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Antioxidant status of pregnant Nigerian Women at Term and its effect on birth weight

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ABSTRACT: Due to the physiological stress generally imposed on the nutritional status of pregnant women and the emerging interest in the antioxidant status of various groups, we decided to assess the serum antioxidant status [serum albumin, vitamin E and glutathione peroxidase (GSH-Px) activity] of some pregnant Nigerian women at term, in comparison to age-matched non-pregnant women from the same community consuming similar diets. Vitamin E and albumin were significantly lower (0.98 ± 0.32 mg/dl as against 1.15 ± 0.44 mg/dl, $p < 0.02$), while GSH-Px activity was maternal group. Vitamin E showed a positive significant relationship with packed cell volume (PCV) and also with albumin, $r = 0.465$, $p < 0.005$ and $r = 0.344$, $p < 0.05$ respectively) in the pregnant women. Although most of the neonates weighed 2.5kg or more at birth, the results suggested that the material age and not serum antioxidant level was a more important determinant of birth weight in this study. The premature ageing and debility, which accompany some pregnancies, may not be unconnected in part to increase in oxidant stress as a result of depletion of serum antioxidants. It is hereby suggested that a closer attention at the antioxidant status of pregnant mothers could be to their advantage.

Key Words: Pregnancy, vitamin E, albumin, glutathione peroxidase, antioxidant status, birth weight.

Introduction

Due to advances in free radical technology, and because exposure to oxidant molecules issued from the environment and nutrition can generate reactive oxygen species (ROS) such as H_2O_2 , O_2 and OH_2 antioxidant status generally has attracted attention of nutritionists, epidemiologists, and clinicians (1,2). Although free radicals are also formed by normal biochemical reactions involving oxygen occur as part of normal cell metabolism (3), they been implicated in the development of many diseases and in ageing process. (4). Reactions involving free radicals often lead to the production of H_2O_2 , which penetrate biological membranes and attack intracellular phospholipids, carbohydrates metaloproteins, and DNA (2,5). The human body however, is equipped with antioxidant defence mechanism to combat free radicals by scavenging these potentially hazardous ions, (6,7). Primary antioxidant enzymes such as superoxide dismutase, and glutathione peroxidase (GSH-Px) decrease the formation of new free radicals while secondary antioxidants including vitamin E, ascorbic acid, β -carotene, uric acid, bilirubin and albumin, trap these free radicals and prevent their amplification (5). Most humans are reported not to be vitamin E deficient, (8) however, oxidative stress situation may be created when there is imbalance between ROS production and antioxidant defence. Oxidative stress resulting from depletion of antioxidants could arise as a result of malnutrition (9), or under nutrition. During pregnancy there is demand for increased nutrients

for proper growth of foetus and of the placenta and the associated maternal tissues. This can place the pregnant woman under a physiological stress condition. Depletion of the maternal nutrients including intracellular secondary antioxidants would increase intracellular ROS accumulation, (2). This paper reports the result of a study in which the serum vitamin E, albumin glutathione peroxidase activity in relation to birth weight was carried out in some pregnant Nigerians at term.

Subjects and Methods

Subjects:

The subjects consisted of sixty Nigerian women aged (20-35 years) who delivered normal babies vaginally at-term (gestation period 38-41 weeks) at the University of Benin Teaching hospital (UBTH). Our subjects had no history or evidence of chronic systemic illness, including diabetes. They were all non-smokers and were on doctors prescribed drugs (folic acid, fesoate, vitamins B complex and C as well as daraprim). Their dietary history revealed that the women consumed the typical Nigerian diet, which consist of cereals and carbohydrate. Sixty non-pregnant, apparently healthy age-matched, Nigerian women served as controls. They were from the same community and consumed similar diets. Approval for this study was obtained from the Ethics Committee of UBTH and informed consent from the participants.

Methods:

Venous blood sample (5ml) was collected from the mother immediately after delivery and from cord vein within 1 min. of cord clamping. Venous blood samples (5ml) were also collected from the controls subjects. The samples were collected into sterile lithium heparin tubes for serum separation. The serum samples were stored at 20°C until analysed (all samples were analysed within one month of collection). Serum vitamin E, albumin, and serum glutathione peroxidase activity were determined according to standard procedures, (10,11, &12 respectively). The packed cell volume (PCV) was also determined (13). Due to limitations of time and resources, not all studies were performed on all subjects.

Statistics Analysis

The results are expressed as means \pm SD, and compared between the groups Pearson's correlation coefficients were calculated to determine associations between the parameters. Means and associations are considered significant at $p < 0.05$.

Results

Age

The subjects were aged between 20-45 years. Mean ages of 30.92 ± 5.94 and 30.40 ± 7.52 years were recorded for the maternal and control groups respectively and thus they were age-matched (Table 1).

Serum vitamin E and albumin

The serum vitamin E and albumin levels were all significantly higher, ($p < 0.02$ and $p < 0.0001$ respectively) in the non-pregnant females compared to the material group (Table 1). Although the material serum vitamin E level was significantly higher ($p < 0.05$) that that recorded for the cord serum the albumin levels were similar.

Table 1: Comparison of age and antioxidant factors of maternal females and non-pregnant females (controls).

Variables	Maternal females	Non-pregnant females	P-value
Age (years), n = 60	30.92 \pm 5.94	30.40 \pm 7.52	ns
Vitamin E (mg/dl), n = 60	0.98 \pm 0.32	1.05 \pm 0.42	P < 0.02
Glutathione peroxidase (μ g/Hb), n = 30	24.09 \pm 5.08	14.74 \pm 3.05	P < 0.001
Albumin (g/l), n = 30	3.80 \pm 0.39	4.33 \pm 0.32	P < 0.001

Values represent the means \pm S.D.; ns = not significant.

Glutathione peroxidase activity

Table 2 shows that the highest glutathione peroxidase activity (μ g/Hb) was observed in the maternal group (24.09 \pm 5.08), followed by the cord serum (23.77 \pm 5.26). Indeed the control group had the lest value (14.74 \pm 3.05).

The results also indicated that the birth weight of the neonates in kilograms ranged between 1.87 and 4.9 with a mean of 2.97 \pm 0.89. Most of the neonates (60%) weighed \geq 2.5. Only 5% had birth weights \leq 2.0, while about 14% weighed between 2.0 and 2.4.

Table 2: Serum antioxidant factors of cord and pregnant women at term.

Variables	Cord	Pregnant women at term	P-value
Vitamin E (mg/dl), n = 60	0.86 \pm 0.32	0.98 \pm 0.32	P < 0.05
Glutathione peroxidase (μ g/Hb), n = 30	23.77 \pm 5.26	24.09 \pm 5.08	ns
Albumin (g/l), n = 30	3.81 \pm 0.39	3.80 \pm 0.39	ns

Values represent the means \pm S.D.; ns = not significant.

Calculation of Pearson's correlation coefficients for some of the parameters revealed that for maternal group where a mean PCV value of 34.80 \pm 5.03%, was recorded, PCV correlated significantly with albumin (r=0.396, p<0.05, n=60), and also with vitamin E(r=0.344, p<0.05, n=60). There was a positive association between albumin and vitamin E(r=0.465, p<0.05, n=30) in this same group. However, no significant association was observed between GSH-Px activity and vitamin E(r=0.049, p<0.05, n=30). In the control group, albumin correlated with vitamin E(r=0.438, p<0.05, n=30). This group also showed a negative association between GSH-Px and vitamin E(r=-0.168, n=30), which is similar to the observation made in the maternal group, was equally not significant. Birth weight was not significantly influenced by any of the parameters measured in this study with exception of age to which it was negatively associated (r=-0.338, p<0.05, n=60). This relationship however, was not unduly influenced by serum vitamin E level (r₁₂=0.338, p<0.05, r_{12.3}=0.324, p>0.05, n=60).

Discussion

Pregnancy is a physiological state that imposes a significant stress on the nutrition status of the mother. This explains the extra nutrients advocated for women during pregnancy (14). Pregnancy is associated with fat deposit and it has been suggested that plasma tocopherol concentration tend to rise and fall with blood lipids (15), however, the level of vitamin E in the maternal subjects in this study was significantly lower compared to that of the controls. Vitamin E status has customarily been estimated by measuring plasma vitamin E concentrations (16). In this study, increased levels of GSH-Px activity in pregnant women accompanied the low serum vitamin E level. GSH-Px activity has been used as a measure of oxidative stress against serum vitamin E level. (17). Indeed it is reported that vitamin E may protect against oxidative stress-induced increase in GSH-Px activity. According to reports, (17) GSH-Px activity increased significantly in the lungs of rats on diets deficient in vitamin E. Also, vitamin activities including GSH-Px activity (8). Vitamin E promotes normal growth and development and helps in the treatment and prevention of vitamin E deficiency in premature and low birth weight infants. It prevents oxidation of free radicals in the body and also acts as an anti-blood clotting agent promoting normal erythrocyte formation (18). This might explain the observed significant association between PCV and vitamin E in the material group in this study. Although serum vitamin E deficiency is reported not to be common (8), there was a gradient between material and cord blood despite the observation of lower levels of the vitamin in the pregnant compared to the non-pregnant controls. Thus it would be expedient to monitor the dietary vitamin E of pregnant mothers to forestall a sub-optimal level that could predispose them to asymptomatic vitamin E deficiency. Evidence from animal and human studies suggest that vitamin E also plays an important role in the maintenance of immune response. (19). Thus the premature ageing and debility that accompany some pregnancies may be due in part to increased oxidant stress brought about partly by depletion in vitamin E status. Additionally, the level of albumin, another secondary antioxidant in the serum was found to be lower in the maternal subjects in this study. Albumin binds copper ions and haem lightly and iron ions weekly. Albumin acts as a specific antioxidant that also scavenges hypochlorous acid and protects α -antiproteinase against it, (5). The resultant effect of lower levels of vitamin E and albumin could be decreased antioxidant status and increased oxidant stress in the maternal group. Antioxidant status in various groups is now being studied for a better understanding and management of different health conditions, (20,21,22). Since the results of this study suggest that, pregnancy could affect indices of antioxidant status, and investigations suggest that endogenous antioxidant defences are inadequate to prevent oxidative completely, (1) dietary sources or supplements may be especially important. Although vitamin E supplement to mothers three days before delivery did not improve the vitamin E status of the neonates, it improved that of the mothers (23). The magnitude of vitamin E protection may not increase proportionately with increased dietary supplementation (8), but it is our belief that paying a closer attention to the antioxidant status of pregnant women could be to their advantage.

This study also recorded a lower cord vitamin E level ($0.86 \pm 0.32\text{mg/dl}$), compared to that of the mothers ($0.98 \pm 0.32\text{mg/dl}$), but this cord vitamin E value is higher than the $3.8 \pm 0.58\text{L}$ reported by other workers (23). They explained that as vitamin E was a fat soluble, the low level of the vitamin in the neonates was as a result of the paucity of lipids in the circulating blood of the neonates

We conclude from our observation that pregnancy depletes antioxidant status that further research is needed to explore the relationship between material and cord serum antioxidant status and birth weight.

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