

# Influence of Maternal Nutritional Status During Pregnancy on the Birth Weight of the Newborn

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## Abstract

**Background-** The factors that affect the supply of nutrition to the fetus depend on the maternal body composition, size as assessed by the pregnancy weight and the weight gain during pregnancy **Objective:** To establish correlation between maternal body mass index and of maternal nutritional status during pregnancy with the birth weight of the new born. **Method-** This was a hospital based prospective study carried out at Dr.B.R. Ambedkar Medical College Hospital, and K.C. General Hospital, Bangalore during the period of Oct. 2001-Sept.2002. The subjects for the study were pregnant women delivering at full term Majority of the pregnant women participated in the study were in the age group of 20-30 years. **Results-** 58 female and 50 male babies were considered for the study, they had a mean birth weight (in Kgs) of  $2.60 \pm 0.28$  and  $3.01 \pm 0.41$  respectively. There was a statistically significant positive correlation between maternal body mass index with birth weight in Group I and Group II ( $P < 0.05$ ) However in Group III male and female babies were non significant. There was no significant correlation between maternal hemoglobin content and birth weight of male babies.

**Conclusion-** It was concluded that there was a significant positive correlation between the maternal nutritional status with the birth weight of the babies.

**Keywords:** Body mass index, Newborn weight, Hemoglobin, Maternal nutritional.

## Introduction

Pregnancy is a physiologically demanding condition. The outcome of pregnancy is strongly influenced by the maternal biosocial factors, intrauterine age, genetic and biological characters of the fetus.

The Birth weight or the Body mass index of the newborn has been used as an important tool to measure the outcome of pregnancy. The growth of the fetus is influenced by the availability of the nutrients and the supply of oxygen. Thus during pregnancy there is an increased nutritional demand.

The factors that affect the supply of nutrition to the fetus depend on the maternal body composition, size as assessed by the pregnancy weight and the weight gain during pregnancy.<sup>1</sup> The foetal growth is also influenced by maternal nutritional stores the calorie and the protein intake.

The nutritional demand of the fetus draws its supply from the maternal side and grows at her expense. Thus when the mother's diet is nutritionally or calorically inadequate both the mother and fetus suffer from nutritional disorders.<sup>2</sup>

Poorly nourished mother's produce intrauterine growth retarded babies with low both weight with irreversible tissue damage it is reported that neonatal mortality and morbidity is very high in such conditions.

<sup>1</sup> Inadequate nutritional supply to the mother as a result of poor socio-economic status, lack of knowledge

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about the balanced diet consequent to the cultural or poor educational back ground can result in the morbid consequences like severe anemia and malnutrition. The severity of anemia, coupled with demonstrable malnutrition during pregnancy, can frequently predispose to the toxemia of pregnancy.<sup>3</sup>

Pre pregnancy weight and height can be an important factor influencing the birth weight. However it is not very clear whether the weight gain during pregnancy has any impact on the outcome of pregnancy.

Hence the present study was carried out with the objectives to establish correlation between maternal body mass index and maternal nutritional status with the birth weight of the new born.

### Material and Method

This was a hospital based prospective study carried out at

Dr.B.R. Ambedkar Medical College Hospital, and K.C. General Hospital, Bangalore during the period of Oct. 2001-Sept.2002.

The subjects were informed in detail about the protocol. They were explained the inherent risk involved during the course of the study and informed consent was obtained from all the subjects.

The subjects for the study were pregnant women delivering at full term. Majority of the pregnant women participated in the study were in the age group of 20-30 years. However 4 subjects were between 31 & 35 years of age. The subjects considered for the study were screened for the following inclusion and exclusion criteria.

#### Inclusion criteria

**Mother:** Normal healthy pregnant women attending AMC Hospital and K.C. General Hospital below the age of 35 years.

**New born:** Healthy normal full term babies/Vaginal Delivery.

#### Exclusion criteria

**Mother:** Twins are excluded from the study. Pregnant women more than 35 years. Pregnant women with bad obstetric history. Pregnant women with previous history of Pre-Eclamptic Toxaemia Subjects

with the H/o. Major illnesses or clinical examination indicating the possibility of the disease were excluded.

**New born:** Congenital anomalies, Still birth, Hundred and eight subjects satisfied the criteria put forth and were included in the study

**Method of data collection:** The relevant details pertaining to the subjects were obtained by a questionnaire. The Personal details of the subject like Name, age address Educational status and occupation was noted. The Socio economic status was determined by noting the type of family (Nuclear or Joint) and its size. The total family income and per capita income of members of the family was estimated.

The subjects were categorized as belonging to low, lower middle, upper middle, high and above Rs.86,000/- P.A. based on the recommendation of National Council of applied economic research. New Delhi 1993-94. Majority of the subjects belong to the first 3 groups.<sup>6</sup>

The Nutritional Status was assessed by a 24 hours dietary recall. Based on the information furnished the approximate carbohydrate, fat, protein and calorie intake were calculated by using CFTRI nutritive chart (Mysore).<sup>4</sup> The subjects were divided into two groups with caloric intake of less than 2000 K.cal and more than 2000 K.cal.

A detailed menstrual and obstetric history were taken. The age of menarche, regularity of periods and the average duration of flow during each cycle were recorded.

In the obstetric history attempts were made to elicit information regarding the previous pregnancies with reference to abortion, complications during pregnancy and child birth.

The Personal History focused on the habit of smoking, consumption of alcohol and tobacco chewing. None of the subjects considered for the study had a habit of smoking or consuming alcohol.

After the detailed history taking a physical examination was done. In the general examination the build was assessed. The other features like pallor, clubbing, cyanosis, jaundice, pedal oedema enlargement of neck veins and thyroid swelling were observed.

A detailed system wise clinical examination was

conducted to rule out any organic illness.

**Weight of the mother** was recorded to the nearest 500 gms using UNICEF adult weighing machine. The Instrument was standardized with known weights before every weighing session. Same grown of known weight was used for each women and this weight was deduced from the observed value.<sup>5</sup>

**Body mass index (BMI)** was calculated by considering the weight and height of the mother.<sup>6</sup>

$$BMI = \text{Weight (in Kgs)} / \text{height (In Meters)}^2$$

The subjects were classified into three groups on the basis of Body mass Index. (BMI). Group I <22.57, Group II 22,57-26.52, Group III>26.52. The value of each group was arrived by taking the mean  $\pm$  SD.

**Birth weight:**Weight of the baby was recorded by using an electronic balance which has sensitivity  $\pm$  5 gms (Electromedik Pvt.Ltd.,)

**Haematological investigation:** 3 ml of blood samples were collected under aseptic precautions mixed thoroughly with EDTA and used for estimation of haematological parameters. By using semi-auto analyser SYSMEX-K-1000 (Transasia Bio Medical Pvt.Ltd., Mumbai).

The RBC count, Hemoglobin content, Haematocrit, MCH, MCHC, MCV were estimated. All haematological parameters were estimated by using a venous sample of blood from the mother and the umbilical cord (Cord Blood).

**STATISTICAL ANALYSIS:** The data obtained was tabulated utilizing computers. The data was analyzed using SPSS (Statistical package for social sciences)

Package. ANALYSIS OF VARIANCE and STUDENT “T” TEST of statistical analysis have been used in this study. P value less than 0.05 was taken to be statistically significant.

**Result:** 58 female and 50 male babies were considered for the study, they had a mean birth weight (in Kgs) of  $2.60 \pm 0.28$  and  $3.01 \pm 0.41$  respectively (Table 1), Male babies weighted more than female babies.

**Table 1: Distributions of Sex of the baby and birth weight**

Sex of the Baby	N	Mean birth weight (In Kgs) $\pm$ SD
MALE	50	$3.01 \pm 0.41$
FEMALE	58	$2.60 \pm 0.28$

Male vs Female  $P < 0.05$

Mothers with a body mass index ( $\text{Kg}/\text{m}^2$ ) of less than 22.57 belonging to group 1 Gave birth to male babies with a mean birth weight (in Kgs) of  $2.59 \pm 0.14$  or female babies weighing  $2.38 \pm 0.40$ . Mothers with a body mass index ( $\text{kg}/\text{m}^2$ ) of 22.57-26.52 belonging to group 11 gave birth to male babies with a mean birth weight ( in kgs) of  $3.40 \pm 0.26$  or female babies weighing  $2.67 \pm 0.24$ . Mothers with a body mass index ( $\text{Kg}/\text{m}^2$ ) of more than 26.52 belonging to group III gave birth to male babies with a mean birth weight (in Kgs) of  $3.40 \pm 0.30$  or female babies weighing  $2.87 \pm 0.67$  (Table ). There was a statistically significant positive correlation between maternal body mass index with birth weight in Group I and Group II ( $P < 0.05$ ) However in Group III male and female babies were non significant ( $P > 0.05$ ).

**Table 2: Correlation of maternal baby mass index and birth weight**

Group	Maternal body mass index ( $\text{Kg}/\text{m}^2$ )	Mean birth weight (In Kgs) $\pm$ SD			
		N	Male	N	Female
I	Less than 22.57	3	$2.59 \pm 0.14$	20	$2.38 \pm 0.40$
II	22.57-26.52	42	$3.04 \pm 0.26$	30	$2.67 \pm 0.24$
III	More than 26.52	5	$3.04 \pm 0.30$	8	$2.87 \pm 0.67$

Group I Vs. II	$P < 0.05$	$P < 0.05$
Group I Vs. III	$P < 0.05$	$P < 0.05$
Group II Vs. III	$P > 0.05$	$P < 0.05$

Mothers with calorie Intake (K cal) of less than 2000 gave birth to male babies with a mean birth weight (In kgs) of  $2.84 \pm 0.22$  or female babies with mean birth weight (In kgs)  $2.41 \pm 0.37$ . Mothers with calorie intake

(k. cal) of more than 2000 gave birth to male babies with a mean birth weight (in kgs) of  $3.14 \pm 0.23$  and  $2.85 \pm 0.33$ . (Table 3). There was a significant correlation between maternal calorie intake and birth weight of male or female babies. ( $P < 0.05$ ).

**Table 3: Comparison of maternal calorie intake and birth weight**

Group	Maternal calorie intake (k.cals)	Mean birth weight (In Kgs) $\pm$ SD			
		N	Male	N	Female
I	Less than 2000	23	$2.84 \pm 0.22$	33	$2.41 \pm 0.37$
II	More than 2000	27	$3.14 \pm 0.23$	25	$2.85 \pm 0.33$

Mothers with hemoglobin content (gm / dl) of less than 10 gave birth to male babies with mean birth weight of  $2.98 \pm 0.30$  or female babies with  $2.44 \pm 0.32$ . Mothers with hemoglobin content (gm / dl) of more than 10 gave birth to male babies with mean birth weight of  $3.09 \pm 0.21$  or female babies with a mean birth weight of  $2.94$

$\pm 0.40$  (Table 4) There was no significant correlation between maternal hemoglobin content and birth weight of male babies ( $P > 0.05$ ) and there was a significant correlation between maternal hemoglobin content and birth weight of female babies ( $P < 0.05$ ).

**Table 4: Comparison of maternal hemoglobin content and birth weight**

Maternal hemoglobin Content (gm/dl)	Mean birth weight (In kgs) $\pm$ SD			
	N	Male	N	Female
Less than /equal to 10	40	$2.98 \pm 0.30$	36	$2.44 \pm 0.32$
More than 10	18	$3.09 \pm 0.21$	14	$2.94 \pm 0.40$

Male babies  $P > 0.05$

Female Babies

$P < 0.05$

## Discussion

The height and weight of the mother, therefore the body mass index is an important factor in deciding the weight of the newborn. The earlier reports, Meharban singh (44) indicate mothers weighing less than 40 kg with a height of less than 145 cms (BMI =  $19.04 \text{ kgs} / \text{m}^2$ ) gave birth to low birth weight babies. In the present study women with a body mass index less than 22.57, gave birth to babies with a lower birth weight when compared to the mothers with a BMI more than 22.57. It is also observed that extremes of age resulted in low birth weight babies.

The mothers who had a low body mass index evidenced by a small stature had inadequate skeletal

growth, a small sized uterus resulting in a compromised placental size.

These maternal limitations could adversely affect the development of the foetus due to poor fetoplacental perfusion.<sup>8</sup>

It is observed that the protein calorie intake has a direct bearing on the outcome of pregnancy. Mothers with a intake of less than 2000 k cal gave birth to babies with a poorer birth weight as compared to mothers with higher and satisfactory calorie intake. Fetus, a true parasite depends on the mother for its nutritional requirement this exerts an extra load on maternal nutritional intake. In conditions of unsatisfactory calorie intake there is a competition between mother and her

growing foetus to satisfy the individual requirement.<sup>9</sup>

Thus in cases of a significantly reduced calorie intake, the foetal growth gets compromised resulting in a low birth weight babies.

The other aspect to be considered while evaluating the outcome of pregnancy is the individual constituent of the composite diet consumed by the pregnant women. It is reported that the proteins, iron, folate, iodine and calcium have a demonstrable influence in the growth and development of the foetus. Though it is observed that protein forms a key factor in the diet there appears to be a conflict in the quantity of proteins to be consumed during pregnancy. A low protein intake results in low birth weight babies due to intrauterine growth retardation. On the other hand a relatively high intake of protein is said to be detrimental to the growth and development of the foetus.

In our study, though we have considered the influence of calorie intake on the outcome of pregnancy, we have not been able to establish a relationship between the individual components of the diet on the intrauterine growth. It is our candid opinion that demonstrating a probable relationship between the major food components like carbohydrates, fats and proteins with the development of the foetus holds a great promise for management of intrauterine growth retardation and to reduce the incidence of low birth weight babies.

A poor nutrition and inadequate supplementation during a stressful condition like pregnancy could retard the placental development, reducing its size with a poor foeto placental perfusion. These changes ultimately will result in a low birth weight baby.<sup>10</sup>

It was observed mothers with lower haemoglobin content gave birth to female babies with a lower birth weight. However this relationship was not true for the male babies the earlier reports by Thangaleela & vijayalakshmi<sup>2</sup> have reported iron status in the mother and newborn as evident from haemoglobin content indicate the transfer of iron from mother to the foetus. Further it is reported babies born to anaemic mothers were not necessarily iron deficient. When they correlated the indicators of newborn status with that of the mother they observed the iron deficiency in the mother adversely influenced iron status of the new born.

Tyagi et al have reported deficiency of maternal haemoglobin had intrauterine growth retarding effect . Thus it could be concluded that female babies were more susceptible to intrauterine growth retardation when the maternal haemoglobin content was significantly low.<sup>11</sup>

However the male babies appear to be less susceptible for retarded intra uterine growth despite a reduction in maternal haemoglobin. The placental HCG stimulates the formation and release of testosterone from the developing foetus between 10 and 20 weeks of gestation. As the foetal androgens enhance the erythropoiesis growth retardation of male babies is not commonly observed.

## Conclusion

It was concluded that there was a significant positive correlation between the mothers having body mass index upto 26.52 with the birth weight of the babies. There was a significant correlation between birth weight of the baby with different levels of maternal calorie intake. The maternal haemoglobin content had an influence on birth weight of the female babies. However no such relationship was demonstrable in case of male babies.

**Conflict of Interest:** None

**Funding:** None

**Ethical Clearance:** Permission for the study was obtained from the College authorities prior to commencement.

## References

1. Viegas O.A.C., Scott P H, Cole T. J, Phyllis Eaton. Dietary protein supplementation of pregnant Asian mothers at Sorrento,Birmingham.II. Selective during third trimester only. British medical journal 1982; 285:592-595.
2. Thangaleela.T and Vijayalakshmi P, Iron status in mothers and their newborns. The Indian Journal Nutrition Dietetics 1997; 34:145-149.
3. Preeti Pandya and Hazra M. N. Feto-maternal outcome in patients of severe anemia in pregnancy. Journal of obstetrics and gynecology of india 1993; 43(1):5-10.
4. Swaminathan Food and Nutrition, balanced diet and Nutritive values of common Indian recipes, 1<sup>st</sup> Edn, No. 42-45.

5. Carol West Sutor, Nutrition assessment of Pregnant women clinical obstetrics and Gynaecology 1994; 37:3:501-514
6. K. Park. obesity. Park's Text Book of Preventive and Social Medicine. 16<sup>th</sup> Edition. Banarsidas Bhanot Publishers, Jabalpur. 2001. P480.
7. Ghai. O.P, Essential Paediatrics 4<sup>th</sup> Edn, CBS Publishers, New Delhi.p1-4.
8. Roberto Frisancho. A., Jorge Matos and Pam Flegel. Maternal nutritional status and adolescent pregnancy outcome. American journal of clinical nutrition. 1983; 38:739-746.
9. Meharban Singh. Care of New born, 5<sup>th</sup> Edn, CBS Publishers, New Delhi.p224-243
10. Devi R.R, Agarwal. K. N. Maternal nutrition and Fetal growth, Indian Paediatrics 1984; 51:443-449.
11. Tyagi. N.K., Bhatia .B.D., Sur. A.M. Low birth weight babies in relation to nutritional status in primipara. Indian Pediatrics 1985; 22:507-449.