CONCENTRATION OF VITAMIN C, VITAMIN E AND IRON IN APPARENTLY HEALTHY PREGNANT WOMEN AND THE CORD BLOOD AT PATURATION

BY

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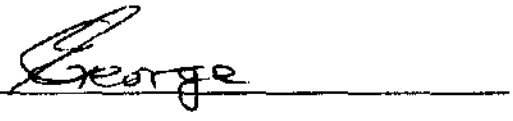
I wish to express my sincere gratitude to Dr. (Mrs.) Obagaiye for conceiving and effectively supervising this project.

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DECLARATION

I declare that this work is wholly the author's and has not been part of any presentation for any other qualification.

SIGNED 

DATE 30. 11. 98

CERTIFICATION

This thesis titled "Concetration of Vitamin C, Vitamin E and Iron in Apparently Healthy Pregnant Women and the Cord Blood at Paturation", by Eleanor George meets the regulation governing the award of the degree of Master of Science, Ahmadu Bello University, Zaria, and is therefore approved for its contribution and literary presentation.

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DEDICATION

I dedicate this work to the memories of my late mother, Aibetu Unah, Esther Onyilo and Irene Agbo Uloko.

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ABSTRACT

The effects of maternal age, parity and Hb concentration on the antioxidant vitamins (Vitamins E and C) and Iron nutriture of 50 women of reproductive age (control) and 60 Nigerian parturient mothers and the cord levels were assessed. The mean serum Vitamin C and E concentrations for 50 non pregenant Nigerian women was 0.96±0.lOmg/dl and 1.65±0.07mg/dl, respectively. Apparently, age and parity had no effect (P>0.05) on the antioxidant status of the women. Age correlated positively with parity (r=0.7l) but inversely (r=-0.85) (P<0.05) with the serum Vitamin C concentrations. Haemoglobin was positively associated (P<0.05) with PCV (r=0.72^ and serum Vitamin C concentration (r=0.31) for these subjects while PCV correlated with both Vitamin C (r«0.30) and Vitamin E (r=0.39) concentrations for the subjects.

The mean maternal serum Vitamin C, Vitamin E and Iron concentration of the parturient mothers studied were 0 . 58 + 0 . llmg/dl, 1. 55±0 . 08mg/dl and 114 . 3±59 . 90/ug/dl, respectively. The corresponding fetal values were 0.77±0.20mg/dl, 0 . 27±0 .19mg/dl and 167 . 9±62 . 20/ug/dl, respectively. Parturient mothers aged 20-24 years had significantly lower maternal Hb, PCV and serum Vitamin E (P<0.C5) compared to other age groups. Anaemic parturient mothers (Hb<10.Og/dl) also had significantly lower (P<0.05), PCV, Vitamin C and Iron compared to non-anaemic subjects (Hb>ll.Og/dl) Parity had no apparent effect (P>0.05) on either

the maternal or fetal antioxidant status. Maternal Hb was positively associated ($P<0.05$) with (PCV) ($r=0.89$), Maternal serum Vitamin C ($r=0.330$) and Iron ($r=0.45$), while maternal PCV correlated ($P<0.05$) with maternal Vitamin C ($r=0.30$) and Vitamin E ($r-0.397$) . Fetal Hb, on the contrary, was not associated with either Fetal Vitamin C ($r=0.10$) or Vitamin E ($r=0.035$) levels but was associated with fetal Iron.

Data from the present study suggests that there are no metabolic relationships ($P>0.05$) between antioxidant Vitamin E and C concentration in non pregnant Nigerian women or between maternal and cord values in parturient women.

CHAPTER ONE

INTRODUCTION

Available evidence (Naeye, 1979) indicate that in most developing countries including Nigeria, the demand for all essential nutrients by the gravid individual are rarely met thus predisposing such mothers to gross under-nutrition. Shaw, (1980), for instance ascribed the higher incidence of maternal and neonatal mortality in most developing countries to severe maternal under-nutrition. The increased risk of intrauterine growth retardation, prematurity anaemia and abortion observed at parturition have also been linked (Lechtig et.al.,1975; Hytten, 1979; Harrison, 1982), to poor maternal nutritional status.

In the present study, attention was focused on the antioxidant vitamins (Vitamin C and Vitamin E), and Iron because of their respective roles in maternal and fetal development. Both Tocopherol and Ascorbic acid for instance have been reported to function as antioxidants in the protection of cell membrane against oxidative stress initiated by free radicals. In addition, Vitamin C has been implicated to have a role in facilitating the absorption of Iron and consequently erythropoiesis (Southon et.al.,1989). Vitamin E has also been identified as an important nutrient in reproductive function. Deprivation of Vitamin E in animals for instance has been associated with haemorrhage, sterility and fetal resorption in

females (Baker and Frank, 1968).

Although previous investigators (Vobecky et.al.,1982) have assessed the Vitamins C and E status of non-pregnant women of reproductive age, as well as maternal and fetal status at parturition, available evidence (Baker et.al.,1975; Vobecky et.al.,1982) indicate that such studies have not been designed to ascertain whether a metabolic inter-relationship exists between these antioxidant vitamins.

It is of particular importance since Ajayi and Ladipo (1987) have produced evidence of a metabolic inter-relationship between Hb and GSH at parturition. They related their findings to the ability of GSH to protect Hb from oxidative stress and the involvement of riboflavin in iron metabolism in neonatal development. Other investigators (Davidson et.al.,1975) have reported that L-ascorbic acid maintains GSH in the reduced state and potentiates the effect of Vitamin E. Dougherty and Hoekstra (1977) have also reported that lipid peroxidation in vivo is stimulated in Vitamin E and selenium deficient rats by increased iron intakes. Realizing that iron supplements are routinely recommended as prophylaxis for pregnant women despite increased cholesterol and hyperlipidemia often observed in pregnancy, the present study was designed to obtain a base line data for vitamins C and E status of Nigerian women of reproductive age and parturient mothers and their neonates, and to ascertain whether any metabolic inter-

relationship exists between these antioxidant vitamins. It was also the objective of this study to ascertain whether any metabolic relationship exists between the antioxidant vitamins, haematological and iron status. The effect of age, sex, socio-economic status and Hb concentration on the antioxidant vitamin status of the subjects is also to be prospectively determined.

CHAPTER TWO

LITERATURE REVIEW

2:1 Menstrual Cycle

The menstrual cycle refers to the culmination of all cyclic changes evident in the non-pregnant female reproductive system (Green, 1991). It includes the periodic preparation for ovum production and ovulation. Normally if the ovum is not fertilised during ovulation, there is the shedding of the uterine mucosa into the uterine cavity, leading to a process called menstruation (Guyton, 1991). Bleeding occurs for 3-5 days. The sequence of events is repeated monthly at an interval of 28 days until the onset of menopause at the age of 45-55 years (Green, 1991).

2:2 Ovulation

Owen (1975) defined ovulation as the culmination of the follicular phase. This occurs on the 14th day before menstruation. The follicular cell is known (Ganong, 1983) to enlarge and finally rupture with the release of the ovum or ova into the fimbriated end of the fallopian tube, where it migrates to the uterus. Speroff and Wiele (1971), reported that during the ovulatory period, there is increased secretion of luteinising hormone and the follicle stimulating hormone with a corresponding decrease in estrogen secretion. Progesterone secretion is activated and the rupture of the

follicle occurs 16-24 hours after the luteinising hormone peak. If the ovum is not fertilised, it remains in the uterine cavity for 14 days. On the 28th day it is then shed together with the endometrium as menses.

2:3 Fertilisation

Jones et.al. (1989), defined fertilisation as the point where the sperm deposited in the female genitalia meets the ovum at the ampulla. For successful fertilisation, sexual exposure must occur within the ovulation period. Collins (1990) indicated that the ovum is transported to the uterus. It has been shown (Guyton, 1991) that following implantation, the fetal-maternal complex also provides its own gonadotrophin which is referred to as Human Chorionic Gonadotrophin (HCG). This is secreted by the conceptus (Speroff and Wiele, 1971). Human Chorionic Gonadotrophin is seen to increase significantly in the maternal circulation after ten days of implantation. Subsequently, amniotic fluid, yoke sac and primitive streak are formed. Trimor-Tirtsch et.al.,(1988) reported that fetal heart beat is detectable at the third and fourth week after the follicular rupture.

2:4 Pregnancy

Pregnancy is a complex physiological process that occurs following the attachment of one or more potential offspring to the lining of the uterus (Collins, 1990). It is the product of

fertilisation which progresses to the development of a full term fetus (Green, 1991).

During pregnancy, the gravid individual undergoes series of physiological adjustments in order to maintain maternal homeostasis and fetal growth (Hytten and Leitch, 1971). Keele et.al.,(1983) highlighted other physiological changes that accompany pregnancy to include the growth of the fetus and the placenta, the enlargement and hypertrophy of the reproductive organs and an increase in circulative blood and other body fluids.

2:5 *Complications in Pregnancy*

Harrison (1982) reported anaemia in pregnancy as the major nutritional disorder affecting maternal and fetal outcome in the tropics. High illiteracy amongst women of reproductive age group, poor nutrition and poor antenatal care have been reported as predisposory factors precipitating the disorder. Isichei et.al.,(1978) also noted toxemia in pregnancy as one of the complications found in primigravid women during pregnancy. Damisse (1990) attributed the high increase of toxemia in pregnancy in women in developing countries to poverty and malnutrition. Toxemia of pregnancy is characterised by proteinuria, edema and high blood pressure (Wyn, 1982). Arlin, (1977) reported the symptom of toxemia to occur by the twentieth week of pregnancy.

Wynn (1982) and Crowther (1990) independently identified eclampsia which is often associated with retardation of fetal growth, acute renal failure, hemolysis and jaundice as another complication of pregnancy. Other secondary complications of pregnancy include spontaneous abortions, ectopic pregnancy and diabetes mellitus. Diabetic pregnancy is characterised by large babies, fetal death and high incidence of pre-eclampsia. Malarial infections have also been reported (James .,1984) to seriously jeopardise the outcome of pregnancy, resulting in a high incidence of abortions, fetal death and premature delivery of infants in the tropics.

2:6 Maternal Weight Gain in Pregnancy

Lawson et.al.,(1988) indicated that maternal weight gain is the best clinical parameter to adjudge the progress of pregnancy. Jelliffe (1966) reported that well fed healthy women usually gain about fifteen to twenty-five percent (15-25%) of their pre-gravid body weight as a result of the developing foetus, placenta, uterus and amniotic fluid and breast enlargement. McClaren (1981) however stated that an average weight gain of 10.9kg is common for most pregnant women, the product of conception ,accounting for fifty percent of the total weight gain. The expanded maternal blood volume accounts for another eighteen percent and the rest of the gain is usually fat with one or two kilogrammes of excess body weight at term. Hytten and Leitch, (1971) indicated that

weight gain in pregnancy is slightly more in young women than older women and in primigravidae than multigravidae.

2:7 Maternal Nutrition in Pregnancy

Available evidence (James, 1984) indicates that the quality of pregnancy and fetal outcome are related to maternal health and nutritional status. Although conflicting reports (Widdowson, 1979) exist in literature with respect to need for increased dietary intake during pregnancy. Other authors (Mclaren, 1981, Hytten, 1990) have provided evidence to indicate that fetal demand is an over-riding factor that necessitates increased intake during pregnancy. Naeye (1979), for instance, observed that in most developing countries maternal malnutrition is the major cause of maternal and fetal complications. In pregnancy the nutrient requirements are increased. A higher daily recommended dietary allowance (RDA) is therefore recommended for pregnant women. Present RDA suggests an average energy allowance calorie increament of 300kcal above normal requirements for non pregnant women (Arlin, 1977; NRC, 1989). Iron supplementation is recommended during the second and third trimesters at the level of 30-60mg per day (McClaren, 1981) while additional requirements for vitamin A during pregnancy is 20-50%. The increment in most vitamins and minerals often range between 25-40% above pre-pregnancy state.

2:8 Fetal Nutrition in Pregnancy

Guyton (1991) reported that nutrition in the fetus during the first few weeks of implantation is provided by trophoblastic digestion and phagocytosis of the endometrium. At this time, the placenta and its blood supply are not sufficiently formed to supply the fetus with nutrients. This type of nutrition by trophoblastic and phagocytosis persists until the twelfth week of pregnancy. Rosso (1977) reported that nutrients are transferred to the fetus from the mother via three major processes, the transfer of nutrients to blastocyte and later to the sinusoidal space before placenta formation and finally the transfer of nutrients via the placenta after implantation. The placenta is the semi-permeable membrane that is connected to the fetus via the umbilical cord and functions in maternal-fetal exchange (Hytten and Thompson, 1977; Ganong, 1979). Vobecky et.al.,(1982) reported that the fetus is supplied all its nutritional needs by the placenta.

Robertson (1980) highlighted four basic transfer mechanisms for the fetal-maternal nutrient transfer. The transfer mechanisms are simple diffusion, active transport, facilitated diffusion and placental synthesis. Mineral salts such as Sodium and Potassium, pyridoxine and lipid-soluble vitamins A,D and E are transferred to the fetus by simple diffusion. Miller and Meritt (1979) reported that the water-soluble vitamins on the contrary are actively transported across the

placenta because fetal levels often exceed maternal values. Amino acids, Calcium and Magnesium are also transported into fetal circulation via active transport.

The established transport system for placental transfer of glucose, the energy source of the fetus is by facilitated diffusion while cholesterol and fatty acids are transferred by placental synthesis. The latter are believed to be synthesised in the placenta, where they are subsequently supplied to the fetus (Hytten and Leitch, 1971). Vobecky et.al.,(1982) reported that placental transfer of nutrients is unidirectional from mother to fetus and is independent of maternal influence. Maternal iron is for instance transferred to the fetus at the expense of maternal erythropoiesis and the storage iron in the liver.

2:9 Fetal Birth-Weight

Fetal birth weight has been shown to be of primary importance in the determination of the weight of the fetus. Hytten and Leitch (1971) reported that the average gestational age for normal full term baby is 280 days at birth. The two best predictors of infant birth weight are the amount of weight gained during gestation and maternal pre-gravid weight. Birth weight is affected by other factors in addition to maternal diet. They include the sex of the infant, maternal age and height, pre-pregnancy weight-height ratio, parity, smoking

habits, illness and diseases (Letchtig et.al.,1975; Miller and Merrit, 1979; Picone et.al.,1982; Hytten, 1990).

Haste et.al.,(1990) noted that mothers who smoke give birth to low birth-weight infants. Bleeding during pregnancy is also a predictor of low birth-weight infants (Mutale et.al.,1991). Mora et.al.,(1979) indicated that fetal birth-weight is generally considered to be the best measure of the quality of pregnancy. It is also well established that (Sagen et.al.,1984; Saunder et.al.,1990) low birth-weight (<2500g) of fetal weight at term is associated with a high risk of infant mortality and morbidity.

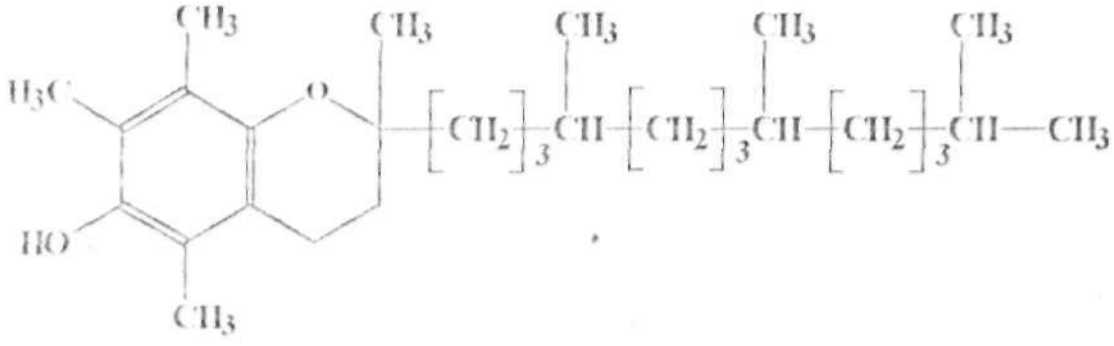
2:10 Maternal-Fetal Ascorbic acid, Vitamin E and Iron Status at Parturition

Many investigators (Baker et.al.,1975; Vobecky et.al.,1982) have assessed the vitamin status of pregnant women at parturition and produced evidence for an association between maternal vitamin status and that of the new born. During pregnancy, plasma tocopherol is increased which decreases during lactation (Hågå et.al.,1982). Wilson and Loh (1973) observed that maternal vitamin C is greatly reduced at conception. They concluded that this phenomenon may be attributed to excessive vitamin C demands imposed on the mother during the varying trimesters of pregnancy. It has been demonstrated (Miller and Merrit, 1979) that ascorbic acid concentration of the venous umbilical blood is significantly higher than that of arterial umbilical blood or maternal

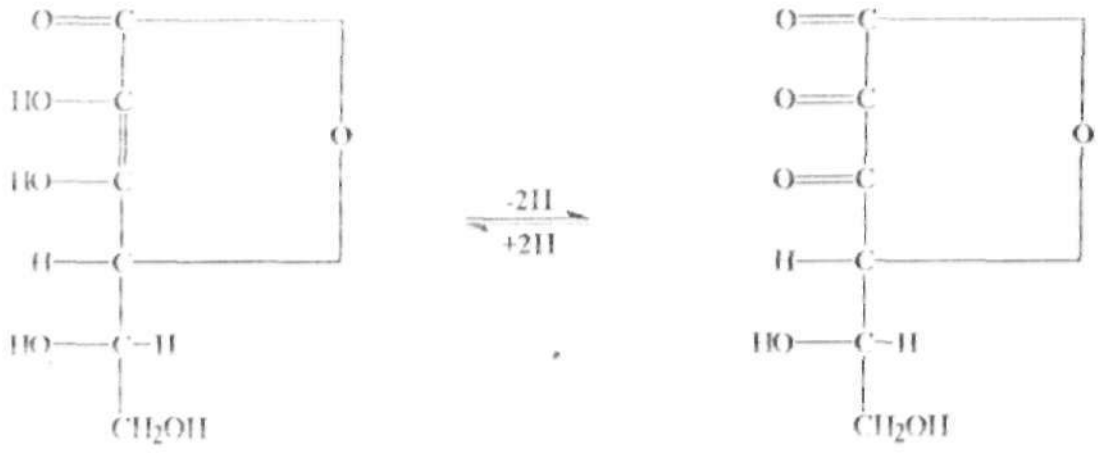
venous blood at parturition.

Martinez et.al.,(1981) reported that in new-born infants, plasma vitamin E concentrations are lower than those of maternal plasma. Fetal iron requirements are also maximal during the last three months of pregnancy.

STRUCTURE OF TOCOPHEROL



STRUCTURE OF ASCORBIC ACID AND DEHYDROASCORBIC ACID



Ascorbic acid
$C_6H_8O_6$

Dehydroascorbic acid
$C_6H_6O_6$

2:13 Properties of antioxidant vitamins (C and E) and Iron

The properties of the antioxidant vitamins are fairly established. Vitamin E is a fat soluble vitamin which is readily destroyed by heat processing and oxidative methods Whitney et.al.,1987). Vitamin C is a water soluble, white crystalline solid which is stable in acidic environment but readily destroyed in alkaline or normal medium. It is liable to heat, oxidation and extremes of pH.

2:14 Occurrence of antioxidant vitamins (C and E) and Iron

Arlin (1977) reported that excellent sources of ascorbic acid-rich foods are citrus fruits, black currants, green vegetables, cabbage and potatoes. Appreciable quantities of the vitamin have also been found in the liver and melon (Arlin, 1977). Although vitamin E is present in all tissue, it is stored primarily in the muscle and adipose tissue (Hole, 1986). Vitamin E is also widely distributed in vegetable oils such as margarine, salad dressing and shortenings. Foods of animal origin constitute excellent dietary sources of Iron. Underwood (1977) reported that the highest concentration of iron is found in liver, spleen, kidney, heart and the brain. Dried beans and fruits, green vegetables, eggs and cane molasses supply appreciable sources of iron. Prasad (1978) indicated that foods that supply negligible amount of iron include milk and milk products, white flour, sugar and bread.

2:15 Function of antioxidant vitamins (C and E) and Iron

The metabolic functions of ascorbic acid, vitamin E and iron in intermediary metabolism has been firmly established (Vobecky et.al.,1976; Ronnholm et.al.,1989). Ascorbic acid for instance is necessary for collagen synthesis and is involved in the development of healthy bones and teeth. Its role in wound healing, the maintenance of tissue integrity and the alleviation of common cold has also been extensively documented (Whitney et.al.,1985). Vitamin C is an antioxidant and has protective effect in maintaining ferrous iron in its reduced state, thus facilitating iron absorption and erythropoiesis (Baker and DeMaeyer, 1979; Murray et.al.,1990). Vitamin E functions as antioxidant in the protection of cellular lipids, lipoproteins and enzyme systems' susceptibility to lipid peroxidation (Martinez et.al.,1981; Hågå et.al.,1982). Altschule, (1978) reported that vitamin E also protects radical oxidative damage and red blood cells from hemolysis. The vitamin also prevents sterility in rats. Underwood (1981) reported that iron is involved in the synthesis of hemoprotein, myoglobin and hemoglobin, the main oxygen carrier of muscle and blood. It is also involved in the synthesis of cytochrome C, ferrodoxine and other oxidative metabolic chromophores.

2:16 Deficiency of antioxidant vitamins (C and E) and Iron

Whitney et.al.,(1985) documented that the earliest signs of

vitamin C deficiency in humans is a disruption of capillary integrity manifested by gum bleeding and hemorrhage. If the vitamin C status is further depleted, overt signs of scurvy such as weakness, listlessness, aching in the bones and dry rough skin appear. Although vitamin E deficiency in human adults is rare, vitamin E deficiency has been reported by Altschule (1978) to result in a wide range of physiological abnormalities which include hemolytic anaemia and neurological disorders. Leonard et.al.,(1972) reported very low blood vitamin E levels especially in premature or preterm infants, and indicated increased red blood cell susceptibility to hemolysis in these infants. Ibeziako and Ette (1982) also indicated that vitamin E deficiency is associated with malabsorption. Baker et.al.,(1968) associated vitamin E deficiency with hemolytic anaemia, fetal death and resorption.

Available evidence (Pitken, 1976; Jenkinson, 1984) indicated that iron deficiency anaemia is the most common nutritional disorder in children and women of reproductive age in the tropics. Anaemia in pregnancy for instance has been shown to account for over 50% of maternal morbidity and fetal wastage evident in pregnant women. Iron deficiency symptoms include listlessness and fatigue and reduced red blood cell production.

2:17 Metabolism of antioxidant vitamins (C and E) and Iron

The metabolism of iron and the antioxidant vitamins E and C is fairly established. Prasad (1978) observed that the hemostasis of iron is maintained primarily by the adjustment of iron absorption because of body's limited capacity for its excretion. Food iron which is usually in the trivalent form is reduced to the absorbable ferrous state in the stomach. Iron is maximally absorbed at the proximal jejunum. Iron absorption is dependent on various factors which include age, the iron status of the individual and the presence of other inorganic and organic dietary constituents. Iron absorption is inhibited by phytates, phosphorus and tannins (Beaton and Bengoa, 1976; Baker and DeMaeyer, 1979) and foods from plant sources. Underwood (1977) and other workers (Whitney et.al.,1987) have reported that vitamin C enhances iron absorption. The consumption of foods of animal origin also enhances iron absorption. Ingested vitamin C is absorbed from the alimentary canal by a passive pH dependent process (Birch and Parker, 1974).

2:18 Requirements of antioxidant vitamins (C and E) and Iron

The minimum daily recommended allowance for ascorbic acid to prevent scurvy and maintain optimal health has been reported as 30mg for infants, 35-75mg for children and 75mg for adult men and 70mg for women. Additional increase of 70mg is proposed for pregnant women (Murray et.al.,1990).

Whitney et.al.,(1985) indicated that other factors that affect vitamin C requirements include infections, burns, presence of toxic levels of heavy metals, barbiturates and oral contraceptive agents. Available evidence (Bothwell et.al.,1979) indicated that iron requirement is raised during pregnancy as a consequence of fetal growth and increased maternal blood volume. At birth the infant is endowed with about 80mg iron/kg from the mother. This level is considered sufficient to meet requirements for doubling body size during the first few months of life. In premature infants, Bothwell et.al.,(1979) observed that the reserve is reduced. In infancy and childhood iron is required for growth. Vitamin E requirement is also increased during pregnancy. Increased vitamin E requirement is also associated with increased polyunsaturated fatty acids in the diet (Luke, 1984).

CHAPTER THREE

MATERIALS AND METHODS

3:1 Subjects

A total of 60 apparently healthy parturient mothers and their neonates were studied. The control population comprised of 50 non-pregnant women of reproductive age who weighed 62.4±18.4kg, were 1.42±0.21m tall and aged 26.4±1.59 years. The deliveries were vaginal and were at term.

Information on age, parity, dietary intake and fetal indices such as the birth-weight and Agpar-score were obtained via a structured questionnaire. Relevant information on family budget for food, occupation of mothers were used to stratify the population into 'low', 'middle' and 'high' socio-economic strata. The format of the study and sampling techniques were approved by the ABUTH ethical committee.

3:2 Blood Sampling

Fasting blood samples (10ml) were obtained from the antecubital vein of the subjects while fetal blood was obtained from the umbilical cord before the expulsion of the placenta. An aliquot of the blood sample (2ml) was dispensed into vacutainers containing EDTA for Hb and PCV estimation while the serum was obtained from centrifuged blood and stored for vitamin C, vitamin E and Iron analyses.

3:3 Estimation of Hemoglobin

Principle:

Hemoglobin estimation involves the oxidation of Iron(II) of hemoglobin to Iron(III) by Ferricyanide followed by the conversion of this complex into the cyanomethemoglobin by the addition of Potassium cyanide.

$$Hb\ Fe(II) + Fe(III)(CN)_6^{3-} \longrightarrow Hb\ Fe(III) + Fe(II)(CN)_6^{4-}$$

$$Hb\ Fe(III) + CN^- \longrightarrow Hb\ Fe(III)CN$$

Procedure:

Hb concentration was determined by the cyanomethemoglobin method (Drabkin, 1951).

An aliquot of blood (0.02ml) was dispensed into 5ml of freshly prepared Drabkin solution, mixed thoroughly and allowed to stand for 10 minutes for maximum color development. The absorbance was then read at 540nm in a colorimeter.

Hb for samples was calculated as:

$$Hb\ g/dl = 251\left\{\frac{Au \times Cs}{As}\right\} \times \frac{1}{1000}$$

where,

251 = Dilution factor of blood to Drabkin's solution (0.02µl to 5.0µl)

Au = Absorbance of sample

As = Absorbance of standard

Cs = Concentration of sample

3:4 Estimation of Serum Vitamin E

Serum vitamin E was measured by the fluorometric micromethod developed by Hansen and Warwick (1969).

Procedure:

Into three sets of tubes A,B,C was dispensed 0.2ml of sample, 0.2ml of standard and 0.2ml of water respectively. Distilled water 1.0ml was added to each tube and mixed for 30 seconds. Subsequently, 2.0ml of ethanol was added after 30 seconds followed by the addition of 5.0ml of Hexane, 30 seconds later. The tubes were centrifuged at 900 x g for 5 minutes. Fluorometric measurement of Vitamin E was made on the supernatant solution.

Vitamin E level was calculated as free vitamin E

$$\text{Vitamin E} = \frac{(\mu F)h}{sf} \text{ mg/dl}$$

where,

μF = The fluorescence of the unknown

sf = The fluorescence of the standard, and

h = The standard concentration in mg per 100ml.

3:5 Estimation of Ascorbic Acid

Ascorbic acid was measured via the modified procedure proposed by Roe (1961).

Principle:

A protein-free filtrate of plasma (3.0ml) was prepared by the

addition of Trichloroacetic acid (7.0ml) to 1.0ml of plasma. Charcoal (0.25g) was added to the filtrate (3.0ml) and the ascorbic acid in the filtrate was oxidised to Dehydroascorbic acid. Dehydroascorbic acid was coupled with 2,4-dinitrophenyl hydrazine (0.5ml) to form the 2,4-dinitrophenyl osazone. Treatment of the osazone with strong sulphuric acid caused rearrangement to yield a yellow coloured complex which was measured at 515nm. Serum ascorbic acid was calculated as

mg ascorbic acid/100ml serum

$$\frac{(Ax - Axb)}{(As - Asb)} - Ab - Abb \times 0.01 \times \frac{100}{0.6}$$

Ax = Sample test

Axb = Sample control

As = Standard test

Asb = Standard control

Ab = Blank test

Abb = Blank control

3:6 Determination of Serum Iron

Serum iron was determined by colorimetric method proposed by International Committee for Standardisation in Hematology (ICSH), Bothwell et al. (1979).

PROCEDURE

Iron-free water (4ml) was added to the tube marked "blank", 1ml of standard was added to the tube marked "standard", then to the third tube (test), 1ml of serum and 4ml standard were

added.

To each of the tubes, 1ml of protein precipitant was added, mixed, allowed to stand for 5 minutes then centrifuged for 20 minutes at 6000 RPM.

The chromogen 1ml was added to each tube containing 1ml of supernatant solution. All tubes were Vortex mixed and allowed to stand for 5 minutes. The colorimeter was calibrated with iron-free water, and reading was taken at 562nm

Serum iron was calculated as:

$$\frac{T - B}{S - B} \times 200\mu g/100ml$$

Statistical Analyses

All data are presented as mean ±SD. One way analysis of variance (ANOVA) and multiple range test was used to ascertain the differences between means. Correlation coefficients and regression analysis were used to ascertain metabolic inter-relationships between fetal and maternal variables. A probability <0.05 (95%) was adjudged significant.

CHAPTER FOUR

RESULT AND DISCUSSION

4:1 Vitamin and Iron Status of non-parturient Mo their Cord Blood

Biochemical data obtained from the present study rev the mean vitamin E concentrations for non-pregnant women resident in Zaria is 1.05±0.31mg/dl. This similar to those reported by (Vobecky et. al.,19 group of college women, but higher than the 0.43 reported by (Leonard et. al.,1972) for a selected non-pregnant females. Adopting a serum t concentration of 0.5mg/dl as a level of normalit women may be said to have acceptable vitamin E stat population. It is evident that the present findin

In the present study, the measurement of hematological parameters (Hb and PCV) and serum iron were used as indices of iron status. Available data revealed that mean Hb and PCV for these women ranged from 11.0 to 14.3g/100ml (mean 12.8g/100ml±1.0) and 32 to 42% (mean 38.0%±2.97), respectively. These values were consistent with those reported by Murray et. al., (1978), for a group of non-pregnant Nigerian women of reproductive age. Adopting an Hb<12g/100ml as indicative of acceptable Hb status, only 20 percent of these women were anaemic. None of the women had an Hb<11.0g/100ml.

The mean serum iron for the parturient women was 143.65±55.07μg/100ml. Cook, (1980) had earlier established a serum iron concentration of 100μg/100ml as indicative of adequate iron status among women. Our data revealed that majority of the subjects (85%) maintained acceptable iron status.

4:2 Effect of Age and Parity on Iron and Antioxidant Status of Non-pregnant Women

The effects of age and parity on iron status, serum vitamin E and ascorbate of the non-parturient subjects are shown in Table 1. The mean age for control subjects was 26.45±7.02 years, while parity ranged from 0 to 8. In fact 55% were primigravidae while 45% were multigravidae. Age correlated positively (r=0.71, P<0.01) with parity. However, age or

parity had no significant effect ($P>0.05$) on the serum vitamin C and E concentration of the subjects. In most subjects the serum iron decreased with increasing age. This phenomenon may be a consequence of poor dietary habits and/or the depletion of iron stores as a consequence of infection (Harrison, 1984) or physiological stress imposed by either repeated pregnancy (Jenkinson, 1984) or menstrual blood loss (Wynn, 1982). Control subject that had not previously delivered (non gravida) had better Hb and PCV concentrations than multigravidae.

It is important to note that subjects were on similar dietary vitamin C intake which in essence lends support to insignificant variation in serum ascorbate levels observed for subjects in this study.

TABLE 1: EFFECTS OF AGE AND PARITY ON ANTIOXIDANT VITAMINS (E & C) AND SERUM IRON OF NON-PREGNANT WOMEN

Effects of Age

AGE (years)	Hb (g/100ml)	PCV (%)	Vit C (mg/dl)	Vit E (mg/dl)	Fe (µg/dl)
14-19	13.56	39.60	0.99	1.11	166.00
n=10	±0.47	±1.36	±0.39	±0.11	±50.83
20-24	12.33	39.33	0.97	1.16	186.67
n=7	±1.10	±2.49	±0.18	±0.21	±51.86
25-29	12.87	38.67	0.63	1.15	163.33
n=7	±0.84	±2.49	±0.11	±0.04	±28.67
30-34	12.58	37.40	1.30	1.14	132.00
n=13	±0.95	±3.14	±0.03	±0.07	±34.87
35-45	12.25	35.25	0.73	0.68	83.25
n=10	±0.79	±2.28	±0.03	±0.10	±30.03
Parity					
para 1	13.37	39.20	0.80	1.16	154.00
	±0.60	±1.78	±0.10	±0.12	±39.29
para 2	11.77	38.00	1.16	1.09	180.00
	±0.56	±2.83	±0.10	±0.14	±74.83
para 3	12.70	37.00	1.05	1.17	105.00
	±2.50	±7.00	±0.09	±0.03	±51.94
para >3	12.38	36.80	1.08	0.94	125.60
	±1.08	±3.60	±0.75	±0.38	±45.23

n = Number of subjects.

4:3 Effect of Haematological Status and Socio-Economic Status on Vitamin C, Vitamin E and Serum Iron of Controls

The effect of socio economic strata and Hb on the antioxidant status and serum iron concentration of the non-pregnant female population is presented in Tables 2 and 3, respectively. Neither Hb concentration nor socio-economic status had any significant effect on the antioxidant vitamins of the subjects. However, Hb correlated positively with PCV (r=0.72) and vitamin C (r=0.31). Likewise, PCV was correlated positively with both serum vitamin C (r=0.30) and vitamin E (r=0.35) concentration (Table 4). The significant association that was evident between PCV and vitamin C or E tends to suggest a role for both vitamins in erythropoiesis. Vitamin E may be needed to keep Vitamin C in a reduced state (Drake and Fitch, 1980).

TABLE 2: EFFECT OF SOCIO-ECONOMIC STATUS ON HEAMATOLOGICAL VARIABLE IN CONTROL SUBJECTS

Socio-economic Status	M-Hb (g/100ml)	M-PCV (%)	M-Vit C (mg/dl)	M-Vit E (mg/dl)	M-Fe (µg/dl)
Low (n=14)	11.20 ±0.90	33.13 ±4.05	0.60 ±0.15	1.04 ±0.31	143.65 ±55.07
Middle (n=28)	12.01 ±1.61	35.40 ±2.41	0.96 ±0.20	1.25 ±0.31	306.00 ±182.20
Higher (n=8)	12.50 ±1.98	37.00 ±3.33	0.96 ±0.05	1.66 ±0.43	320.80 ±184.00

n = Number of subjects.

TABLE 3: EFFECT OF HAEMATOLOGICAL STATUS ON VITAMIN C, VITAMIN E AND SERUM IRON OF NON PREGNANT WOMEN

Hb (g/100ml)	PCV (%)	VIT.C (mg/dl)	VIT.E (mg/dl)	Fe (μg/dl)
11-12 (n=7)	35.20 ±3.66	1.12 ±0.03	0.73 ±0.25	149.60 ±82.47
>12 (n=43)	38.93 ±1.81	0.89 ±0.08	1.15 ±0.10	141.67 ±39.48

TABLE 4: INTER-RELATIONSHIP IN VITAMIN C, VITAMIN E AND IRON STATUS OF CONTROL POPULATION

Parameters	Regression equation	Pearson Coeff.	Level of
Vit C vs Vit E	y = -0.149+0.76x	r = 0.344	p> (0.05)
Vit C vs Fe	y = -0.1933+0.0197x	r = 0.632	p> (0.05)
Age vs Parity	y = 28.090+1.933x	r = 0.418	p> (0.05)
Hb vs PCV	y = -72.170+2.204x	r = 0.720	p< (0.05)
Vit E vs Fe	y = 0.234+0.006x	r = 0.573	p> (0.05)
Hb vs Vit C	y = 1.34+0.670x	r = 0.310	p> (0.05)
PCV vs Vit C	y = 32.12+0.240x	r = 0.300	p> (0.05)
PCV vs Vit E	y = 7.680+0.411x	r = 0.350	p< (0.05)
Age vs vit C	y = 55.471+3.865x	r = 0.845	p> (0.05)
Age vs Vit E	y = 58.962+8.575x	r = 0.716	p> (0.05)

Although Drake and Fitch, (1980) have reported that vitamin E may not be ordinarily required for erythropoiesis in humans, accumulating evidence from animal studies (Baker and Frank, 1968) tend to indicate that vitamin E deprivation in animals promotes anaemia as a consequence of ineffective erythropoiesis. Although the biochemical explanation for these associations cannot be ascertained, various workers (Chen et.al.,1977) have related the ineffective erythropoiesis in vitamin E deficiency to a possible sequestration of iron in skeletal muscle as occurs in rabbits or as a consequence of increased susceptibility of erythroid cells to oxidant-induced haemolysis.

The association between ascorbic acid and Hb or between acorbic acid and PCV may be due to the well established inter-relationship between ascorbic acid and iron metabolism. Ascorbic acid is known to be involved in maintaining iron in the ferrous state thereby facilitating the absorption of iron from the gastro intestinal tract.

4.4 **Maternal Nutriture: Effect of Age and Parity**

The effect of maternal age and parity on maternal and fetal antioxidant vitamin (E and C) and iron status are presented in Tables 5 and 6 respectively. The current data revealed that with the exception of women above 35 years of age, who had significantly lower ($P<0.05$) serum vitamin C concentrations

compared to younger women, age and parity had no consistent effect ($P>0.05$) on the haematological and antioxidant vitamin status of the subjects.

TABLE 5: EFFECT OF MATERNAL AGE ON MATERNAL AND CORD CONCENTRATION OF ANTIOXIDANT VITAMINS (E & C) AND IRON

AGE	M-Hb	F-Hb	M-PVC	F-PCV	M-VitC	F-VitC	M-VitE	F-VitE	M-Fe	F-Fe	F-BWT
15-19 n=13	11.9 ±3.0	13.7 ±2.6	37.5 ±8.1	45.1 ±7.3	0.70 ±0.02	0.90 ±0.02	1.50 ±0.20	0.30 ±0.03	122.9 ±59.7	164.6 ±63.9	2.8 ±0.4
20-24 n=17	11.4 ±2.6	13.5 ±2.3	33.1 ±7.1	44.1 ±9.7	0.70 ±0.10	0.90 ±0.11	1.40 ±0.50	0.23 ±0.04	99.0 ±54.4	177.8 ±65.3	3.0 ±0.1
25-29 n=11	12.0 ±2.3	12.6 ±2.5	36.8 ±8.1	39.5 ±4.0	0.60 ±0.20	0.64 ±0.02	1.70 ±0.90	0.30 ±0.24	107.5 ±51.9	165.0 ±56.4	3.2 ±0.2
30-34 n=14	12.6 ±1.9	14.9 ±1.6	39.2 ±7.0	43.0 ±5.1	0.60 ±0.10	0.70 ±0.10	1.20 ±0.15	0.40 ±0.10	131.8 ±79.7	168.8 ±72.7	3.1 ±0.8
35-45 n=5	11.9 ±0.7	13.7 ±1.6	37.4 ±1.8	43.2 ±5.5	0.20 ±0.05	0.50 ±0.02	1.55 ±0.19	0.20 ±0.01	110.0 ±23.5	147.0 ±40.0	3.0 ±0.4

TABLE 6: EFFECT OF MATERNAL PARITY ON MATERNAL PARAMETERS

Parity	Age (yrs)	Wt (kg)	Ht (M)	Hb (g)	PCV (%)	Vit.C mg/dl	Vit.E mg/dl	Fe µg/dl
1	20.24 ±5.74	58.72 ±7.57	1.56 ±0.03	12.09 ±2.69	37.00 ±7.26	0.57 ±0.13	1.36 ±0.02	119.15 ±64.16
2	21.83 ±4.37	50.60 ±9.72	1.52 ±0.02	10.87 ±2.68	32.58 ±8.80	0.66 ±0.20	1.52 ±0.02	91.56 ±45.42
3	26.14 ±3.76	69.40 ±9.30	1.59 ±0.08	11.46 ±2.77	35.00 ±8.79	0.67 ±0.11	1.43 ±0.12	146.13 ±54.73
>3	30.67 ±5.65	73.50 ±5.64	1.54 ±0.04	12.47 ±1.64	38.58 ±5.64	0.53 ±0.10	1.73 ±0.63	112.94 ±63.00

TABLE 7: RELATIONSHIP BETWEEN MATERNAL PARAMETERS

Parameters	Regression Equation	Pearson Coeff.	Level of Significance
Vit.C Vs Fe	y=1.760+0.010x	r=0.0753	p < 0.050
Vit.E Vs Fe	y=1.422+0.004x	r=0.0641	p < 0.050
Hb Vs PCV	y=-17.010+0.787x	r=0.890	p < 0.050
Hb Vs Vit.C	y=6.410+11.102x	r=0.330	p < 0.050
Vit.C Vs PCV	y=33.840+5.024x	r=0.275	p < 0.050
Fe Vs PCV	y=26.023+0.078x	r=0.646	p < 0.050
Hb Vs Fe	y=9.338+0.002x	r=0.438	p < 0.050
Hb Vs Vit.E	y=8.586+2.003x	r=0.359	p < 0.050

Age was however positively correlated with parity (r=0.71) but inversely associated with vitamin C (r=-0.85) (Table 4).

4.5 Effect of Maternal Socio Economic Strata Hb on Maternal Indices

When maternal Hb was used as an index for categorising the subjects, data presented in table 8 revealed that mothers with acceptable Hb (Hb>12.0g/100ml) had significantly higher (P<0.05) serum vitamin C and vitamin E concentration compared to anaemic mothers (Hb<11.0). Such mothers also maintained significantly higher (P<0.05) iron status. Maternal Hb was positively associated with PCV (r=0.76) and vitamin C (r=0.31) while maternal PCV was associated with maternal vitamin C (r=0.30) and vitamin E (r=0.39)

concentrations. Mothers from higher socio-economic strata (Table 9) had significantly higher serum vitamin C and Iron compared to mothers of low or medium economic status.

4.6 Comparison of Biochemical Data for Pregnant and Non-Pregnant Women

In the present study, PCV and Hb was significantly higher ($P<0.05$) for non-pregnant compared to corresponding values for parturient women (Table 10). Serum ascorbate concentration for parturient mothers were also significantly lower ($P<0.05$) than the values observed for control subjects. On the contrary vitamin E concentration of parturient mothers was significantly higher ($P<0.05$) than those observed for control subjects. Likewise, iron status for non-pregnant women was only slightly better ($P>0.05$) than those observed for pregnant women in this study.

TABLE 8: EFFECT OF Hb ON VITAMINS E & C AND IRON CONCENTRATION IN PATURIENT WOMEN

Hb (g/100ml)	AGE (years)	Hb (g/100ml)	M-PCV (%)	M-VIT.C (mg/dl)	M-VIT.E (mg/dl)	M-Fe (μg/dl)
<10.00 (n=10)	22.90 ±3.90	8.44 ±1.48	25.70 ±6.09	0.31 ±0.09	1.14 ±0.67	68.01 ±42.74
=10.00-10.90 (n=12)	24.60 ±7.17	10.48 ±0.44	34.80 ±4.67	0.33 ±0.07	1.58 ±0.48	87.91 ±32.30
=11.10-11.90 (n=7)	27.86 ±10.50	11.66 ±0.27	36.71 ±2.14	0.46 ±0.02	1.70 ±0.44	92.70 ±21.41
>12.00 (n=31)	26.00 ±6.70	13.66 ±1.43	40.58 ±6.44	0.73 ±0.20	1.63 ±0.67	144.31 ±62.6

n = Number of subjects.

TABLE 9: EFFECT OF SOCIO-ECONOMIC STATUS ON MATERNAL PARAMETERS

Socio-economic Status	Hb (g/100ml)	PCV (%)	VIT C (mg/dl)	VIT E (mg/dl)	Serum Fe (μg/dl)
Low (n=10)	11.90 ±1.00	35.40 ±3.72	0.41 ±0.12	1.67 ±0.38	133.00 ±23.30
Middle (n=31)	11.46 ±1.61	33.13 ±5.34	0.42 ±0.15	1.55 ±0.41	163.85 ±21.00
High (n=19)	11.74 ±1.98	36.40 ±5.77	0.60 ±0.25	1.68 ±0.43	190.00 ±20.35

n = Number of subjects.

TABLE 10: COMPARISON OF PARAMETERS FOR PATURIENT AND NON PREGANANT WOMEN

Groups	AGE years	Hb g/100ml	PCV %	VIT.C mg/dl	VIT.E mg/dl	IRON μg/dl	PARITY
Paturient (preg.)	25.42 ±6.90	11.90 ±2.30	38.50 ±7.40	0.58 ±0.11	1.55 ±0.08	114.30 ±59.90	2.48 ±0.4
Controls (non preg)	26.50 ±7.10	12.80 ±1.00	38.00 ±3.00	0.66 ±0.20	1.05 ±0.31	143.70 ±55.10	2.50 ±0.30

4.7 **Fetal Birth-Weight**

In the present study, the mean birth-weight of term babies was 3.02±0.58kg. This was higher than the mean birth weight 2.8kg±0.5 reported by Olusi et. al., (1979) but lower than values (3.40kg) reported by Camilleri and Cremona (1970) for groups of term babies in Europe. Hytten and Leitch (1971) reported a mean birth-weight of 3.1kg from Senegal and 3.19kg from Ghana. Gebre-Medhin and Gobezie (1975) reported a mean birth-weight of 3.1kg for non-privileged and a mean of 3.58kg for privileged women in Ethiopia. Birth-weight has been shown to be affected by nutritional status of mothers. In the present study, birth-weight was not significantly associated ($P>0.05$) with maternal vitamin C, vitamin E and iron status. This is consistent with previous reports (Ibeziako and Ette, 1982). However, mothers aged 25-29 years gave birth to significantly bigger ($P<0.05$) babies than mothers of other age groups. Maternal Hb had no apparent effect on fetal birth-weight (Table 11).

TABLE 11: EFFECT OF MATERNAL AGE, ON BIOCHEMICAL PARAMETERS ON FETAL BIRTH-WEIGHT

AGE	M-Hb (g/100ml	M-PCV (%)	M-VIT C (mg/dl)	M-VIT E (mg/dl)	M-FE (µg/dl)	F-BWT (kg)
15-19 (n=13)	11.93 ±2.98	37.46 ±8.13	0.65 ±0.28	1.52 ±0.76	122.85 ±59.68	2.87 ±0.39
20-24 (n=17)	11.35 ±2.55	33.06 ±7.07	0.65 ±0.20	1.39 ±0.48	99.00 ±54.41	2.97 ±0.56
25-29 (n=11)	11.95 ±2.32	36.82 ±8.08	0.60 ±0.14	1.67 ±0.94	107.53 ±51.94	3.24 ±0.60
30-34 (n=14)	12.57 ±1.90	39.21 ±1.90	0.58 ±0.16	1.68 ±0.45	131.77 ±79.65	3.05 ±0.77
35-45 (n=5)	11.98 ±0.65	37.40 ±1.82	0.16 ±0.05	1.53 ±0.42	110.00 ±23.45	2.98 ±0.39

4.8 *Cord Parameters: Effect of Maternal Age and Parity*

In Tables 12 and 13 are presented the effects of maternal age and parity on fetal antioxidant vitamins and iron status, respectively. Fetal Hb was significantly higher ($P<0.05$) than maternal levels irrespective of maternal age. Cord Hb corresponding to mothers aged 30-34 years was also significantly higher ($P<0.05$) than those observed for women of other age groups (Table 12). Cord vitamin C decreased slightly as the age of the mothers increased. Thus, the younger mothers 17-24 years gave birth to babies with higher ascorbic acid concentrations than older women. Vitamin C levels of cord blood was consistently higher than maternal status. Cord iron concentration was similar and not influenced by maternal age.

It has been reported (Vobecky et.al.,1982) that the level of iron in the fetal blood is always higher than maternal blood, even if the mother is anaemic. The concentration of Hb in the fetus is usually in the normal range and explains the significantly lower levels observed for these parturient women.

TABLE 12: EFFECT OF MATERNAL AGE ON CORD LEVELS OF ANTIOXIDANT VITAMINS (E & C) AND IRON

AGE	F-Hb (g/100ml	F-PCV (%)	F-VIT C (mg/dl)	F-VIT E (mg/dl)	F-Fe (µg/dl)	Birth weight (kg)
15-19 (n=13)	13.74 ±2.57	45.08 ±7.31	0.89 ±0.20	0.26 ±0.09	164.62 ±63.86	2.82 ±0.39
20-24 (n=17)	13.50 ±2.30	44.06 ±9.70	0.89 ±0.18	0.23 ±0.06	177.78 ±65.32	2.97 ±0.56
25-29 (n=11)	12.60 ±2.50	39.50 ±4.00	0.64 ±0.12	0.27 ±0.12	165.00 ±56.40	3.24 ±0.60
30-34 (n=14)	14.90 ±1.55	43.00 ±5.11	0.68 ±0.10	0.32 ±0.16	168.80 ±72.70	3.06 ±0.77
35-45 (n=5)	13.66 ±1.60	43.20 ±5.50	0.48 ±0.02	0.10 ±0.01	147.00 ±40.00	2.98 ±0.39

n = Number of subjects.

TABLE 13: EFFECT OF PARITY ON FETAL PARAMETERS

Parity	Age (yrs)	B- Wt (kg)	Hb (g)	PCV (%)	Vit.C mg/dl	Vit.E mg/dl	Fe µg/dl
1 (n=28)	20.24 ±5.74	2.94 ±0.39	13.97 ±2.45	45.52 ±8.20	0.89 ±0.52	0.26 ±0.03	180.60 ±68.60
2 (n=7)	21.83 ±4.37	2.90 ±0.65	14.00 ±1.80	45.25 ±7.47	0.89 ±0.14	0.21 ±0.03	158.08 ±51.10
3 (n=7)	26.14 ±3.76	3.11 ±0.50	12.36 ±1.99	40.86 ±8.31	0.55 ±0.10	0.30 ±0.13	209.29 ±42.63
>3 (n=17)	30.67 ±5.65	3.09 ±0.67	13.41 ±2.20	41.04 ±7.31	0.67 ±0.14	0.30 ±0.29	151.79 ±63.08

4.9 Effect of Hb on Fetal Status

In Table 14 is presented the effect of maternal Hb on cord levels of vitamin E, C and Iron. All mothers regardless of the Hb value gave birth to neonates with acceptable Hb status. Cord vitamin C concentration increased slightly with maternal Hb concentrations. Cord vitamin E concentration was significantly higher for mothers with low Hb 10.0-11.0g/dl. Likewise, cord concentration was similar, regardless of Hb maternal concentration. Fetal iron was also consistently higher for this group relative to their maternal Hb groupings.

4.10 Mean Values of Fetal Indices Studied

The mean hematological parameters (Hb and PCV) for the neonates was 13.6±2.2g/dl and 43.1±7.8% respectively. The concentration ranged from 8.0-19.3g/100ml for Hb and 22-65% for PCV respectively. The mean iron concentration for the new born was 167.9±62.2μg/dl while mean vitamin C and vitamin E for cord blood was 0.77±0.5mg/dl and 0.27±0.19mg/dl respectively. Vitamin E values were highest in maternal blood (1.55±0.63mg/dl) and lowest in cord blood (0.27±0.19mg/dl).

TABLE 14: EFFECT OF MATERNAL Hb ON FETAL INDICES

M-Hb	F-Hb (g/100ml	F-PCV (%)	F-VIT C (mg/dl)	F-VIT E (mg/dl)	F-FE (μg/dl)	BWT (kg)
<10.00 (n=10)	13.45 ±2.60	42.40 ±11.50	0.55 ±0.09	0.25 ±0.06	173.83 ±46.96	3.05 ±0.37
10-11 (n=12)	13.26 ±1.36	42.30 ±6.81	0.79 ±0.12	0.25 ±0.15	178.08 ±73.20	2.85 ±0.75
11.1-12 (n=7)	12.51 ±2.13	41.14 ±5.80	0.76 ±0.19	0.20 ±0.12	158.57 ±60.46	2.96 ±0.35
>12.00 (n=31)	13.96 ±2.33	44.16 ±7.41	0.82 ±0.23	0.23 ±0.09	164.19 ±64.59	3.08 ±0.60

n = Number of subjects.

4.12 Inter-relationship Between Fetal Parameters

Regression data for cord parameters are presented in Table 15. Cord Hb was correlated positively with cord PCV ($r=0.83$, $P<0.05$), iron ($r=0.280$) but was not related to vitamin C ($r=0.10$, $P>0.05$) or vitamin E ($r=0.035$, $P>0.05$), respectively. Likewise, cord PCV was associated with fetal iron ($r=0.37$, $P<0.05$) as well as with vitamin C but not with vitamin E concentration ($r=0.03$, $P>0.05$). Cord Vitamin C did not correlate ($r=0.169$, $P>0.05$) with either iron or vitamin E levels ($r=0.038$, $P>0.05$). No metabolic inter-relationship was also evident between cord vitamin E ($r=0.169$) and iron concentration.

4.12 ***Relationship Between Maternal and Fetal Vitamin Status***

In this study the vitamin E concentrations were considerably lower in infants compared to maternal values (Table 16) whereas the ascorbic acid concentrations for infants was comparatively higher than maternal values. The significantly elevated vitamin E levels observed for the mothers relative to fetal levels support previous reports by Vobecky et.al. (1982). These authors attributed the phenomenon partly to either a physiological demand of the mothers for increased tocopherol, a release of tocopherol from the liver and fatty tissue to increase placenta and mammary transfer of tocopherol to the fetus (Martinez et.al.,1981), or an increase in the transport capacity of tocopherol in plasma as a consequence of increased ß-lipoprotein and lipids in pregnancy.

TABLE 15: RELATIONSHIP BETWEEN FETAL PARAMETERS

Parameters	Regression Equation	Pearson Coeff.	Level of Significance
Vit.C Vs Fe	y=0.399+0.002x	r=0.169	p > 0.050
Vit.E Vs Fe	y=0.289+0.001x	r=0.119	p > 0.050
Hb Vs PCV	y=0.039+0.306x	r=0.830	p < 0.050
Hb Vs Vit.C	y=13.090+0.470x	r=0.100	p > 0.050
Vit.C Vs PCV	y=44.050+0.202x	r=0.409	p < 0.050
Fe Vs PCV	y=43.850+0.021x	r=0.375	p < 0.050
Vit.C Vs Vit.E	y=0.030+0.435x	r=0.038	p > 0.050
Hb Vs Fe	y=12.189+0.070x	r=0.280	p < 0.050
Hb Vs Vit.E	y=15.997+99.957x	r=0.035	p > 0.050
PCV Vs Vit.E	y=28.193+54.353x	r=0.030	p > 0.050

TABLE 16: INTER-RELATIONSHIP BETWEEN FETAL AND MATERNAL PARAMETERS

Parameters	Regression Equation	Pearson Coeff.	Level of Significance
F-Vit.C Vs M-Fe	y=0.318+0.003x	r=0.465	p < 0.050
F-Vit.E Vs M-Fe	y=0.240+0.0003x	r=0.068	p > 0.050
F-Hb Vs M-PCV	y=12.685+0.208x	r=-5.397	p < 0.050
F-Hb Vs M-Hb	y=10.934+0.217x	r=0.194	p < 0.050
F-PCV Vs M-Hb	y=15.390+2.481x	r=0.757	p < 0.050
F-PCV Vs M-PCV	y=43.106+0.026x	r=0.025	p < 0.050
F-Vit.E Vs M-Vit.E	y=-0.680+0.245x	r=0.090	p > 0.050
F-Vit.C Vs M-Vit.E	y=-0.178+0.622x	r=0.060	p > 0.050
F-Fe Vs M-Fe	y=-458.600+4.813x	r=-0.005	p > 0.050
F-Vit.C Vs M-Vit.C	y=0.778+0.073x	r=0.519	p < 0.050

The latter hypotheses have been more justifiably supported by Hågå et.al.(1982) who observed similarity in the ß-lipoprotein/ tocopherol ratio of neonates and mothers at parturition. Other authors (Leonard et.al.,1972; Martinez et.al.,1981) conclusively reported that the differences in maternal and fetal vitamin E concentrations might be due mainly to differences in maternal-fetal transport capacities for vitamin E in plasma.

In the present study, no metabolic relationship existed between either maternal iron and fetal iron (r=0.005) or maternal and fetal

vitamin E (r=-0.09) (Table 16). The lack of an intricate relationship between maternal and fetal serum iron in the present study validates previous reports (Vobecky et.al.,1982).

In conclusion, in the study, no metabolic inter-relationship was observed between antioxidant vitamins in either non-pregnant or parturient Nigerian mothers.

4.13 CONCLUSION

The antioxidant vitamin status of 55 parturient mothers and their neonates were assessed. Our data revealed that Nigerian paturient women maintain acceptable vitamin C and E status. There was however no metabolic inter-relationship between the vitamin C and E status of the subjects studied.

Comparative data obtained from 50 non-pregnant women of reproductive age also revealed no metabolic association between vitamin C and E status although vitamin C was independently associated with Iron for the subjects.

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