

**A STUDY OF CORRELATION BETWEEN THE MATERNAL WEIGHT
GAIN DURING PREGNANCY, HEIGHT AND SERIAL SERUM
PROTEIN ESTIMATION WITH FOETAL OUTCOME**

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Introduction and Review of Literature

Birth weight is one of the important indices in estimating the health and maturity of the newborn. Extremes of birth weight are of great concern both to the obstetrician and pediatrician. The large babies usually present difficulties during delivery and are liable to complications in the neonatal period, whereas low birth weight babies are at risk both during intrauterine life as well as after birth.

The birth weight depends on multiple factors such as maternal weight gain, height, socio-economic and nutritional status etc.

Maternal Weight Gain

Slemons and Fagan (1927) studied weight gain during pregnancy in 500 cases and found that the weight of the newborn at term paralleled the weight gain in the mother during pregnancy. Various other workers have also reported a positive correlation between maternal weight gain during pregnancy, and baby's birth weight.

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Toombs and Tenn (1931), McIlroy and Rodway (1937), Waters (1942), Klein (1946) and Rohatgi and Bhalla (1975) failed to establish any such relationship.

Das (1976) found that there was correlation between birth weight of newborn and maternal weight gain upto 7 kg, after that no significant correlation could be established.

Maternal Height

The physical dimension of the mother has a recognizable influence on the birth weight. The taller mothers give birth to heavier babies (Niswander and Gordon, 1972; Lennei, 1942; Thomson, 1951; Hewitt and Stewart, 1952; Canley *et al*, 1954).

Baird (1945) studied 8,808 mothers and observed that when mother was less than 5 feet in height, 34% of the newborns were between 5.5-6.5 lbs and only 5.5% of the babies were over 8.5 lbs. With maternal height 5½ feet and above 13.7% of the babies were over 8.5 lbs.

Kloosterman (1970) also stated that for every centimetre increase of mother's height above baseline value, there is an increase of 16 gms in baby's birth weight.

Niswander and Gordon (1972) reported sharp increase in birth weight as maternal height increased progressively

above 60 inches. Rohatgi (1975) observed significant increase in mean birth weight of the babies whose mothers were taller than 140 cms but Tiwari and Roy (1977) did not find any correlation between height of the mother and weight of the newborn.

Maternal Serum Protein

Very few studies have been done regarding the relationship of maternal serum protein to the birth weight of the baby though a lot of work has been done on the level of maternal serum protein in normal and abnormal pregnancies.

Singh *et al* (1967) reported that there was no correlation between maternal serum protein and infants' birth weight.

Material and Method

The present study included 150 pregnant women who were followed up from 8-16 weeks of pregnancy to delivery. The total number of patients selected for the study was 180. Patients with the history of toxæmia in the previous pregnancies were excluded. Thirty patients had to be excluded from the study due to either abortion, multiple pregnancy, premature labor, still birth or loss of follow up.

On the first visit a detailed history was taken. Socioeconomic status was ascertained according to ICMR classification. Routine antenatal check up was done including height and weight and blood pressure record, urinalysis and haemoglobin estimation.

Serum protein estimation was done at the first antenatal visit and again at 30 and 36 weeks of pregnancy. A total of 500 samples of serum proteins were studied, though only 450 were analysed in this study.

Baby weight after delivery was noted in Kilograms.

Ten patients in this study developed

pre-eclamptic toxæmia. They were admitted to the hospital and treated conservatively. Rest of the patients were admitted in the Labour room at the onset of labour.

The weight was recorded by the same individual on the same weighing machine with the same clothings on the first visit followed by at 20, 24, 28, 30, 34, 36, 37, 38 and 39 weeks of gestation. Height of the patient was measured in centimeters at the first antenatal visit without any footwear with the help of a tape.

Total serum protein estimation was carried out by conventional Biuret method.

Observations

A total of 150 normal pregnant patients were selected for this study out of which 10 developed pre-eclamptic toxæmia in the 3rd trimester of pregnancy. Majority of the patients were in the age group of 21-25 years i.e. 49.34%, the best fertility period as such with the multigravidas predominating (59.33%).

Majority of the patients (51.34%) belonged to class III and none belonged to class VI (classification of ICMR) of socio-economic status.

Weight Gain During Pregnancy

The weight gain ranged between 3 kg to 12 kg (6.6-26.4 lbs) with the mean weight gain of 6.43 kg with standard deviation of 1.57 kg in 150 patients studied.

In 140 patients in whom the pregnancy continued normally the weight gain ranged between 3 kg to 11 kg (6.6-24.2 lbs) with the mean weight gain of 6.27 kg with S.D. of 1.43 kg. In 10 patients who developed signs of pre-eclamptic toxæmia the weight gain ranged between 7 kg to 12 kg (15.4-26.4 lbs) with the average weight gain during pregnancy being 8.65 kg with S.D. 1.87 kg. Primigravidas gained more

weight during pregnancy (6.78 kg) than multigravidas (6.34 kg).

Relationship of weight gain of mother and birth weight of baby is seen in Table I which shows that in cases of normal pregnancy the birth weight of the newborn was directly proportional to the weight gain of the mother upto 9 kg. Thereafter the number of cases were too small to determine any significant correlation.

linear regression equation is a straight line and also called prediction equation which is statistically highly significant with the value of $p < 0.001$. From this equation it is possible to predict the value of birth weight from the given value of maternal weight gain. The regression equation or prediction equation for baby's birth weight in relation to maternal weight gain is as follows.

$$\text{Baby's birth weight in Kg} = 2.212 +$$

TABLE I
Weight Gain of Mother and Birth Weight

Weight gain in Kg	No. of cases	Percentage	Mean weight gain in kg	S.D.	Mean birth wt. of baby in kg	S.D.
<4 kg	10	6.67	3.75	0.35	2.49	0.23
4.1-5	23	15.33	4.74	0.26	2.68	0.19
5.1-6	40	26.67	5.80	0.25	2.70	0.24
6.1-7	36	24.00	6.76	0.25	2.79	0.15
7.1-8	28	18.66	7.70	0.25	2.92	0.26
8.1-9	7	4.67	8.92	0.19	3.13	0.31
9.1-10	3	2.00	9.80	0.29	3.03	0.36
>10.1	3	2.00	11.50	0.50	2.95	0.58

Fig. 1 shows linear regression equation for the weight gain in pregnancy in relation to the baby's birth weight. This

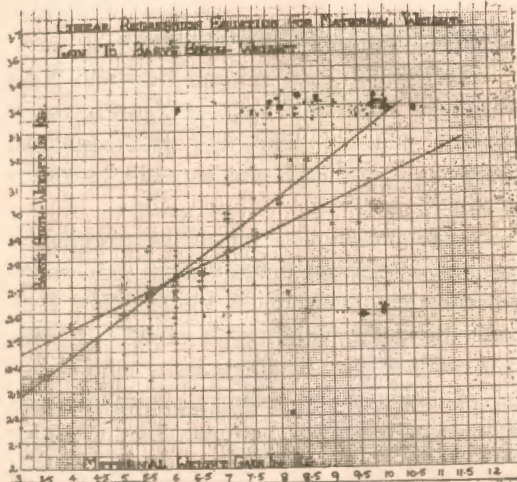


FIG: 1

$0.087 \times \text{mat. wt. gain in Kg. } 2.212 = \text{intercept derived from multiple linear regression equation.}$

0.087 is regression coefficient.

Height of Mother

The height of the mothers ranged between 130 cm to 162 cm with the average height of 147.8 cms with S.D. of 5.3 cm.

No definite correlation could be obtained between the height of the mother and the weight of the newborn as seen from Table II.

The multiple regression equation shows a significant relationship between the maternal weight gain and baby's birth weight as seen from regression analysis and the corresponding P value of < 0.001 but height measurement with the baby's

TABLE II
Height of the Mother and Birth Weight

Height in cms	No. of cases	Percentage	Mean birth wt (kg)	S.D.
<140	18	12.00	2.63	0.24
141-145	33	22.00	2.84	0.30
146-150	56	37.33	2.75	0.24
151-155	33	22.00	2.81	0.30
156-160	8	5.34	3.01	0.36
>161	2	1.33	2.91	0.30

TABLE III
Relationship of Regression Equation Between Maternal Weight Gain and Birth Weight

Variable No. 1	Regression co-efficient	Variation of regression co-efficient	STD errors of regression	Computed T-value	P value
X (1)	.000412	.00001	.00366	1.12695	0.2
X (2)	.08456	.0015	.01234	6.84822	0.001

Variable X1—Height of mother
X2—Weight gain of mother

birth weight could not be correlated as seen from Table III.

Serum Protein in Pregnancy

No definite correlation could be drawn from the serum protein values to the birth weight of the newborn as seen from Table IV.

the newborn as a part of the weight gain during gestation is contributed by the foetus.

A significant correlation was observed between 3-9 kg of maternal weight gain to 2.49-3.13 kg of the baby's birth weight in this study.

Nathanson (1950), Mukherjee and

TABLE IV
Serum Protein Values and Birth Weight

No. of cases	Percentage	Serum protein in gm% Range	Mean value	Mean birth wt. of baby in kg.	S.D.
16	10.67	5.1-5.5	5.40	2.77	0.33
77	51.33	5.6-6.0	5.81	2.75	0.25
50	33.33	6.1-6.5	6.26	2.82	0.22
7	4.67	6.6-7.0	6.61	2.69	0.33

Discussion

It is reasonable to expect some correlation between the maternal weight gain during pregnancy and the birth weight of

Biswas (1959), Hytten and Leitch (1964) and Love and Kinch (1965) reported a definite correlation between maternal weight gain and baby's birth weight.

Toombs (1931), McIlroy and Rodway (1937), Waters (1942) and Klein (1946) did not observe any correlation between the maternal weight gain and the birth weight of the baby.

As formula established by Eastman and Jackson (1968) a similar formula was formulated by multiple linear regression in this study to estimate the birth weight of the baby from the weight gain during pregnancy (Mentioned in observations).

By multiple regression analysis a significant correlation was observed between the maternal weight gain during pregnancy and the baby's birth weight as the p value being < 0.001 .

Our findings are in agreement with the results of Bhatt *et al* (1972) and Das (1976). Bhatt *et al* (1972) also reported a definite correlation between the baby weight and the maternal weight gain upto 7 kg only. But beyond that the results were not significant.

Das (1976) also reported a positive correlation between the birth weight of the newborn and the maternal weight gain upto 7 kg after that no significant correlation could be established.

Height of the Mother and Birth Weight

No positive correlation between the height of the mother and the birth weight of the newborn could be obtained in our study. This is in agreement with that of Eastman and Jackson (1968) and Tiwari and Roy (1977).

Lennei (1943), Baird (1945), Thomson (1951), Hewitt (1952) and Canley (1954) reported a positive correlation between the height of the mother and newborn's weight.

Niyogi and Gajwani (1963) observed a correlation between the mean infant weight to the maternal height upto 58 inches. Thereafter no correlation between the two was observed.

Love and Kinch (1965), Kloosterman (1970) and Shaw and Shaw (1972) also reported good correlation between the maternal height and baby's birth weight.

Even by multiple regression analysis no definite conclusion could be drawn between the height of the mother and the baby's birth weight.

Serum Protein in Pregnancy

There was a gradual fall in the level of serum proteins as mentioned under observation. Our results were consistent with the observations of Kishore and Gupta (1963) and Basu and Arulanantham (1973) who also reported a continuous decrease of plasma proteins during pregnancy.

Plass and Bogert (1924) reported a decrease of plasma proteins from 6.93 gm% (1st trimester) to 6.21 gm% (6th month) followed by an increase to 6.61 gm% at term. Bagga and Mullick (1966) observed a continuous decrease of serum protein from 7.02 gm% at 4-8 weeks of gestation to 5.78 gm% between 21-24 weeks and then rose to 5.81 gm% between 33-36 weeks of pregnancy.

The decrease of serum proteins during pregnancy is due to hydraemia, growing foetal demands, nutritional deficiencies and disturbances in hepatic function.

No significant correlation was observed in this study between the maternal serum protein values and the birth weight of the newborn. Singh *et al* (1967) also reported similar findings.

Conclusion

1. The mean weight gain was 6.43 kg with S.D. 1.57 kg, range being 3-12 kg.
2. Maximum weight gain occurred between 21-30 weeks of pregnancy i.e. 3.58 kg.
3. There was correlation between

- height of the mother upto 160 cm and weight gain during pregnancy.
4. A significant correlation between the maternal weight gain during pregnancy and the baby's birth weight was observed upto 9 kg of weight only. There onwards the observations were inconclusive.
 5. The maternal height per se played a minor role in determining the birth weight.
 6. No significant relationship was established between the maternal serum protein level to the birth weight of the newborn.

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