

MATERNAL HEMOGLOBIN AND SERUM ALBUMIN AND FETAL GROWTH

S. Swain
S. Singh
B.D. Bhatia
S. Pandey
M. Krishna

ABSTRACT

Four hundred and eighty four pregnant women and their off springs were studied to determine the relationship of maternal hemoglobin and serum protein levels on the birthweight of offspring. The correlation coefficient of maternal hemoglobin as well as serum albumin level ($y = 0.1097$ and 0.0936 , respectively) with birthweight were not statistically significant. However, mean birthweight of neonates born to non-anemic mothers was significantly higher than of those born to anemic mothers. The prevalence of low birthweight babies was significantly higher among anemic mothers ($p < 0.01$); however, no such trend was observed in relation to maternal serum albumin ($p > 0.05$).

Key words: Low birthweight, Maternal nutrition, Serum albumin, Maternal anemia.

From the Department of Obstetrics and Gynecology and Pediatrics, Institute of Medical Sciences, Banaras Hindu University, Varanasi 221 005.

Reprint requests: Dr. Sahadev Swain, Senior Resident, Department of Obstetrics and Gynecology, JIPMER, Pondicherry 605 006.

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Many studies from different parts of the world have shown that there is an increased prevalence of low birth weight (LBW) babies as well as increase in perinatal mortality and morbidity in pregnancies associated with maternal anemia(1-3). Bhargava *et al.* (4) reported that once weight was controlled, the maternal hemoglobin levels did not have any correlation with birth weight of the baby. Similarly, various studies have documented a definite correlation of maternal serum albumin level with birth weight of the baby(5) whereas, others could not demonstrate any significant relationship between serum albumin levels and birth weight(6). Bhatia and Tyagi(6) demonstrated that maternal serum albumin lost its influence over birth weight once other variables like maternal height, weight, gestation and hemoglobin level were controlled. We undertook the present study to: (a) examine the relationship of maternal hemoglobin and serum albumin levels with birthweight, and (b) to analyze the hemoglobin and serum albumin levels of mothers who had low birthweight deliveries (preterm as well as term low birthweight).

Material and Methods

Four hundred and eighty four pregnant women and their singleton off springs (dyads) constituted our study population. They were recruited from the Labor Ward of the Department of Obstetrics and Gynecology, Institute of Medical Sciences, Banaras Hindu University, Varanasi over a period of one and half years from July 1986 to March 1988. The first set of dyads included 247 gravidas with uncomplicated pregnancies at 37-41 weeks of gestation and their singleton newborns. Maternal and fetal complications known to influence fetal growth (*i.e.*, hypertensive disorder of pregnancy, cardiac failure, acute or chronic infection, multiple

pregnancy and metabolic disorders like diabetes mellitus) were excluded. Newborns with obvious congenital anomalies, hemolytic disease of the newborn were also excluded from the study. Detailed medical and obstetric history of the mothers were recorded. In addition to maternal height, weight, mid-arm circumference and skinfold thickness, the mother's hemoglobin, serum albumin and total protein levels were estimated by standard technique(7). The newborns were weighed naked immediately after delivery. The gestational age was calculated from the mother's last menstrual period (LMP) and confirmed by clinical criteria(8). The offsprings were classified in relation to gestation and intrauterine growth, using local percentile curve(9). The corresponding data pertaining to the second set of dyads (two hundred and thirty seven consecutive low birthweight deliveries that occurred during the above period) were also collected prospectively. The data were analyzed by simple statistical technique. The tests of significance like Student's t-test and Analysis of Variance (ANOVA) and Chi square test were applied wherever required. Simple and multiple regression analysis was done for the first set of dyads to find out correlation values (r) of the parameters likely to have influence on the birth weight (BW).

Results

Table I depicts the general characteristics of the first set of study population. As it is evident from the analysis of correlation coefficient (r value) of the biochemical parameters, hemoglobin and serum albumin with birthweight were statistically non-significant (*Table II*).

The data in *Table III* shows that the means of birthweight were significantly lower and prevalence of low birthweight

TABLE I – *General Characteristics of the Population Under Study (First Set of Dyads)*

Parameters	Mean/Number ±SD (%)
Maternal weight for	
height ratio index (WHRI)	0.2258 ± 0.0265
Gestation (weeks)	39 ± 1.27
Birth weight (g)	2795 ± 362
LBW (< 2500 g)	67 (35.2)
Ponderal index	2.37 ± 0.52
<i>Intrauterine growth status</i>	
IUGR	13 (05.26)
AGA	216 (83.40)
LGA	18 (07.28)

IUGR = BW <10th percentile for gestation;

AGA = BW 10-90th percentile for gestation;

LGA = BW >90th percentile for gestation.

TABLE II - *Correlation Coefficient of Various Maternal Parameters with Birth Weight (n=247)*

S. No.	Parameters	r-value
1	Age	0.1131 NS
2	Parity	0.0513 NS
3	Literacy	0.1721 **
4	Occupation	0.1626 **
5	Height	0.2991 ***
6	Pre-delivery weight	0.3562 ***
7	Post-delivery weight	0.2939 ***
8	Mid-arm circumference	0.2511 ***
9	Biceps skinfold	0.2310 ***
10	Triceps skinfold	0.2782 ***
11	Fundal height	0.3411 ***
12	Abdominal girth	0.2524 ***
13	Serum albumin	0.0936 NS
14	Hemoglobin	0.1097 NS

NS = Not significant; ** p <0.01; *** p <0.001

TABLE III- Birth Weight in Relation to Maternal Serum Albumin and Hemoglobin (Total number of cases = 247; Total number of LBW = 67)

Biochemical parameters				F-value (one way ANDV A)	Chi-square value
<i>Albumin</i>	≤3.0	3.1-3.5	>3.5		
Total	127	64	56		
Mean BW ±SD	2755±348	2819±367	2840±366	1.3272	3.04
No. of LBW	37	16	14	NS	NS
Percentage	29.1	25	25		
<i>Hemoglobin</i>	<11.0	11.0			
Total	69	178			
Mean BW ±SD	2662±283	2846±377		13.4484***	15.36***
No. of LBW	31	36			
Percentage	44.9	20.2			

*** p <0.001; NS = Not significant; BW = Birthweight; LBW = Low birth weight.

babies significantly higher in those born of anemic mothers (hemoglobin less than 11 g/dl) as compared to non-anemic mothers. There was no significant change in the means of birth weight as well as the incidence of low birth weight babies in relation to maternal serum albumin level.

Table IV shows cross tabulation of the birth weight in relation to maternal hemoglobin and serum albumin. It is evident that the means of birth weight increased significantly in relation to hemoglobin in each maternal serum albumin group. On the other hand, there was no significant change in birthweight in anemic and non-anemic mothers with increase in maternal serum albumin status.

The hemoglobin and serum albumin values of the mothers delivering 237 consecutive singleton low birthweight babies (BW less than 2500 g, 81 preterm, 156 term)

revealed that 65% of mothers who gave birth to low birth weight babies (preterm and fullterm) were anemic. On the contrary, out of all the mothers who gave birth to LBW babies there was no statistically significant difference in the proportion of mothers who were hypoalbuminemic (≤3 g/dl) and those who had normal serum albumin (>3g/dl) (Table V).

Discussion

A number of workers have correlated the birthweight (BW) of newborns with maternal hemoglobin levels(1,4,10-14). Bhatia and Tyagi(6) noted that maternal hemoglobin significantly correlated with BW even after controlling for maternal weight, height and gestation. In the present study, though the maternal hemoglobin did not significantly correlate with BW, the means for BW increased with increasing hemoglobin levels, and the incidence of low

TABLE IV- Birth Weight in Relation to Maternal Serum Albumin and Hemoglobin Level (Cross Tabulation) (n=247)

		Hemoglobin (g/dl)		F-value
		<11	≥ 11	(two way ANOV A)
<i>Serum Albumin</i>				
2.0-3.0	Mean	2634	2819	C=F _{5,241} =15.8809***
	SD	277	365	R=F _{5,241} =1.4105 NS
	n	43	84	
3.1-3.5	Mean	2747	2844	
	SD	243	399	
	n	17	47	
3.6-4.0	Mean	2518	2895	
	SD	208	359	
	n	9	47	

R = Row; C = Column; *** p < 0.01; NS = Not significant.

TABLE V-Distribution of Low Birth Weight Babies in Relation to Maternal Hemoglobin and Serum Albumin Level (n=237)

Group	Total No. of LBW babies	Percentage	Significance of proportion (p value)
<i>Hemoglobin</i>			
Anemic mothers (Hb ≤ 11 g/dl)	155	65.4	4.5 (p < 0.01)
Non-anemic mothers (Hb > 11 g/dl)	82	34.5	
<i>Serum albumin</i>			
Maternal low albumin level (≤ 3 g/dl)	127	53.5	1.09 (p > 5.0) NS
Normal albumin level (> 3 g/dl)	110	46.5	

birthweight (LBW) babies was significantly higher in anemic mothers (Hb < 11.0 g/dl). This is in conformity with earlier reported

studies(1,13,14). We observed no significant relationship of maternal serum albumin with BW. Earlier studies have shown that

the correlation between maternal serum albumin and BW is lost when other maternal parameters are controlled(6,14).

We observed that the means of BW increased significantly in relation to hemoglobin in each maternal serum albumin group. On the other hand, there was no statistically significant change in BW in non-anemic and anemic mothers with increase in albumin level. Bhargava *et al.* (4) observed that if the albumin was normal in average weight women then hemoglobin levels above 10 g/dl had an augmentation of the mean birthweight.

Although the biochemical parameters of maternal nutrition had no statistically significant correlation with birthweight of offsprings, the mean birthweight of non-anemic mothers was significantly higher than the anemic mothers. The prevalence of low birthweight was significantly lower among nonanemic mothers in comparison to anemic mothers. Similarly, amongst the low birth weight deliveries, maternal anemia was present amongst about 65% cases. Maternal hemoglobin is an indirect indicator of overall maternal nutrition and, therefore, a low maternal hemoglobin can identify the undernourished mothers whose fetus may suffer ill effect of malnutrition. On the contrary, maternal serum albumin did not appear to be significant determinant of birthweight; neither there was any significant difference in the incidence of low birth weight babies amongst the mothers with low and normal serum albumin values. Thus of the two biochemical nutritional parameters studied by us, maternal hemoglobin appears to be the more important determinant of birth weight. Although as a single parameter it is not enough to predict fetal outcome, maternal hemoglobin is a simple

inexpensive way of evaluating the maternal as well as fetal nutrition.

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