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SERUM LEVELS OF IRON, TOTAL IRON-BINDING CAPACITY AND VITAMIN-A IN MATERNAL AND CORD BLOOD.

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ABSTRACT:

Studies have shown that vitamin-A supplementation has beneficial effect on iron deficiency anaemia. The adequacy or otherwise of this supplementation and the effect this has on iron and vitamin-A status in maternal and cord blood was therefore the focus of this study. Fifty-three (53) maternal and cord blood samples were used with twenty age-matched control samples from non-pregnant women Informed consent was given by all the subjects and ethical clearance was obtained from the ethics committee of the institution before the commencement of the study. Haemoglobin (Hb) level, vitamin A, total iron binding capacity and and serum iron were all estimated using standard operative procedures. The result showed a significantly higher level of iron and vitamin A ($P<0.05$) for the control over the test and significantly lower level of total iron-binding capacity (TIBC) ($P<0.05$). Cord blood vitamin-A and iron were significantly elevated over the maternal blood while the TIBC were lower ($P<0.05$). Inspite of this significant difference, there was a positive correlation between the TIBC, serum iron and vitamin-A levels of maternal and cord blood samples. Both vitamin-A and serum iron of the group with low haemoglobin were significantly lower when compared with the rest of the test groups. Increased vitamin-A and iron supplementation may therefore be required for pregnant women with low haemoglobin to prevent infant and maternal mortality in developing countries.

Key Words: Serum Iron. Vitamin-A, TIBC, Maternal, cord blood.

INTRODUCTION

Vitamins and minerals, collectively referred to as micronutrients, have important influence on health of pregnant women and growing fetus (Black, 2000). Micronutrients are necessary for many biological processes, including adequate fetal development and immune system function.

Vitamin A increases the integrity of epithelial cells of the intestinal tract with resultant better absorption of iron. A study suggested that vitamin a can increase the absorption of iron fortified foods by two folds and beta carotene by three folds. It also prevents the inhibitory effect of phytates on iron absorption in humans (Garcia et al, 1998). The control of body iron content depends upon control of absorption by an active process in the upper small intestine (Ponka, 1997). Normally about 1mg of iron is absorbed each day and this just replaces loss. This amounts to about 10% of that taken in the diet, although the proportion depends to some extent on the type of food (Gilloy et al, 1994).

Anaemia is a universal important public health problem, the prevalence being as high as 60-70%. Pregnancy is a period of great anabolic activity during which, rapid growth rate takes place especially during third trimester and the maternal requirements increase significantly.

It is a common experience that anaemia in pregnancy is sometimes not corrected despite iron supplementation which may be due to underlying deficiency of other micro nutrients which affect pregnancy, child birth and fetal development (Reddy et al, 1997) and most anaemia in women of child-bearing age and pregnant women are related to iron deficiency (Svanberg et al, 1996).

Iron deficiency results in anaemia which may increase the risk of death from hemorrhage during delivery, however its effects on fetal development and child birth out come still needs further elucidation (Sandstrom, 2001). It is thought that iron deficiency in infancy has serious long-term consequences for cognitive and psychomotor development (Russian et al., 1990), and evidence of developmental delay has been associated, though more rarely with vitamin deficiency (Neuman and Hanison, 1994). Low levels of serum vitamin A have been reported in some populations in developing countries with particular respect to pregnant and lactating mothers and their infants (Specker et al, 1999).

The reduction in vitamin A level as seen in malnourished children could be as a result of the effect of protein energy malnutrition which interferes with hepatic synthesis and release of retinol binding protein (BBP) required for vitamin A transport to the liver (Ikekpeazu et al, 2010).

Over the last decade, the role of vitamin A in decreasing the mortality and morbidity of infectious diseases in children has been established. Maternal mortality is a major public health problem in developing countries and decreasing its burden is very vital. Of the estimated 585,000 maternal deaths that occur every year, approximately 5% are caused by hemorrhage, 15% by infections, 13% by abortion complication, 12% by complications of hypertensive disease in pregnancy, and pre-eclampsia or eclampsia, and anaemic mothers are at higher risk of death if these complications occur (WHO, 2004). The recent study by Ikekpeazu et al, (2010) reported that vitamin A level is significantly lowered in malnourished children, and this possibly predisposes them to poor visual co-ordination and consequently, increased supplementation of vitamin A in addition to dietary protein and calories should be considered for this category of children.

Combination of vitamin A and iron supplementation results in significantly important reduction in the prevalence of anaemia in pregnancy when compared with vitamin A supplementation alone (Khan and Baseer, 1999). Vitamin A has been shown to be essential for the immune function of infants

Associations have been documented between diminished cord serum ferritin and negative neurodevelopment outcomes as well as teratogenic effects resulting from iron deficiencies (Shobana et al, 1982). There is thus the need to assess the levels of serum iron, TIBC and vitamin A in maternal and cord blood to know the possible predisposition of pregnant women to anaemia which can lead to abnormal fetal developments and maternal mortality.

SUBJECTS AND METHODS

Subjects

A total of Seventy three (73) women were used for the study. The test subjects consisted of 53 pregnant women at full term with their cord blood, whereas 20 apparently healthy non-pregnant women of child-bearing age were used as control subjects. All subjects with pregnancy complications such as gestational diabetes, pre-eclampsia and those on contraceptives were not included in the study. Informed consent was given by all the subjects and appropriate approval was given by the ethics committee of the institution before the commencement of the study.

Sample Collection and Preparation

Approximately 5ml of venous blood were collected from the pregnant women at labour and the control subjects, via a clean vene-puncture from the ante-cubital vein while

were collected from the maternal end of the umbilical cord of the test subjects after birth. Four (4) mls of the collected samples were transferred into sterile plain bottles while 1ml each was transferred into EDTA anticoagulant bottles for haemoglobin estimation. The samples in the plain bottles were allowed to clot and then centrifuged at 3000rpm for 5mins to obtain the separated clear serum supernatant.

The serum samples were transferred into sterile Bijou bottles, capped and used for the analysis of serum iron, total iron-binding capacity (TIBC) and vitamin A, immediately. When immediate analysis was not possible, they were stored at 2ºC and analysis was done in 48hrs.

Analytic Methods

The serum vitamin A was assayed using the trichloroacetic acid (TCA) method of Neeld-Person (1963), whereas serum iron and the unsaturated iron-binding capacity (UIBC) were assayed by the method of Young (Russian et al, 1990) using iron Ferrozine ® kit. Whereas the total iron-binding capacity was calculated by adding the value of the UIBC and the serum iron (Russian et al, 1990).

Statistical Analysis

The statistical analysis of the data (student's t-test and ANOVA) was done using the statistical package for social sciences (SPSS) and the results are presented as mean ± standard deviation (±SD)

RESULTS

The results showed increased Hb level in the cord blood compared to the pregnant and non-pregnant women ($P<0.05$) whereas serum iron, TIBC and vitamin A were all increased ($P<0.05$) in the non-pregnant women compared to both the cord blood and the pregnant women (table 1). The least concentration of all the assayed parameters was observed in the pregnant women.

The correlation studies showed significant positive correlation ($P<0.001$) between serum iron, TIBC and vitamin A in both the pregnant women and cord blood samples. (Table 2). Significant positive correlations ($P<0.001$) was also recorded between the serum iron, TIBC and vitamin A both in the pregnant women and the non-pregnant women (control). (Table 3).

DISCUSSION

Micronutrient interactions are particularly important during pregnancy, when the developing fetus is vulnerable to inappropriate micronutrient status (Gambling et al, 2003). In developing countries, iron-deficiency anaemia is quite common and recent studies have shown that, vitamin A

Tables: 1
MEAN ± SD OF SERUM IRON, TIBC AND VITAMIN-A IN MATERNAL, CORD BLOOD AND NON-PREGNANT WOMEN.

Parameters	Non-Pregnant Women (n=20)	Pregnant Women (n=53)	Cord Blood (n=53)	P-Value
Haemoglobin (g/dl)	12.3± 2.6	11.6 ± 3.2	13.5 ± 2.8	P<0.05
Serum Iron (µg/dl)	123.25 ± 17.37	77.58 ± 22.33	95.59 ± 20.62	P<0.05
TIBC (µg/dl)	257.63± 8.1	122.49 ± 47.27	161.89 ± 47.03	P<0.05
Vitamin A (IU/L)	217.60 ± 25.25	122.49 ± 47.27	161.89 ± 47.03	P<0.05

Table: 2
Correlation Between Micronutrient Levels In Maternal And Cord Blood.

Parameters	Pregnant Women (n=53)	Cord Blood n=53)	Coefficient of Correlation (r)	P-Value
Serum Iron (µg/dl)	77.58 ± 22.33	95.59 ± 20.62	0.933	P<0.001
TIBC (µg/dl)	122.49 ± 47.27	161.89 ± 47.03	0.560	P<0.001
Vitamin A (IU/L)	122.49 ± 47.27	161.89 ± 47.03	0.910	P<0.001

Table: 3
Correlation Between Micronutrient Levels In Pregnant And Non-Pregnant Women.

Parameters	Non-Pregnant Women (n=20)	Pregnant Women (n=53)	Coefficient of Correlation (r)	P-Value
Serum Iron (µg/dl)	123.25 ± 17.37	77.58 ± 22.33	0.933	P<0.001
TIBC (µg/dl)	257.63± 8.1	122.49 ± 47.27	0.560	P<0.001
Vitamin A (IU/L)	217.60 ± 25.25	122.49 ± 47.27	0.910	P<0.001

supplementation has beneficial effect on iron-deficiency anaemia. Vitamin A supplementation is part of the activities of the national immunization programme in Nigeria. The adequacy or otherwise of this supplementation and the effect on iron status in pregnant women and their fetus is therefore worthy of study.

The results of the study indicates that despite routine supplementation of iron and vitamin A during antenatal clinics, the pregnant women had significantly low haemoglobin (Hb) and iron levels (P<0.05) compared to their age-matched controls which could be due to reluctant intake, in addition to increased metabolic demands and inappropriate supplementation.

This may therefore explain the rise in total iron-binding capacity (TIBC) (P<0.05) as compared to non-pregnant women. Despite iron deficiency in pregnant women, new born remained unaffected. Their Hb and serum iron levels were significantly higher (P<0.05) than the uptake of iron by the fetus (Balai et al, 1992).

The positive correlation (r) (P<0.001) between the vitamin A of the pregnant mothers and cord blood suggests that the maternal vitamin A status influences the vitamin A level of the new born. This implies that mothers with adequate vitamin A status tend to produce babies with correspondingly adequate vitamin A levels. Interestingly, serum iron level in cord blood followed similar trend as vitamin A, hence newborn's had significantly higher levels of iron as compared to their mothers. This may be as a result of the fact that vitamin A supplementation increases the integrity of the epithelial cells of the intestinal tract, with resultant increased absorption of iron (Standstorm, 2001). On the other hand, new born of the pregnant mothers with low Hb had low serum iron and vitamin A levels as compared with those from pregnant mothers with normal Hb. This may be due to

supplements by their mothers. Vitamin A deficiency may exacerbate iron deficiency anaemia and studies have shown that vitamin A supplementation has beneficial effect on iron deficiency anaemia and improves iron nutritional status among children and pregnant women. Supplementation of vitamin A and iron seems to reduce anaemia more effectively than supplementation of iron or vitamin A alone (Panth et al, 1990).

CONCLUSION

From this study, there was a positive correlation between the micronutrient parameters assayed in both maternal and cord blood. There was a general decrease in the micronutrients in the pregnant women and investigations show that the women that had low levels of vitamin A and iron were from the rural areas, thus the need to educate pregnant women on the benefits of supplementation of these micronutrients during antenatal visits, especially in the rural areas. This will go a long way to prevent infant and maternal mortality, mostly resulting from nutritionally-acquired immune deficiency diseases.

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