MATERNAL ANTHROPOMETRY AND HAEMOGLOBIN LEVELS: AS DETERMINANTS OF GESTATION AT BIRTH

By

NARESH KUMAR TYAGI AND MUKESH AGRAWAL

SUMMARY

Three hundred and eighty primipara mothers in the age group of 20-28 years were subjected to anthropometry [weight (MW), height (MH), and head circumference (MHC)] and hemoglobin (MHB) estimations. Gestation maturity was recorded at birth. Its relationship was studied with maternal variables. The mean gestation increased with increase in MW, MH, MHC, MHB. Variation in gestation were maximum ($p < 0.001$) with MHB levels followed by MH and MHC ($p < 0.01$) and MW ($p < 0.05$). Incidence of prematurity was 10% and decreased with increase in all maternal parameters. It was markedly low in cases with MW > 50 kg, MH > 155 cm, MHC > 54 cm and MHB > 11 g/dl.

Introduction

Maternal nutrition is a well known determinant of fetal growth. Various authors have shown the relationship of birth weight of newborn with maternal parameters of health and nutrition, with high incidence of low birth weight (LBW) babies in malnourished mothers. However Low birth weight (LBW) is not a homogenous group, and includes both, LBW babies due to prematurity and full term LBW babies due to intra-uterine growth retardation (IUGR). Therefore from previous studies, it is difficult to identify the influence of maternal nutrition on gestational maturity of foetus.

In India, incidence of prematurity is relatively higher (7.1-22.3%) than in developed countries (approximately 5%). Process of labour also starts relatively early in our country with maximum births between 39-40 weeks of gestation as compared to that between 40-41 weeks in developed countries (Bhargava, 1985). Since maternal malnutrition and anaemia are also widely prevelent in India, it would be worthwhile to examine the effect of maternal nutritional status over gestation. Although, few studies on this aspect are available, none of them attempted to find the direct influence of parameters of maternal nutrition on gestational age.

Therefore, present study was conducted to examine the effect of maternal nutrition on gestational age using maternal weight (MW), height (MH), head circumference (MHC) and hemoglobin levels (MHB) as nutritional parameters.

From: Department of Community Medicine, Mahatma Gandhi Institute of Medical Sciences, Sevagram.

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Material and Methods

Three hundred and eighty consequentively delivered primiparous mothers of singleton live born neonates and their offsprings constituted the study material. All mothers were of age group 20-28 years and gone in labour spontaneously. Mothers with conditions likely to influence fetal maturity e.g., infections, hypertension, asthma, cardiac problems and pregnancy related illnesses were excluded from the study. However, mothers with anaemia were not excluded, as MHB was one of the maternal variables in the study. The mothers giving birth to babies with congenital malformations, hemolytic diseases etc., were also excluded.

All mothers were subjected to weight (nearest to 0.1 kg, taken after 7 days of delivery), height and head circumference (both nearest to 0.1 cm) and hemoglobin estimation just before deivery.

The gestational age was estimated by last menstrual period and subsequently confirmed by the clinical criteria on physical examination of newborn (Dubowitz, 1970). In case of gross disparity between gestational age obtained by two methods, the particular case was excluded.

One way analysis of variance was used to test the significance.

Observations

The mean and SD for maternal weight, height, head circumference and hemoglobin of total 380 mothers were 46.11 ± 1.99 kg, 152.4 ± 1.80 cm, 52.65 ± 1.32 cm and 10.32 ± 1.85 g/dl respectively. The mean gestational age was 38.09 ± 1.87 weeks. Thirty eight (10.0%) deliveries were preterms (< 37 weeks).

The data in Table I shows that the mean gestational age of offsprings increased significantly with increase in MW, MH, MHC and MHB. Highest gestational maturity of the newborns was seen in mothers having weight between 55 to 59.9 ng, height > 165 cm, head circumference ≯ 56 cm and Hemoglobin levels between 11 to 12.9 g/dl. Although not much significant, a decline in gestational age was noted in offsprings of mothers having weight > 60 kg and Hb > 13 gm/dl.

Incidence of prematurity decreased with increasing MW, MH, MHC and MHB (Table I). While 11.39 per cent deliveries were preterm in mothers weighing < 50 kg, in higher MW group frequency of prematurity was only 6.06 per cent. Similarly, in mothers of < 155 cm height prematurity was more common (12.97%) than in relatively tall statured mothers (4.96%). Preterm deliveries were also more frequent in mothers having head circumference of < 54 cm i.e. 11.4 per cent as compared to 4.17 per cent in case of MHC > 54 cm. In present study, incidence of maternal anaemia (WHO critaria, 1959) was 51.58 per cent. In presence of maternal Anaemia, in premature deliveries were approximately three times more common as compared in nonanaemic mothers (14.29% versus 5.43%).

The mean values of all maternal parameters in various categories of gestation increased with duration of gestation. Variations in MH and MHB levels were significant (P < 0.01, and < 0.001 respectively) with respect to gestation. Mothers delivering at full term had relatively more height and haemoglobin concentration than delivering preterm. Mean MW and MHC were relatively less in cases of preterm deliveries but the differences were not satistically significant (Table II).

TABLE I

Gestational Age of Newborns in Relation to Various Maternal Anthropometric Parameters and Hemoglobin Concentration

Maternal Parameter	No. of cases	Gestational Age (wks.) Mean	SD	Number of Preterm Deliveries	Maternal Parameter	No. of cases	Gestational Age (wks.) Mean	SD	Number of Preterm Deliveries
(a) Weight (kg)					(b) Height (cm)				
<40	56	37.71	2.44	8 (14.29)	<140	2	38.00	1.41	0 (0.00)
40-44.9	117	37.86	2.02	14 (11.97)	140-144.9	30	37.00	2.49	7 (23.3)
45-49.9	108	38.20	1.45	10 (9.26)	145-149.9	99	37.92	2.07	10 (10.10)
50-54.9	57	38.05	1.87	5 (8.77)	150-154.9	108	37.86	1.85	14 (12.96)
55-59.9	26	39.23	1.34	1 (3.85)	155-159.9	105	38.50	1.50	5 (4.76)
>=60	16	38.62	0.96	0 (0.00)	160-164.9	29	38.83	1.28	2 (6.90)
					>=165	7	39.00	1.15	0 (0.00)
$F_{5,374} = 3.14^{*}$					$F_{6,373} = 3.74^{**}$				
(c) Head Circumference (cm)					(d) Hemoglobin Concentration (gm/dl)				
<50	4	39.00	0.81	0 (0.00)	<7	12	36.42	3.03	4 (33.33)
50-51.9	76	37.82	1.87	11 (14.48)	7-8.9	47	36.96	2.64	10 (21.28)
52-53.9	227	37.94	2.02	24 (10.57)	9-10.9	137	38.19	1.83	14 (10.22)
54-55.9	69	38.71	1.14	3 (4.35)	11-12.9	155	38.43	1.42	9 (5.81)
>=56	4	40.25	0.50	0 (0.00)	>=13	29	38.34	1.08	1 (3.45)
$F_{4,375} = 4.35^{**}$					$F_{4,375} = 8.87^{**}$				

* $p<0.05$; ** $p<0.01$.

TABLE II
Mean Maternal Variables According to Gestational Age of Newborns

Gestation Age	Maternal Weight (kg)		Maternal Height (cm)		Maternal Head (cm)		Maternal Hemoglobin Covels (g/dl)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
28-30 (4)	43.25	5.67	150.0	1.95	52.68	0.54	9.45	2.70
31-32 (8)	43.25	4.92	148.9	1.31	52.00	0.60	8.16	1.02
33-34 (7)	41.79	5.86	147.4	1.36	51.57	0.93	7.67	2.81
35-36 (19)	45.95	4.66	152.5	1.74	52.61	1.09	10.56	1.73
37-38(184)	45.75	6.17	151.8	1.74	52.58	1.06	10.64	1.90
30-40(141)	46.82	6.45	153.7	1.83	52.76	1.61	10.91	1.59
> 40 (17)	48.12	7.57	153.5	1.55	53.21	1.63	10.83	0.99
	$F_{6,373} = 1.67$		$F_{6,373} = 3.22^{**}$		$F_{6,373} = 1.90$		$F_{6,373} = 6.82^{***}$	
Preterm (38)	44.33	5.12	150.6	1.69	52.29	0.99	9.41	2.26
Fullterm (342)	46.31	6.38	152.6	1.80	52.68	1.34	10.76	1.75
	$F_{1,378} = 3.41$		$F_{1,378} = 4.66^{*}$		$F_{1,378} = 3.08$		$F_{1,378} = 19.3^{***}$	

* $p<0.05$; ** $p<0.01$; *** $p<0.001$.

Discussion

It is well documented that he incidence of prematurity is significantly affected by maternal age, socio-economic status, obstetrical history and presence of various preexisting or pregnancy related infections and illnesses (Koltreider *et al*, 1980) as well as by maternal nutrition status. In present study only primiparous mothers in the age group of 20-28 years and free from preexisting or pregnancy related illnesses were included to avoid variations due to these factors while attempting to study the influence of maternal nutritional status using maternal anthropometric (MW, MH and MHC) and biochemical (MHB) parameters, on gestaion. Cases with neonatal problems such as congenital malformations, Haemolytic disease etc. are known to lead premature delivery (Kaltreider *et al*, 1980); Therefore, in the present study the cases with these problems were also excluded. The socio-economic status was not taken in to consideration because maternal parameters studied are more objective in nature and indirectly reflects the socio-economic status.

In present study, significant influence of all maternal anthropometric parameters on gestational maturity at the time of delivery was observed. Variations in gestational maturity at the time of delivery were more with MH and MHC ($P < 0.01$ in both) than with MW ($P < 0.05$). Since MW is also affected by various physiological and hormonal changes during pregnancy e.g., fluid retention, lesser significance of MW as determinant of gestational age is not unexpected. Significant impact of MH and MHC on gestational age of the newborn suggests that general nutritional status of mother in her earlier growth periods including intrauterine period are far more important in determining gestational maturity of offsprings and chances of preterm deliveries, than the nutrition during pregnancy. Since Height and

Head circumference are also determined genetically, a possibility of genetic factors in causation of preterm deliveries can not be ruled out, as also suggested by Rush (1977). In present study, high incidence of prematurity was observed in short (< 155 cm) and light (< 50 kg) mothers as well as in mothers with head circumference of less than 54 cm. High risk of preterm deliveries has been also reported by Fedrick *et al* (1976) and Gayatri Vijay *et al* (1988) in mothers of < 50.8 kg and < 152.5 cm.

Maternal anaemia during pregnancy is widely prevalent in developing countries (Demaeyer *et al*, 1985) and high incidence of premature deliveries has been reported (Kaltreider, 1980; Tyagi *et al*, 1985) in anaèmic mothers. In present study highly significant ($P < 0.001$) influence of MHB on gestation was found. Mean gestational age increased with increase in MHB levels. Prematurity was also approximately three times more common in anaemic mothers.

To conclude, present study reveals that parameters of maternal nutritional status carry very significant influence on gestational age at the time of delivery, even when other factors known to affect gestation are excluded. Although important, MW is relatively less significant as it is a fluctuating parameter, affected by other pregnancy related factors.

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