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Original Research Article

Determinants of Neonatal Birth Weight in Women without Gestational Diabetes Mellitus

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ABSTRACT

Background: Birth weight reflects mother's health and nutritional status during pregnancy. Other than diabetes during pregnancy, there are also many other factors which affect birth weight.
Methods: Out of 304 patients screened between 24 and 32 weeks of gestation in the antenatal clinic of a tertiary care centre, 214 non-GDM mothers were included. These mothers were then followed up till delivery and birth weight was measured for all newborns.
Results: The proportion of low birth weight babies in this study was 7% with mean birth weight of 3 ± 0.43 kg. Factors like maternal weight, gestational age at delivery and gender of neonates were significantly associated with birth weight in multiple regression analysis. Male babies were heavier than females (3.09±0.42 vs. 2.92±0.43 kg, P = 0.003).
Conclusion: Both maternal and neonatal factors are important for determination of birth weight among glucose tolerant mothers.

Key Words: Birth weight; Gestational diabetes mellitus; Neonates.

INTRODUCTION

Birth weight is an important determinant of neonatal survival and their long term health. It is affected by different parameters related to the fetus, mother and the environment. Among maternal illnesses complicating pregnancy, diabetes mellitus is a common disorder at present due to increasing prevalence of gestational diabetes mellitus (GDM). [1] Diabetes during pregnancy is a risk factor for both low birth weight (LBW) and macrosomia, which are associated with neonatal morbidity and mortality and chronic non-communicable diseases during adulthood. [2,3] Additionally, LBW is also important from the point of view of public health. It reflects the status of antenatal care and maternal nutrition in a

community. [4] More than 20 million infants worldwide are born with low birth weight, out of which nearly forty percent is contributed by India alone. [5]

Other than diabetes during pregnancy, there are also many other factors, which affect birth weight. Therefore, this longitudinal study was done to find out the determinants of neonatal birth weight in women without GDM.

MATERIALS AND METHODS

This prospective study was undertaken in a tertiary care centre from August 2011 to July 2012. [6] The study was approved by the ethical committee of the institute. All pregnant mothers registered at the antenatal clinic of this institute within the first trimester were included as study subjects.Those with overt diabetes mellitus, multiple pregnancies and chronic systemic illnesses (chronic liver diseases, chronic renal diseases, hypertension, anemia, patients on steroid therapy etc.) were excluded. A detailed history was taken and physical examination was performed in each case. Maternal weight, height and body mass index (BMI) were determined from antenatal record. Gestational age was calculated from last menstrual period and confirmed by first trimester ultrasound. Oral glucose tolerance test (OGTT) with 75 gram anhydrous glucose (plasma glucose at fasting, 1st & 2nd hr) was performed in all the pregnant women between 24 to 32 weeks of gestation after taking informed consent from them. Out of total 304 cases, 214 mothers were included in the final analysis after excluding 90 GDM patients diagnosed by either international association of diabetes and pregnancy study groups (IADPSG) or world health organization (WHO) criteria. [7,8] According to IADPSG criteria, GDM is characterized by at least one abnormal value in 75 gram OGTT: fasting plasma glucose ≥ 92 mg%, 1 hr plasma glucose ≥ 180mg% or 2 hr plasma glucose ≥ 153mg%. In contrast, according to WHO criteria, subjects having either fasting plasma glucose ≥ 126mg% or 2 hr plasma glucose ≥140mg%, are categorized as GDM. These mothers were then followed up till delivery. The neonatal birth weight was recorded with an electronic scale having a precision of 10 gram within one hour of birth. Three separate measurements were taken and the mean was recorded. The babies were then categorized as LBW (< 2.5 kg) and normal birth weight (≥2.5 kg). [5] Preterm newborns include those delivered before 37 completed weeks of gestation.

Statistical analysis was done using SPSS software version 17. The continuous variables were expressed as mean ± SD and categorical variables as percentages. Correlation between the variables was evaluated using Pearson's correlation coefficient. For multivariate regression analysis, neonatal birth weight was used as dependent variable. $P < 0.05$ was considered as statistically significant.

RESULTS

Table 1: Maternal and neonatal parameters

Parameters (N =214)	Mean ± SD
Maternal Age (years)	24.20 ± 3.98
Gravida (Primigravida : Multigravida)	108: 106
Maternal Height (cm)	155.06 ± 5.60
Maternal Weight (kg)	54.27 ± 10.30
Maternal BMI (kg/m^2)	22.65 ± 4.14
GA at OGTT (weeks)	27.74 ± 2.86
Fasting Plasma Glucose (mg %)	80.14 ±6.70
One Hour Plasma Glucose (mg %)	127.07 ±21.56
Two Hour Plasma Glucose (mg %)	96.56 ± 17.33
GA at Delivery (weeks)	38.80 ± 1.26
Birth weight of neonates (kg)	3 ± 0.43
Gender of neonates (Male : Female)	106 ± 108

BMI: Body mass index, **GA:** Gestational age, **OGTT:** Oral glucose tolerance test.

Table 1 shows different maternal and neonatal characteristics. The mean age of mothers was 24.2 ± 3.98 years. Out of 214 mothers, 108 (50.5%) were primigravida. The average gestational age at delivery was

38.80±1.26 weeks with 106 (49.5%) male babies. The mean birth weight was 3 ± 0.43 kg. Male babies were heavier than females (3.09±0.42 vs. 2.92±0.43 kg, *P* = 0.003). Out of total 214 babies, 15 (7%) were LBW. Forty percent (6/15) of LBW babies had preterm delivery.

Table 2 and 3 depict the correlation of different maternal and neonatal factors with birth weight. Maternal weight, BMI, gestational age at delivery and gender of neonates were significantly correlated with birth weight (table 2). However, maternal BMI did not have significant contribution to birth weight in multiple regression analysis (table 3).

Table 2: Correlation of maternal and neonatal parameters with birth weight

Parameter	Correlation Coefficient (r)	*P* Value
Maternal Age (years)	0.093	0.17
Gravida	0.029	0.67
Maternal Height (cm)	0.060	0.40
Maternal Weight (kg)	0.200	0.006
Maternal BMI (kg/m2)	0.185	0.01
GA at OGTT (weeks)	-0.060	0.39
Fasting Plasma Glucose (mg %)	0.030	0.66
One Hour Plasma Glucose (mg %)	0.112	0.10
Two Hour Plasma Glucose (mg %)	0.005	0.94
GA at Delivery (weeks)	0.366	< 0.001
Gender of neonates	0.189	0.006

BMI: Body mass index, **GA:** Gestational age, **OGTT:** Oral glucose tolerance test.

Table 3: Multiple regression analysis with birth weight as dependent variable

Parameters	Beta	*P* Value
Maternal Weight (kg)	0.481	0.005
Maternal BMI (kg/m^2)	- 0.249	0.15
GA at delivery (weeks)	0.462	< 0.001
Gender of Neonates	0.170	0.008

BMI: Body mass index, **GA:** Gestational age.

DISCUSSION

LBW is an important public health problem all over the world. The prevalence of LBW in our study is 7%, which is less than its global prevalence of 15.5%. [5] The incidence of LBW babies, as reported by Indian studies, varies from 8.8% to 26.4%. [4,9] These studies were done at primary health care centers in rural areas. Our study, being done at a tertiary care hospital in an urban area, may explain its lower prevalence. Though our study was done among non-GDM mothers, its protection against LBW babies is controversial because of inconsistent findings in different studies. [3,10,11] The majority of our LBW babies were delivered at term, similar to reports from other developing countries. [12]

Maternal age has U shaped relationship with birth weight. Both younger (< 20 yrs) and older (> 35 yrs) mothers have high risk of having LBW babies. [11,13,14] This is due to the high prevalence of preterm delivery among younger mothers [13] and associated comorbidities like obesity, GDM and hypertension among elder mothers. [11] In our study, maternal age was not associated with birth weight which may be explained by the presence of few subjects in the extreme age groups (22 were less than 20 yrs and 3 were above 35 yrs) and possibly, by improved maternal care for complicated pregnancies. Similar results were reported by Janjua et al [10] from Pakistan and Kadam et al [15] from India.

Both primigravida and grand multigravida (≥5) were associated with low birth weight in a study by Janjua et al. [10] However, both Bener et al [11] and Xue et al [14] have reported increase in birth weight with parity. In our study, gravida did not correlate with birth weight, similar to the study by Kadam et al. [15] This may be explained by the difference in sample size, maternal characteristics and presence of various confounding variables in different studies. Gestational age is another maternal factor, which is correlated with birth weight in our study, similar to the report by Xue et al. [14] Gestational age is very important as preterm delivery is the major cause of LBW babies in developed countries. [12] This is due to the fact that maximum growth of

fetus occurs during 3rd trimester of pregnancy. [16]

Plasma glucose values in OGTT during pregnancy have association with birth weight even in non diabetic mothers. [17,18] Fasting plasma glucose was associated with birth weight among normal glucose tolerant mothers in a study by Peters et al. [17] But Miyakoshi et al [18] has reported the correlation between birth weight and one hour plasma glucose value among gestational impaired glucose tolerant mothers from Japan. However, none of the plasma glucose value during OGTT was associated with birth weight in our study.

Maternal anthropometry (height, weight & BMI) has variable association with neonatal birth weight. [9-11,14,15,19] Maternal height reflects genetic potential for fetal growth whereas maternal weight/BMI reflects nutritional contribution to neonatal birth weight. Maternal height is directly proportional with birth weight has been reported by Xue et al, [14] which was not confirmed in this study. Although in our study, there was significant correlation of both maternal weight and BMI with birth weight, maternal BMI did not have significant contribution to birth weight in multiple regression analysis. Similarly, Kadam et al [15] reported the association between maternal weight and birth weight from India. The relationship between BMI and birth weight was confirmed in the study by Xue et al, [14] but not in other studies. [10,11] Interestingly, both low and high maternal weights were associated with low birth weight due to nutritional deficiency and gestational complications of obesity respectively, in a study from Brazil. [19]

Other than maternal factors, neonatal parameters like gender of the baby, is also associated with birth weight. Male babies were heavier than females in some studies, similar to our finding, but not in others. [10,15,20] These variable results reflect different interplay of various growth factors in both genders at birth in different ethnicities. [20]

Our study had few limitations. This study was not done primarily to determine the effects of various factors on neonatal birth weight. Rather, it was a post-hoc analysis of the study, which was primarily done to compare the feto-maternal outcomes among GDM and non-GDM mothers. [6] Additionally, various factors like detailed obstetric history in previous pregnancies, maternal socioeconomic status and addictions, which affect the birth weight of neonates, were not considered in our study.

CONCLUSION

Maternal factors like weight during pregnancy and gestational age at delivery determine the neonatal birth weight. These factors indirectly reflect maternal nutritional status and standard of antenatal care during pregnancy respectively, which is reflected in birth weight of newborn babies. Additionally, gender of neonates influenced birth weight, males being heavier than females. To conclude, both maternal and neonatal factors are important determinants of birth weight among non-GDM mothers in developing countries like India.

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