoto. This study is inconsistent with the previous findings of Erhabor *et al.* (2013) among pregnant women attending Maryam Abacha Women and Children Hospital Sokoto and that of Gwarzo and Ugwu (2013) which recorded the prevalence of 21.3% and 24.5% respectively. The lower prevalence recorded in this study could be as a result of public awareness against the effect of anaemia during pregnancy and regular antenatal care. Although larger sample size was used in this study compared to previous study of Erhabor *et al.* (2013).

It is well-established that physiologic, metabolic, and hormonal changes during pregnancy affect the metabolism and body needs for micronutrients in each of the three trimesters among pregnant women. In this study the serum copper levels of pregnant women in the second and third trimesters were higher than that in the first trimester ($p < 0.05$). No significant change in value was observed between the second and third trimesters in terms of copper levels. Serum zinc level during the third trimester was significantly lower than that during the first and second trimesters ($p < 0.05$). There was no significant alteration in value between the first and second trimesters in terms of zinc levels. Findings pertaining serum levels of zinc and copper in pregnant women observed in this study were in close agreement with results reported previously (Awadallah *et al.*, 2004; Martin *et al.*, 1998). The reduction in maternal zinc levels observed during the third trimester could be attributed to several factors such as increased zinc uptake by the foetus and placenta, increased transfer of plasma zinc to maternal erythrocytes, expanded plasma volume and decreased serum albumin availability for zinc binding during pregnancy.

The observed higher levels of copper in maternal blood in the second and third trimesters may be caused by increased mobilization of stored copper in tissues, especially the liver, for its use

by the developing foetus. Additionally, the concentration of ceruloplasmin which is a major copper-binding protein increases as the pregnancy progresses (Awadallah *et al.*, 2004). Therefore, the expected difference between serum copper levels of the mother and foetus could be attributed to the much higher concentration of ceruloplasmin in the maternal serum (Cousins *et al.*, 2000).

The mean serum concentration of manganese in the controls is less than the value earlier reported by Iyengar and Wolttlez but higher than the values reported by West Midland Toxicology Laboratory (Sylvester *et al.*, 2014). This difference may not be unconnected with the differences in soil and food contents in these different areas. Since manganese is ubiquitous in food stuff (Manganese, 2000). Its concentration in the body will be dependent on dietary intake, which in turn is dependent on the soil content. When compared with the value from pregnant women there was a significant increase of this element in pregnancy. This agrees with earlier studies on the same group of patients (Spencer, 1999; Taker *et al.*, 2004). This gradual increase will help to prevent inborn errors of metabolism and brain damage in neonates and ensure adequate utilization of other nutrients for normal growth (Blaurock-Busch, 2009). However, more worrisome is the significant increase in the serum concentration of this element of each parity group over controls, to the tune of 2-3 times the control value. Manganese readily crosses the blood brain barrier in developing foetuses, neonates, and even mature mammals, causing in coordination (Sylvester *et al.*, 2014).

Conclusion/ Recommendations

In conclusion, the findings show that serum levels of zinc, copper, manganese and Packed Cell Volume were adequate in the studied group of healthy pregnant women. The anaemia observed among some of the study subjects had no deleterious effect on the pregnancy. Health education of pregnant women in Sokoto community on the need for supplementing their diet with micronutrients is advocated. Study on soil analysis in the locality should be encouraged to be able to accurately predict the level of these micronutrients. Determination of parameters used for the diagnosis of anaemia among pregnant women should be encouraged in antenatal care to facilitate the diagnosis and monitoring of pregnant women with anaemia.



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