Effect of Maternal Body Composition and Hemoglobin Percentage at Term Gestation on Labour and Neonatal Outcome

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Abstract

Background: The Pre-pregnancy body weight and the haemoglobin percentage are two important parameters which determine and influence the maternal and fetal outcome. The fetal weight gain during pregnancy is about 9-12 kgs in Indian conditions. The maternal body composition is dependent on many factors like genetic, constitutional, racial, socioeconomic and nutritional factors

Objectives: To study the effects of maternal body composition and haemoglobin percentage at term gestation on labour and neonatal outcome

Methods: A total of 150 patients were taken into study. Gestational age was calculated from LMP and by early Ultra-sound Examination. Patient's haemoglobin was measured by spectrophotometric method. The following set of measurements were taken by single examiner. Maternal nutritional anthropometric measurements were taken, two to three days before EDD or after completion of 38 weeks by USG.

Results: Around 49% of the mothers belonged to the group 3 and a significant(35.32%) no. of mothers had HB% levels of <9. This indicates the nutritional status of the pregnant women in our population. All the parameters were significantly correlated with HB% when comparison is made between severely anaemic and non- anaemic group.

Conclusion: The young, illiterate women belonging to lower socioeconomic status have poor dietary intake as evidenced by lower fat free mass, fat mass, ANW, BMI and HB%. They showed adverse pregnancy out comes as evidenced by high prevalence of low birth weight babies, lower mean birth weight, lower Ponderal index and lower APGAR scores compared to non-anaemic women.

Keywords: APGAR, BMI, Nutrition, Ponderal

Introduction

The Pre-pregnancy body weight and the haemoglobin percentage are two important parameters which determine and influence the maternal and fetal outcome. The fetal weight gain during pregnancy is about 9-12 kgs in Indian conditions. The maternal body composition is dependent on many factors like genetic, constitutional, racial, socioeconomic and nutritional factors.

Although the overall effect of weight gain during pregnancy has been established, the components of weight gain that is fat versus fat free mass have, been shown to have an independent effect on birth weight.

During gestation alterations in maternal metabolism provides nutrients for fetal growth in addition to maternal and fetal energy requirements. The maternal fat stores are significantly increased in early gestation and provide for energy requirement

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in midgestational to late gestation. All these factors influence the outcome of pregnancy and the infant's birth weight.

A recent study showed that one in five women booking for antenatal care were with increased BMI had more incidences of obstetric complications. They are also more prone to postoperative wound infections, endometritis and subfertility due to increased insulin resistance. In addition, maternal obesity substantially increases a child's risk of being overweight. Off springs of obese mothers are at increased risk of neural tube defects, macrosomia, neonatal death and morbidity associated with subsequent childhood obesity1. And the incidence of obesity complicating pregnancy is now 18-38% of all pregnancies 2,3,4,5.

On the contrary, in developing countries like India we also have a problem of low BMI because of high prevalence of malnutrition. Pregnancies in women with low BMI also is known to be associated with increased risk of preterm deliveries, premature rupture of membranes and low birth weight and low APGAR score. However, it has also shown to have reduction in other pregnancy complications like preeclampsia, diabetes and obstetric interventions.6,7

Anaemia in pregnancy is one of the most important public health problems not only in India but also in most of the South East Asian countries. About 16% to 40% of maternal deaths occur due to anaemia.

Standards laid down by WHO suggests haemoglobin below 11 gm% as anaemia. Incidence of anaemia during pregnancy in India ranges between 65% to 75%8.Birth weight plays an important role in infant mortality and morbidity, childhood development and adult health. Low birth weight is a significant risk factor for adverse health outcomes, including many childhood diseases. Reduced birth weight is related to the risk of type 2diabetes and ischaemic heart diseases in later life. At the other end of the birth weight spectrum, macrosomia increases the risk of caesarean section delivery, delivery complications (i.e., shoulder dystocia) and subsequent childhood obesity 9.

The present study enables the effect of various components of maternal weight gain, also the effect of haemoglobin which is taken as a marker of maternal nutritional status on birth weight and APGAR score. Therefore, this study was done to document the effect of body composition on maternal and fetal outcome.

Materials and Methods

Department and Setting: This study was done at Dept of Obstetrics& Gynaecology,

Sample Size: A total of 150 patients were taken into study.

Gestational age was calculated from LMP and by early Ultra-sound Examination. Patient's haemoglobin was measured by spectrophotometric method. The following set of measurements were taken by single examiner. Maternal nutritional anthropometric measurements were taken, two to three days before EDD or after completion of 38 weeks by USG.

The various anthropometric measurements taken were:

Mid Arm Circumference — It was measured at a point halfway down the -left arm between the tip of acromion and olecranon to the nearest 0.1cm

Skin fold thickness — All measurements were taken with the subject seated on a stool, on the left side of the body with the Harpenden skin fold calipers. Four sites were selected

- Bicep's region over the midpoint of the muscle belly with the arm resting supinated on the subject's thigh.
- Triceps region over the mid part of muscle belly, midway between the olecranon and the tip of the acromion, with the upper arm hanging vertically.
- Subscapular region just below the tip of the inferior the angle of the scapula, at an angle of 45 degrees to the vertical
- Supra iliac region just above the iliac crest in the mid axillary line.

At these four sites, the skin fold was pinched up firmly between the thumb and fore finger and pulled away slightly from the underlying tissues before applying the calipers for the measurement.

- Maternal weight was measured using the same standard hospital equipment before and after delivery to the nearest 0.5 kg.
- Maternal height was taken by a standard height rod to the nearest 1cm.

Figure 1: Recording of Height

BMI as defined by Quetelet was computed as follows:

BMI= weight in kg / [height in mts]2. Post-partum weight was taken for calculating BMI.

Maternal body fat was calculated by the Standard Anthropometric formula

Body fat mass= WB/100 X [(522. 5/DB)-480.5]

DB — Body density, WB -- Body weight.

Body density was calculated by standard formula 'C-M x log of Sum of skin folds' where C = 1.1549, M = 0.0678

Maternal Fat free mass was calculated by subtracting Body Fat mass from the total body weight.

Maternal hemoglobin was measured by Spectrophotometric method.

Neonatal data included

Birth Weight: Birth weight which was recorded within 24 hours after birth on a pre-zeroed electronic weighing balance with the baby naked to the nearest 5 gms.

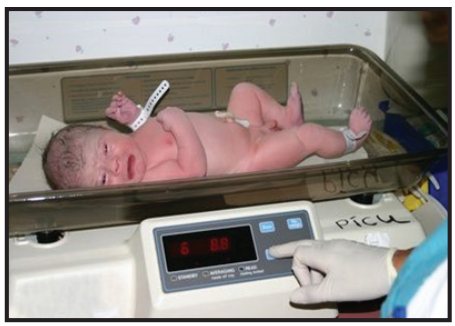

Figure 2: Birth Weight recording

- Length: Length of the baby was measured using an infant meter to the nearest of 0.1 cm.

The criteria taken into consideration for the study were as follows:-

Inclusion criteria

- Singleton uncomplicated pregnancy, booked for regular antenatal care.

Exclusion criteria

- Hypertension
- Endocrinal problems
- Multiple gestation
- Preterm delivery (before 37 completed weeks)
- Any medical illness complicating pregnancy.

Observation and Results

A total of 150 booked patients delivering at the study hospital, who met the criteria for eligibility were included in the study. All patients were divided in to four groups depending on the hemoglobin levels.

Table 1: Distribution based on Haemoglobin

GROUP	HB%	NO	%	MEAN HB%
GROUP 1	< 7 Gms	19	12.67	6.6163
GROUP 2	7.1-9 Gms	34	22.67	8.282
GROUP 3	9.1-11 Gms	74	49.34	10.220
GROUP 4	>11 Gms	23	15.34	11.93

Up to 49%of the mothers belonged to the group 3 and a significant(35.32%) no of mothers had HB% levels of <9. This indicates the nutritional status of the pregnant women in our population.

Table 2: Distribution based on Various maternal and neonatal parameters

Age Group	Frequency	Percentage
<19 Yrs.	22	14.67
>19 Yrs.	128	85.34
Parity		
PRIMI	60	40
Multi	90	60
BMI		

Age Group	Frequency	Percentage
< 20	25	16.66
>20	125	83.33
Literacy		
Illiterate	47	31.34
Literate	103	68.67
Ponderal Index		
<2.3	49	32.66
>2.3	101	67.33
Birth Weight		
<2.5Kgs	28	18.66
>2.5Kgs	122	81.33

Maternal age ranged from 17 yrs. to 32 yrs. About 1/4th of the mothers were young(<20 yrs.). Around 60% were Multipara and 40% were Primi parous. Maternal

BMI was >20 in 83% of the cases and <20 in 16.66% of the cases

Illiteracy was reported in 31.34% of the cases.

Ponderal Index was <2.3 in 32.66% of the cases and >2.3 in 67% of the cases.

Low Neonatal birthweight was seen in 18.66% of the cases.

Table 3: Distribution based on Mode of delivery across groups

HB%	<7	7-9	9.1-11	11
Vaginal Delivery	12(63.15%)	21(61.7%)	44(59.4%)	14(60.8%)
LSCS	7(36.8%)	13(38.2%)	30(40.5%)	9(39.1%)

LSCS was done in Group I, II, III and IV with incidence of 36.8%, 38%, 40.5% and 39%.

Vaginal Delivery was done in Group I, II, III and IV with incidence of 63%, 62%, 59%, 61%.

Table 4: Comparision of Various parameters across all Hb Groups

Hb PARAMETER	Group-I	Group-II	Group-III	Group-IV
	<7% (19)	**7.1-9%(34)**	**9.1%(74)**	**>11%(23)**
ANW	51.55+5.35	55.14+6.22	59.06+2+7.7	64.9+8.31
BMI	19.99+2.11	22.066+2.44	23.31+72.59	25.099+2.92
MAC	22.876+1.924	24.476+2.13	25.07+52.10	26.43+2.02
Body Fat	9.7+2.32	14.2+6.88	14.3+3.71	16.3+3.69
Body Fat %	18.972+3.77	23.885+4.81	24.115+3.73	26.466+3.37
Body FFM	41.193+3.55	41.868+3.8	44.227+5.066	47.633+5.37
Birth weight	2.334+0.19	2.642+0.27	2.83+0.26	3.286+0.402
PI	2.070+0.15	2.338+0.179	2.415+0.161	2.515+0.185
APGAR	8.63+1.38	9.35+1.011	9.35+0.94	9.3+0.97
% of L B W	10%	5.34%	2.67%	0.67%

All the parameters improved as the HB% improved except for the Apgar Scores comparisons between Group-I and Group-II, Group II and Group-III, Group-III and Group-IV, and Group-I and Group-IV were made and the following results obtained.

Body fat free mass weight and Ponderal index had significant correlation with HB% when comparison is made between group I and group II.

Between group II and group III there was not much difference in the parameters except for the birth weight.

Only body fat free mass, birth weight and ponderal index had significant correlation with HB% between group III and group IV.

All the parameters were significantly correlated with HB% when comparison is made between severely anaemic and non- anaemic group.

Discussion

Low birth weight continues to be a significant public health problem. In both developed and developing countries. An infant's birth weight is probably the single most important factor affecting neonatal mortality and is a significant determinant of postnatal, infant and later childhood morbidity. Thus, birth weight has been a target for public health intervention. Therefore, various maternal parameters which influence birth weight were studied.

It was observed that very significant number i.e.,84.67% of patients were anaemic whose HB % was below 11gms.This shows that in India a large number of pregnant women were anaemic in spite of various Government programmes to prevent it and which significantly contributes to maternal and perinatal mortality and morbidity.12.6% of women belonged to severely anaemic group with HB% levels of less than 7gms depicting poor nutrition. It was observed in our study that patients with moderate and severe anaemia had less BMI, body fat, body fat free mass and delivered low birth weight babies with less Ponderal index compared with women who are mildly or not anaemic.

In present study the mean birth weight of babies born to severely anaemic mothers (Haemoglobin< 7 gms) was lowest and that of babies born to mothers with normal hemoglobin values was highest. Babies born to patients with severe anemia had lower Apgar scores. However, there was no correlation of Apgar scores with anemia in other groups.

The effects of components of maternal weight, that is fat and fat free mass on birth weight were considered, it was observed in the present study that body fat free mass has a significant influence on birth weight. Similar observations were made by the study done by Franscisco mardones et al,10 and other studies done in western countries which concluded that maternal FFM was the most important variable, influencing birth weight followed by maternal fat mass.11

The stronger influence of body fat free mass on birth weight compared with body fat suggests that the effect of maternal weight is mainly mediated through genetic or constitutional factors followed by nutritional intake.

The Indian women constitutionally and genetically are of smaller built and also have a poor nutritional intake. These three factors are responsible for the low birth weight babies. The first two factors being unmodifiable, the only means to increase the birth weight of babies born to these women is to improve their nutritional status by increasing the quality and quantity of their dietary intake.

In summary, there appear to be several maternal nutritional variables that seem to be operating in association with low birth weight and IUGR in developing country. While socio-economic status is one such, and may indeed have been issues that underpins many of the other etiological factors It also seems that maternal weight gain is important, in addition to specific nutrients such as vitaminB12,folate and essential fatty acids, particularly n-3 LCPUFA.12 The analysis of the clustering of these risk factors in specific socio-economic or home circumstances, or in specific cultural behaviour, or in food intake patterns is of interest, as such analyses may provide the way forward for effective and sustainable prevention strategies.

In present study a significant number of women (35%) who are pregnant for the first time were very young (below 20 years). This shows that in our population a large number of women are becoming mothers at a very young age which could have detrimental effects on the health of the mother and fetus. This is because dietary intake of teenage pregnant mothers will not be sufficient to meet the requirements of maternal growth and the additional pregnancy demands. Teenage pregnancy is still a common occurrence. It has adverse impact on the health of teenage mothers leading to various adverse maternal and fetal outcomes.

This has been aptly brought out in the present study, where in it was shown that most of the young Primi gravidas were anemic had lower BMI, had less fat and fat free mass and delivered LBW babies with low Pl.

The teenage mothers developed more adverse perinatal complications such as preterm births, stillbirths, neonatal deaths, and delivered low birth weight babies, when compared with those of the adult Primi gravida mothers.40% of the studied patients were Primi gravidas and 60% were multi gravidas. It is seen in the present study that the difference in hemoglobin levels: birth weight, BMI, body fat and fat free mass between the two groups is not significant. However, the percentage of LBW babies in Primi was 21.6% where as it was 16.6% in multis. This correlated well with the study done by Fedrick and Adelstein where in the rate of LBW babies was highest in Primi gravida (33.6%).Thus the rate of LBW babies was high in Primi gravida and this accounted for the seemingly high rate in young women.13

Post-natal weight measured within 48 hours after delivery was used for BMI. This was taken to represent the pre pregnancy BMI. It was seen that 52% of babies born to women of BMI of < 20 were of LBW compared to 12% of babies born to women with BMI of >20. This clearly indicates the strong

influence of maternal height and weight on birth weight. These IOM's recommendations were – for the first time – specified by mother's pre pregnancy BMI group because BMI is a significant modifier of infant's birth weight. Underweight women are more likely to have a low birth weight infant but the risk is reduced if they gain an appropriate amount of weight during pregnancy.14

Normal weight women have the lowest risk for delivering a low birth weight or a high birth weight infant. Overweight women have higher risk for developing gestational diabetes mellitus and delivering a high birth weight infant especially if they gain a lot of weight during pregnancy.

Excessive gestational weight gain is associated with an increase in maternal fat stores rather than being beneficial for fetal growth.

The only significant difference of Apgar scores was observed between severely anaemic and non-anaemic groups.

The mode of delivery based on BMI and HB% was studied and it was noted that the caesarean section rate was upto 42%.This analysis proves that as the BMI rises, there is a rise in C-Section rate. There was no significant difference in the C-Section rate with the severity of anaemia

Recommendations

1. Health education about nutrition during pregnancy may influence mothers favourably and remove the doubts related to diet during pregnancy.
2. Improving the level of education in our society especially female education.
3. Increasing the age at marriage so as to avoid teenage pregnancies.
4. Iron and folic acid supplementation to antenatal mothers.
5. Ensuring antenatal services to all the pregnant women.
6. So, with good antenatal care, certain factors can be modified and thus the incidence of LBW babies can be reduced.
7. Preconception counselling in obese women planning pregnancy should be counselled regarding ideal weight and importance of losing weight before entering pregnancy. Nutritional education, behaviour modification, dieting and exercise should be stressed on.

Conclusion

Maternal nutritional status during pregnancy played a crucial role on the outcome of pregnancy and the birth weight of the infant as shown by the present study. The young, illiterate women belonging to lower socioeconomic status have poor dietary intake as evidenced by lower fat free mass, fat mass, ANW, BMI and HB%. They showed adverse pregnancy out comes as evidenced by high prevalence of low birth weight babies, lower mean birth weight, lower Ponderal index and lower APGAR scores compared to those women with good diet intake, who had no anemia, had more antenatal weight, more body fat and fat free mass who gave birth to bigger babies with good APGAR scores. The rate of C-section is more as the body composition increases.

Ethical clearance- Ethical Clearance was taken from the Osmania Medical College Institutional ethics committee prior to the commencement of the study

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Conflict of Interest - Nil

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