

Birth Weight in Relationship with the Level of Vitamin A and Alpha-tocopherol in Cord and Maternal Serum

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Introduction

Birth weight is probably the most important single factor that affects infant's future survival and quality of life. Infants born with low birth weight (LBW) have poorer chances of survival and healthy growth and development than infants born with normal birth weight. LBW-babies experience greater morbidity and mortality and have greater mental and physiological handicaps later in life ^{1, 2}. Because of higher prevalence of intrauterine growth retardation (IUGR) in developing countries, its etiology needs to be well defined. Maternal nutritional status influences infant's birth weight ^{1, 3}. Recent studies indicated associations between maternal vitamin A status, intrauterine growth and neonatal vitamin A status ⁴⁻⁶. LBW, in case of full term infants, was found to be associated with lower maternal serum vitamin A ⁷. Moreover, a cohort of studies revealed a rela-

tionship between fetal growth and vitamin A levels in the umbilical cord ^{8, 9}. Maternal vitamin E deficiency is also one of the features related to prematurity and intrauterine growth retardation ¹⁰. There has been little information in Bangladesh regarding vitamin A and E status of infants at birth. Nor there is any study on maternal status of these vitamins during delivery. Thus, present study was undertaken where we sought to assess the neonatal as well as maternal status of vitamin A and alpha-tocopherol. The study also looked at the degree of association between birth weight and the levels of vitamin A and alpha-tocopherol in cord and maternal serum.

Materials and Methods

One hundred and sixtyfive (n= 165) live born babies and ninety three (n=93) mother-infant pairs were studied in a hospital at Dhaka (Dhaka National Medical Institute

and Hospital). Only full term babies (gestational age ≥ 37 weeks) of normal vaginal delivery were included in this study. Mother's age varied from 15 to 40 years. Mothers with chronic diseases, diabetes, hypertension or complicated pregnancy were excluded. For the assessment of gestational age, mothers were questioned about the last menstrual date with the help of a local calendar and, if necessary, by using local events. Gestational age was taken as menstrual age minus 2 weeks to allow for ovulation.

Measurement of birth weight - Neonate's birth weight was measured by a balance (YAMATO-Japan) to the nearest of 20 g, usually within half an hour of delivery.

Blood collection - Mixed venous - arterial cord blood (10 ml) from the clamped umbilical cord (placental line) just after delivery (prior to expulsion of the placenta) was collected directly into an acid washed tube. Maternal venous blood sample (5 ml) was drawn by a disposable syringe. All blood samples were protected from direct light exposure. Serum was separated by centrifugation and preserved at -18°C until further analysis.

Biochemical analysis - Vitamin A and alpha- tocopherol in cord and

maternal serum were determined simultaneously by HPLC according to Bieri *et al*¹¹, with slight modification. To 150 μl serum (cord/maternal) was added equal volume of absolute alcohol containing internal standards-retinol acetate (50 $\mu\text{g}/\text{dl}$) and alpha-tocopherol acetate (5 mg/dl). The content was mixed well in a vortex and extracted twice in a total volume of 1.0 ml n-hexane. Pooled extract was then evaporated under a stream of nitrogen. Residue was dissolved in 150 μl of absolute alcohol. Ten microliter of this solution was then injected into HPLC (Pye Unicam Model 4010, PU 4020 Detector) at 291 nm using C_{18} column with a solvent system of methanol : water (97.5:2.5). Co-efficient of variation for retinol was 3.75% and that for alpha-tocopherol was 4%.

Statistical analysis - Data were analysed using SPSS (SPSS/PC+ Version 3.0 : SPSS Inc. Chicago). Mean and variation between groups were assessed by one way analysis of variance and Student's-t-test. Pearson-correlation co-efficient was employed to assess the association between variables.

Results

Table-1 shows mean (\pm S.E) birth weight and mean (\pm S.E) concentrations of vitamin A and alpha-

tocopherol in cord and maternal serum. Cord serum vitamin A level was found to be 33.64 $\mu\text{g}/\text{dl}$ (± 0.98) with a range of 14.21 - 91.64 $\mu\text{g}/\text{dl}$, while maternal serum vitamin A was 41.46 $\mu\text{g}/\text{dl}$ (± 1.65) with a range of 18.32 - 89.87 $\mu\text{g}/\text{dl}$. Concentrations of alpha-tocopherol in cord and maternal serum were 0.21 mg/dl (± 0.01) and 0.86 mg/dl (± 0.05) respectively. Cord serum alpha-tocopherol ranged from 0.03 to 0.96 mg/dl, while that of maternal serum ranged from 0.03 to 2.36 mg/dl. Mean birth weight of neonates was 2850 g (± 27) with a range of 1800-4500 g. As depicted in table-2, mean birth weight was found to be 2880 g (± 40) for male and 2820 g (± 36) for female. Birth weight did not vary significantly for the variation of sex; still male infants tended to have higher values as compared to females. Concentration of cord serum vitamin A were 34.34 $\mu\text{g}/\text{dl}$ (± 1.40) for male and 32.08 $\mu\text{g}/\text{dl}$ (± 1.38) for female, while those of alpha-tocopherol were 0.20 mg/dl (± 0.01) and 0.22 mg/dl (± 0.01) for male and female respectively. There was no sex difference for cord serum vitamin A and alpha-tocopherol. As depicted in fig. 1, cord serum vitamin A concentrations were low ($< 20 \mu\text{g}/\text{dl}$) for 19.3 percent, adequate (20-20 $\mu\text{g}/\text{dl}$) for 26.9

percent and above adequate for the rest 53.8 percent of the infants. Maternal serum vitamin A values were low for 4.7 percent, adequate for 24.7 percent and above adequate for the rest 70.6 percent of mothers. Table-3 depicts neonate's birth weight in relation to the levels of vitamin A and alpha-tocopherol in cord and maternal serum. Infants with higher birth weight have been found to have higher values for cord serum vitamin A. Infants having birth weight (≥ 3000 g) had significantly ($P < 0.01$) higher values for cord serum vitamin A as compared to those having birth weight (< 3000 g). Maternal serum vitamin A tended to increase with increasing birth weight. Alpha-tocopherol content in cord and maternal serum did not vary significantly for the variation of birth weight. Though not significantly, maternal alpha-tocopherol tended to increase with increasing birth weight. Birth weight, as depicted in table-4, correlated positively ($r = 0.41$, $P < 0.01$) to cord serum vitamin A, while it tended to correlate ($r = 0.10$) positively to maternal serum vitamin A. Birth weight did not correlate significantly to the levels of alpha-tocopherol in cord and maternal serum, though the trend of correlation was positive.

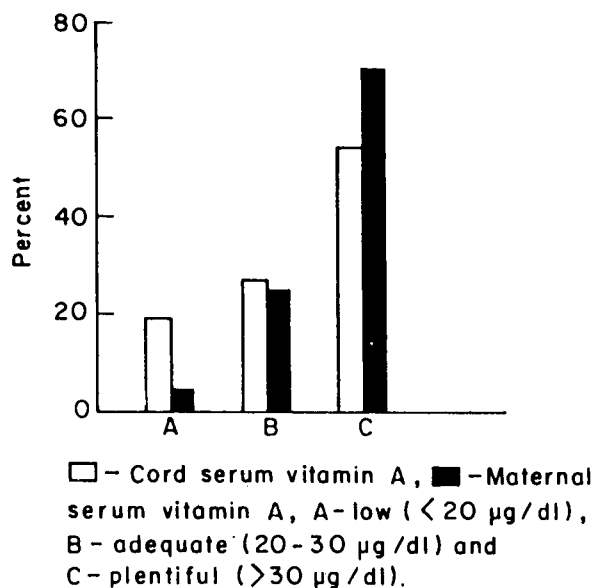


Fig. 1, Distribution of cord and maternal serum vitamin A

Table 1. Mean birth weight and concentrations of vitamin A and alpha-tocopherol in cord and maternal serum.

Measures	Mean ± S. E	Range
Birth weight (g)	2850 ± 27 (258)	1800 - 4500
Cord serum-vitamin A (µg/dl)	33.64 ± 0.98 (238)*	14.21 - 91.64
Maternal serum-vitamin A (µg/dl)	41.46 ± 1.65 (85)	18.32 - 89.87
Cord serum alpha-tocopherol (mg/dl)	0.21 ± 0.01 (230)**	0.03 - 0.96
Maternal serum alpha-tocopherol (mg/dl)	0.86 ± 0.05 (84)	0.03 - 2.36

Number in the parentheses indicates the number of samples, *P < 0.001 and ** P < 0.001 when compared to respective maternal values.

Table-2. Birth weight and the levels of vitamin A and alpha-tocopherol according to sex.

Measures	Sex	
	Male	Female
Birth weight (g)	2880 ± 40 (132) ^a	2820 ± 36 (126) ^{ab}
Cord serum vitamin A (µg/dl)	34.34 ± 1.40 (118) ^a	32.08 ± 1.38 (120) ^{ab}
Cord serum alpha-tocopherol (mg/dl)	0.20 ± 0.01 (114) ^a	0.22 ± 0.01 (116) ^{ab}

Values are mean ±S. E. Number in the parentheses indicates the number of samples. Values in the same line sharing common superscript are not significantly different.

Table -3. Birth weight of neonates in relation to the levels of vitamin A and alpha-tocopherol in cord and maternal serum.

Measures	Birth weight (g)			
	≤ 2500	2600-3000	3100-4500	F value
Cord serum vitamin A (µg/dl)	28.14 ± 1.88 (58) ^a	32.32 ± 1.42 (105) ^{ab}	40.46 ± 1.93(75) ^c	4.7900
Maternal serum-vitamin A (µg/dl)	38.20 ± 3.04 (22) ^a	40.50 ± 2.41 (38) ^{ab}	45.68 ± 3.41 (25) ^{abc}	0.2770
Cord serum alpha-tocopherol (mg/dl)	0.22 ± 0.02 (55) ^a	0.21 ± 0.01 (103) ^{ab}	0.19 ± 0.10 (72) ^{abc}	1.0379
Maternal serum alpha-tocopherol (mg/dl)	0.79 ± 0.07 (22) ^a	0.87 ± 0.08 (37) ^{ab}	0.91 ± 0.09(25) ^{abc}	0.4427

Values are mean ±S.E. Number in the parentheses indicates the number of samples. Values in the same line not sharing common superscript letter are significantly (P < 0.01) different.

Table-4. Correlation co-efficient between birth weight and the levels of vitamin A and alpha-tocopherol in cord and maternal serum.

Variables compared	r	Level of significance
Birth weight and CS vitamin A	0.41 (238)	P < 0.01, S
Birth weight and MS vitamin A	0.10 (85)	NS
Birth weight and CS alpha-tocopherol	0.07 (230)	NS
Birth weight and MS alpha-tocopherol	0.08 (84)	NS

Number in the parentheses indicates the number of samples. CS-cord serum, MS-maternal serum, S-significant, and NS-not-significant.

Discussion

In the present study, mean birth weight was found to be lower than Western values - 3006 - 3385 g^{12,13} but very similar to the Indian values - 2700 - 2870 g^{7,8,10}. It is, however, higher than Bangladeshi means - 2506 - 2593 g reported in previous studies^{14,15}. Incidence of low birth weight (LBW) is 24.8% which is higher than the WHO criterion (10% LBW) suggested for a healthy community (16). In previous studies^{14,15} of Bangladesh, incidence of LBW was reported to be much higher (44 - 45%). Despite an absence of significant sex difference for birth weight, male infants tended to have higher birth weight than females. It is in agreement with the findings of previous investigators^{14,15}.

Mean concentrations of cord and maternal serum vitamin A were within normal range ($\geq 20 \mu\text{g}/\text{dl}$). But 19.3 percent of infants had low cord serum vitamin A at birth, while only 4.7 percent of mothers had low serum vitamin A during delivery. This is noteworthy, as low vitamin A status, with which these infants are born, predisposes them to higher risk of developing postnatal consequences of vitamin A deficiency. Vitamin A level in cord serum was lower than that in maternal serum. Similar observa-

tions have been reported by previous investigators^{8,13,17}.

Lower concentration of cord serum vitamin A is in agreement with poorer placental transport of fat soluble vitamins^{17,18}. Positive correlation between birth weight and cord serum vitamin A, as observed in present study, confirms similar findings made by other investigators^{8,13,19}. Positive effect of cord serum vitamin A on birth weight is of special importance in view of well known role of vitamin A in cellular growth and differentiation²⁰. Influence of retinoic acid on growth hormone production through regulation of gene expression²¹, stresses the importance of retinoids for normal growth and development. Thus, inadequate supply of vitamin A to growing fetus may be partially responsible for intrauterine growth retardation or in other words for low birth weight. Our value for alpha-tocopherol content in maternal serum is lower than the reported values for Japanese (1.13 mg/dl) and Caucasian (1.21 mg/dl) women²². Cord serum vitamin E concentration of Indian infants was reported to be 0.42 mg/dl (10). Though total vitamin E content was not determined in present study, alpha-tocopherol value, which represents about 88% of total

vitamin E²², probably indicates lower vitamin E content as compared to Indian value¹⁰. Despite an absence of sex difference, female infants tended to have higher values for cord serum alpha-tocopherol. Similar observation was made by other investigators^{10, 23}. Lower value for cord serum alpha-tocopherol as compared to maternal value is also supported by similar observation in previous studies^{10, 23}. Lower level in cord serum may be due to the fact that maternal serum alpha-tocopherol rises throughout pregnancy to about 60% above nonpregnancy level²⁴. Since most plasma vitamin E is carried by lipoprotein, this increase is probably associated with the normal hyperlipidemia of pregnancy²⁵. Moreover, lower vitamin E value in cord serum may be attributed to the limited placental transport (18). Despite an absence of significant relationship between birth weight and alpha-tocopherol in cord and maternal serum, maternal alpha-tocopherol tended to increase with increasing birth weight. This trend is in the line of the observation that maternal vitamin E status influences infant's birth weight¹⁰.

We conclude that infants in the present study do not have severe hypovitaminosis A. However, since

19.3 percent of the infants had low level of the vitamin, an increased inclusion of locally available provitamin A-rich food, such as leafy vegetables and colourful fruits in the diet of pregnant and lactating women is recommended. Infant's vitamin A status may also be improved through enriching breast milk by providing vitamin A supplements to mothers immediate after child birth.

Summary

Birth weight was studied in relation to the concentration of vitamin A and alpha-tocopherol in cord and maternal serum. The study was conducted on 165 new born babies and 93 mother-infant pairs. Infant's mean birth weight was 2850 g (\pm 27). Mean concentrations of vitamin A in cord and maternal serum were 33.64 μ g/dl (\pm 0.98) and 41.46 μ g/dl (\pm 1.65) respectively, while those of alpha-tocopherol were 0.21 mg/dl (\pm 0.01) and 0.86 mg/dl (\pm 0.05) respectively. Birth weight and the levels of vitamin A and alpha-tocopherol in cord serum did not show significant sex difference, Cord serum vitamin A was found to be significantly ($P < 0.01$) higher for higher birth weight. Moreover, birth weight correlated positively ($r = 0.41$, $P < 0.01$) to cord serum vitamin A. Maternal serum vitamin A as

well as maternal and cord serum alpha-tocopherol did not show significant relationship with birth weight; still maternal serum vitamin A and alpha-tocopherol tended to be higher for higher birth weight.

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