

Correlation of Maternal Anthropometry with Intrauterine Growth Restricted Neonates' Birth Weight

Mithun Chandra Konar*, Nabanita Kora, Kamirul Islam, Archan Sil, Taraknath Ghosh and Kaustav Nayek

Department of Pediatrics, Burdwan Medical College and Hospital, Burdwan -713104, West Bengal, India

QR Code



*Correspondence Info:

Dr. Mithun Chandra Konar, M. D. (Pediatrics),
Assistant Professor,
Department of Pediatrics,
Burdwan Medical College and Hospital,
Burdwan -713104, West Bengal, India

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Abstract

Objectives: To determine the correlation between weight, height and body mass index (BMI) of the mothers with their term intra-uterine growth restricted (IUGR) neonates' birth weight.

Material and methods: An observational, cross sectional study was conducted involving 322 term IUGR neonates and their mothers, and was compared with 336 term appropriate for gestational age (AGA) neonates matched for that gestational age, and their mothers over a period of one year. The anthropometric measurement was done on birth weight, length, head circumference, ponderal index of neonates, and height and BMI of mothers. The maternal weight was obtained from antenatal cards.

Results: Majority (72.04%) of the mothers having IUGR neonates were primi-gravida, 63.04% were of poor economic status. Mean age, weight, height and BMI of the mothers of IUGR neonates were 20.2 ± 0.8 years, 49.1 ± 2.3 kg, 144.1 ± 37.2 cm, and 17.6 ± 2.1 kg/m², respectively. These parameters for the mothers of AGA neonates were 22.3 ± 2.5 years, 54.3 ± 2.7 kg, 155.2 ± 42.1 cm, and 19.2 ± 2.3 kg/m², respectively. Comparison of these maternal parameters between both the groups showed a significantly higher value in the second group ($p < 0.01$ in all cases). Maternal weight, height and BMI showed a strong negative correlation {Pearson's correlation coefficient of -0.53, -0.76, and -0.42 respectively; adjusted odds ratio (95% CI) of 0.72 (0.54-0.91), 0.40 (0.28-0.52) and 0.76 (0.54-0.96), respectively with the neonates' birth weight, but maternal age did not {Pearson's correlation coefficient of -0.32, adjusted odds ratio (95% CI) of 0.89 (0.10-1.55)}.

Conclusion: There are lesser chances of development of IUGR neonates with increase in maternal weight, height and BMI.

Keywords: Intra-uterine growth restricted neonates, weight, height, body mass index.

1. Introduction

Birth weight is an important predictor for both obstetricians and pediatricians. It is a very useful parameter, which could be indicative of the immediate viability of the neonate and the state of maternal health and nutrition during pregnancy [1]. Several maternal anthropometric and demographic variables like pregravid weight, height, body mass index (BMI), gestational weight gain, parity, and gestational age at delivery independently predict birth weight [2]. A low birth weight (LBW) baby bears a greater risk for becoming sick due to various reasons and

ultimately leads to increased neonatal mortality rate. Intra-uterine growth restriction (IUGR) is an important health problem of developing countries as well as the world. These IUGR infants have both short-term and long-term complications, which make them high-risk neonates requiring a vigorous monitoring during immediate postnatal period. These infants are more likely to develop adult onset disease because of fetal epigenetic changes [2].

In general, IUGR neonates are termed for those neonates who weigh less than 10th percentile for their gestational age [3, 4].

So, both term and preterm neonates can be affected and can be symmetrical or asymmetrical IUGR. The terms "IUGR" and "small for gestational age (SGA)" have been used interchangeably in medical literature, but small differences exist between the two [5]. SGA has been defined as those neonates whose birth weight is less than the 10th percentile for that particular gestational age or two standard deviations below the population norms on the growth charts, whereas an IUGR is a clinical definition and applies to neonates born with clinical features of malnutrition and in-utero growth retardation, irrespective of their birth weight percentile. These neonates have higher perinatal morbidity and mortality [5-7], and are at an increased risk of sudden infant death syndrome. It poses a great problem both in developing and developed countries, but more so in developing countries as it has a strong correlation with low socioeconomic status (SES). The nutritional status of women and children is particularly important, because the pernicious effects of malnutrition are propagated to future generations through women and their off-spring. Malnutrition will result in low pregnancy weight gain and IUGR, followed by LBW, with its associated greater risks of infection and higher perinatal mortality rates which only further undermines the economic development of the family and society. Thus, IUGR contributes to the intergenerational cycle of poverty, disease and malnutrition as sketched by United Nations Administrative Committee on Co-ordination / Sub-Committee on Nutrition (ACC/SCN) [8-10]. In this vicious cycle a LBW baby grows up to be a small adult woman, who eventually with early pregnancies in turn bears small children.

IUGR is associated with certain medical conditions having compromised placental circulation, decreased placental weight and surface area. Besides, birth weight among various population depends upon environmental factors (extra fetal) rather than genetic differences in growth potentials [11]. So IUGR can be a normal fetal response to nutritional and/or oxygen deprivation. It affects 3-10% of all pregnancies. 20% of stillbirth occurs in IUGR neonates. In India, according to recent UNICEF surveys, the incidence of IUGR is 25-30% [12]. Prevalence of IUGR in excess of 20% has been recommended as the cutoff point for triggering public health action [13]. There are several studies in English literature which showed the relationship between maternal anthropometry with the birth weight of baby [2, 14, 15].

The present study has been conducted to determine the correlation between weight, height and BMI of the mothers with their term IUGR neonates' birth weight in Burdwan district, West Bengal, India.

2. Material and Methods

2.1 Study Area

The study was conducted in the Department of Gynecology & Obstetrics and Department of Pediatrics, Burdwan Medical College & Hospital, Burdwan, West Bengal, India; over a period of one year (from March, 2013 to February, 2014).

2.2 Sample size calculation

Average number of deliveries per year in our institution during last three years was 18236 and prevalence of IUGR neonates in India is 30% of total deliveries [12]. Taking a 95% confidence interval and 5% confidence limit, the estimated sample size became 318. We selected 322 IUGR neonates by simple random sampling.

2.3 Study population

A total of 322 term (born at 37-40 weeks of gestation) IUGR neonates and their mothers were taken as samples, and compared with 336 term appropriate for gestational age (AGA) neonates matched for that gestational age, and their mothers.

2.4 Case selection criteria

Cases were selected consecutively according to inclusion and exclusion criteria. In our study we used the term SGA and IUGR interchangeably. The inclusion criteria included neonates born at gestational age of 37-40 wks, birth weight < 10th percentile for that age, normal term neonates, and the booked antenatal mothers. Exclusion criteria on mother's part included maternal diabetes, tuberculosis, hypertension or any chronic illness like anemia or infections, smoker or alcoholic, any bad obstetrical history, multiple pregnancies, and on the neonatal part included congenital malformations, intrauterine infections and chromosomal abnormalities.

2.5 Ethical clearance and procedure

We took proper approval from institutional ethical committee (memo number BMC/PG/336 dated 24th January 2013) which is complied with international "World Medical Association Declaration of Helsinki". Appropriate consent from all the mothers were also taken before including them and their neonates in the study. The detailed clinical history of the mothers was taken and maternal height was measured postnatally, pre-pregnancy or early pregnancy weight was taken from antenatal records and BMI was calculated {BMI = weight (Kg)/height (m)²} accordingly. The detail of anthropometry of the newborn like birth weight (using electronic weighing machine to the nearest 1.0 gm), length (using infantometer), head circumference and chest circumference were measured using a non-stretchable elastic tape to the nearest 0.5cm, and ponderal index {PI = weight (g)/length (cm)³ × 100} were calculated.

The gestational age of the newborns were calculated as per the history taken from the mothers about their first day of last menstrual period in a regular cycle, USG biometry and matched with the physiological and neurological parameters by modified Ballard's scoring [16].

2.6 Statistical methods

Collected data were compiled into Microsoft excel worksheet. Mean and standard deviation were calculated for continuous variables whereas proportions were used for categorical variables. Categorical variable was coded (IUGR-1/ no IUGR- 0). Using Shapiro-wilk test we found that the data were normally distributed. Hence, a parametric test (Student's t test) & chi-square test were used to find the significance of association in tables. Significantly associated variables in tables were further considered for Pearson's correlation to find out strength and direction of their association. Finally a binary logistic regression model was created taking IUGR as outcome variable, to find out adjusted odds ratio with 95% confidence interval. P <0.05 was considered as statistically significant. All the statistical analysis was done using SPSS version 20.0

3. Results

This study was conducted in 322 IUGR neonates with their mothers admitted in the department of Gynecology and Obstetrics, at different hours of life but less than 12 hours of birth. Out of the 322 neonates, 168 neonates were male (52.17%) and 154 were female (47.82%). The neonates were seen and measured at different hours of life, mean was 3 hours and 56 minutes (range 1-7hrs). 174 neonates (54.03%) had PI below two and 148 neonates (45.96%) had this index above two. The majority of asymmetrical IUGR depicted that the cause had occurred in the late pregnancy. There was no significant difference between mean gestational age of IUGR & AGA neonates. [38.19±0.99 weeks vs. 38.23±1.01 weeks; Student's t= 0.5128, p>0.05]. Mean birth weight of IUGR neonates were 1.93 ± 0.169 kg, while that of AGA neonates were 2.75±0.213 kg.

Majority (232, 72.04%) of the mothers were primi-gravida, 203 (63.04%) were of poor SES. Majority of the mothers of IUGR neonates had a height of <145 cm (53.7%) and weight of < 50 kg (51.5%) and BMI of < 20 kg/m² (52.55%).

Mean maternal weight (49.1±2.3 kg vs. 54.3±2.7 kg), height (144.1±37.2 cm vs. 155.2±42.1 cm), BMI (17.6±2.1 vs. 19.2±2.3) and age (20.2 ±0.8 yrs vs 22.3±2.5 yrs) were significantly lower (p<0.05) among the mothers of IUGR neonates (Table 1).

Table 1: Distribution of IUGR and AGA neonates' group according to maternal age and anthropometric parameters

Parameters	IUGR group (n=322)	AGA group (n=336)	Significance
Mean maternal age (± SD)	20.2 ± 0.8	22.3 ± 2.5	Student's t = 9.3 (p<0.01)
Maternal weight			
<50 kg	166 (51.5%)	137 (40.7%)	χ ² =4.13 (p=0.04)
≥50 kg	176 (48.5%)	199 (58.3%)	
Mean maternal weight (± SD)	49.1 ± 2.3	54.3±2.7	Student's t = 26.5 (p<0.01)
Height (maternal)			
<145 cm	173 (53.7%)	106 (31.5%)	χ ² =33.1 (p<0.01)
≥ 145 cm	149 (46.3%)	230 (68.5%)	
Mean maternal height (± SD)	144.1 ± 37.2	155.2 ± 42.1	Student's t = 2.61 (p<0.01)
Mean maternal BMI (± SD)	17.6 ± 2.1	19.2 ± 2.3	Student's t = 9.3 (p<0.01)

IUGR was significantly & negatively correlated with maternal age (r=-0.32), maternal weight (r=-0.53), maternal height (r=-0.76), maternal BMI (r=-0.42) and signifying that increase in these variables will protect the baby from being IUGR (Fig. 1-4).

Fig. 1: Relationship of birth weight of IUGR neonates with their mothers' age

Scatter diagram showing relationship of birth weight with maternal age

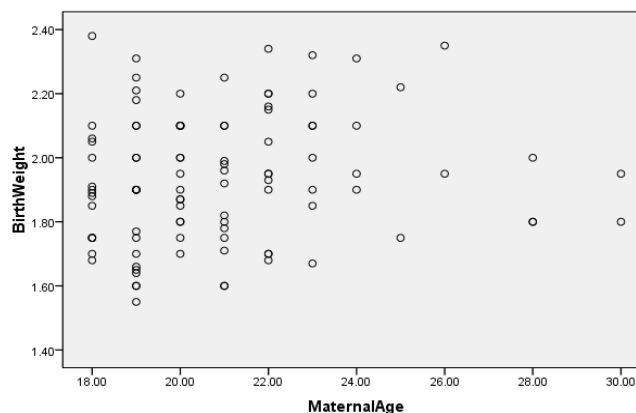


Fig. 2: Relationship of birth weight of IUGR neonates with their mothers' weight

Scatter diagram showing relationship of birth weight with maternal weight

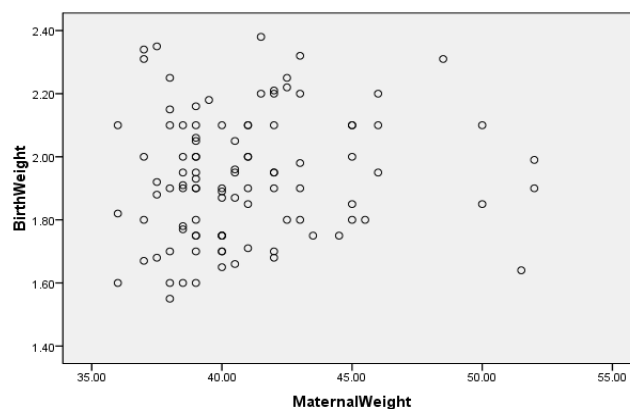


Fig. 3: Relationship of birth weight of IUGR neonates with their mothers' height

Scatter diagram showing relationship of birth weight with maternal height

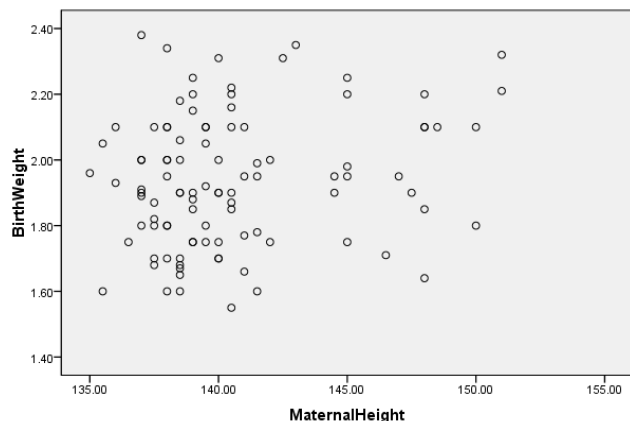
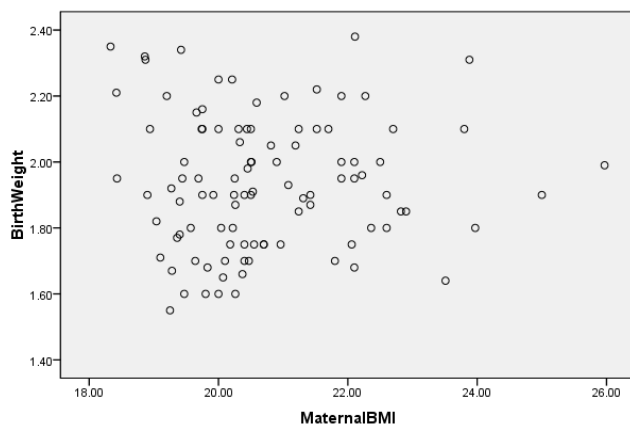


Fig. 4: Relationship of birth weight of IUGR neonates with their mothers' BMI

Scatter diagram showing relationship of birth weight with maternal BMI



Increase in maternal height, maternal weight, maternal BMI and maternal age decrease the chance of an IUGR neonate as evidenced by their adjusted odds ratio, 0.40 (95% CI=0.28-0.52), 0.72 (95% CI=0.54-0.91), 0.76 (95% CI=0.54-0.96) & 0.89 (95% CI=0.10-1.55), respectively. All these odds ratios were statistically significant except that for maternal age (Table 2).

Table 2: Pearson's correlation coefficient (r) & adjusted odds ratio of maternal age and anthropometric parameters in relation to IUGR neonates' birth weight (n=658)

Variables	Correlation coefficient (r)	Adjusted odds ratio (95% CI)
Maternal age	-0.32*	0.89 (0.10-1.55)
Maternal weight	-0.53*	0.72* (0.54-0.91)
Maternal height	-0.76*	0.40* (0.28-0.52)
Maternal BMI	-0.42*	0.76* (0.54-0.96)

* Correlation is significant at the 0.01 level.

Maternal height, maternal weight and maternal BMI collectively can explain 46.7% to 63.1% variability of IUGR, out of which only maternal height can explain

38.1% to 53.2% variability of IUGR. Overall our model can correctly predict 46 % of the outcome variable. Though, maternal age was found to be significantly correlated to IUGR in the correlation matrix, it became insignificant in the regression model. However we could not find any correlation between the maternal age and anthropometric parameters with the PI of IUGR neonates as evidenced by the table mentioned below (Table 3) –

Table 3: Correlation between maternal age and anthropometric parameters with the occurrence of symmetrical and asymmetrical IUGR

Variables	Symmetrical IUGR (PI<2) {n=174}	Asymmetrical IUGR (PI≥2) {n=148}	Significance
Maternal Age	20.22±0.5	20.31±0.44	Student's t = 1.70, p>0.05
Maternal Weight	49.16±0.45	49.25±0.51	Student's t = 1.68, p>0.05
Maternal Height	144.1±36.5	144.3±36.7	Student's t = 0.04, p>0.05
Maternal BMI	17.65±2.18	17.56±2.12	Student's t = 0.37, p>0.05

4. Discussion

IUGR is one of the leading causes of perinatal mortality and morbidity in newborns [5]. It has a multi factorial causation. A critical analytical view of the current situation of our country points out the roots of the problem to be based in our social, cultural, economic and political infrastructure. The basic contributing determinants are family and community resources, information, and education. The underlying determinants like inadequate food, hygiene, sanitation and health services are all interconnected with disease and LBW. The SES is widely recognized as one of the important factors affecting health condition of an individual or a family. Modified BG Prasad scale is a commonly used scale to measure the SES of families [17,18]. As our study population included both rural and urban population, we used revision of the Prasad's social classification scale for the year 2013 in this study. [19]. According to this scale per capita income of Rs. 767 – 1532/- per month was taken as poor SES in our study.

In our study it was noted that 168 (52.17%) of neonates were males and 154 (47.82%) were females. Our findings correspond with the findings of Bisai *et al* where they found 53.6% males and 46.4% females, respectively [20]. No significant difference (p=0.7) was noted in the gender distribution of the infants in the study of Muhammad *et al* [21]. The mean gestational age of the neonates in the present study was 38.19±0.99 weeks, which is quite similar to Kumar *et al* study [22] where the mean gestational age at delivery was 38.13±1.89 weeks. Rao *et al* [23] in their study found that the mean gestational age was 39.2 ± 1.9 wks. The mean birth weight in our study was

1.93±0.169 kg but Muhammad *et al* [21] found 1.8±0.33 kg as the mean birth weight in their study. Mean ± SD for weight, height and BMI of the mothers of IUGR neonates in our study were 49.1±2.3 kg, 144.1±37.2 cm, and 17.6±2.1 kg/m², respectively. Bisai *et al* [20] reported that the mean ± SD for weight, height, and BMI of Bengalee pregnant women were 149.3 ± 5.5 cm, 47.2 ± 6.7 kg and 21.1 ± 2.6 kg/m², respectively. In an earlier study, Bhadra *et al* [24] noted the means for weight, height and BMI as 54.6 kg, 156.3 cm, and 23.1 kg/m², respectively, among young (18–22 years) Bengalee adult women of Kolkata. Maternal weight and BMI, which are the indicators of maternal nutrition, have been consistently proved to be directly correlated with birth weight and length [14, 25].

Maternal weight (<45kg) maternal height (<145cm) and BMI (<18.5) were significantly associated with IUGR in the study by Acharya *et al* [26]. We also observed the same findings in the present study. In our study we found that 232 (72.04%) mothers were primigravida and 203 (63.04%) were of poor SES which is quite familiar to the finding of Goyal *et al* [27]. They also found 76.6% neonates in primigravida mothers belonging to below poverty line of socioeconomic class and teenage in 57.55% of pregnancies. Proportion of primigravida was high among cases as compared to control in the study of Acharya *et al* [26] but the difference was not statistically significant. In contrast, studies conducted in India [28] and Pakistan [29] has revealed that primiparity is significantly associated with IUGR like ours.

We found that 171 (53.1%) mothers were in teen age group (<21 yrs). The mean maternal age of IUGR neonates in our study was 20.2 ± 0.8 years where as the same was 22.9 ± 4.5 years and 24.3 ± 3.52 years in other studies. A lot of different studies in world's literature showed correlation of IUGR with teen age pregnancy, but Mavalankar *et al* [28] from India and Fikree *et al* [29] from Pakistan strongly contradicted it. Ferraz *et al* [30] in Brazil has shown that young maternal age (<20 years) is a significant risk factor of IUGR. Our present study also did not find any significant correlation between maternal age and neonates' birth weight.

5. Conclusion

From the study it was concluded that maternal pre pregnancy weight, height and BMI are independent factors affecting pregnancy outcome. These factors have strong relation with IUGR neonates' birth weight but maternal age is not a determining factor for IUGR neonates' birth weight. Incidence of IUGR is more common in primigravida mothers and in those with poor SES.

6. Limitations of the study

1. It was a cross-sectional study. To get a more accurate correlation between maternal anthropometry and IUGR neonates' birth weight, the number of the study population has to be increased.
2. The weight of the mother was taken from the antenatal card, which was recorded in the in their first visit of antenatal check up and the first visit was not uniform in all the cases. Moreover, mothers were weighed with clothes in the out-patient department.
3. The calibrating system had weighted mothers up to the nearest 0.5 kg. More accurate observation could be done, if they had been weighted in electronic weighing machine.

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