Correlation between gestational weight gain and birth weight of the infants

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ABSTRACT

Birth weight is an important determinant of infant's well being as low birth weight is known to increase the risk adult onset of diseases like type -2diabetes and ischemic heart disease. Maternal weight gain is one of the most important independent predictors of infant birth weight. Institute of Medicine of the National Academics, USA has recommended that total weight gain of mothers should be according to their prepregnancy body mass index (BMI). Therefore, this study was conducted to observe the total weight gained by the pregnant women and the correlation between the weights gained by them with the birth weight of their infants. 98 women who delivered full term single baby at Patan hospital were included after taking their verbal consent. The details of the newborn and the history of the pregnant women were taken from the hospital records. The information about the family income, dietary habit, birth spacing and the type of work done by the pregnant women was obtained from the women themselves. The mean weight gain of the mothers was 9.48 (SD=3.41) kilograms and the mean birth weight of the infants was found to be 2965.66 (SD=364.37) grams. Multiple Liner Regression Models showed the effect of Gestational weight gain (GWG), Age and Parity on birth weight of the infant. Step-wise multiple regressions gave rise to models that showed effect of GWG and age on birth weight of the infants. This study concluded that gestational weight gain has positive linear relationship (correlation) with the birth weight of infants.

Keywords: Gestational weight gain, age, Patan hospital.

INTRODUCTION

Birth weight (BW) is an important determinant of infant's well being.[1] Several factors such as mothers' genetic characteristics, socio-cultural, demographic, behavioural factors, prepregnancy body mass index (BMI), gestational weight gain (GWG) etc contribute to birth weight.[2] BW is important as low birth weight is known to increase the risk of adult onset diseases like type -2 diabetes and ischemic heart disease.[1]

Maternal weight gain is one of the most important independent predictors of infant birth weight.[3] Institute of Medicine of the National Academics, USA has recommended that total weight gain of mothers should be according to their prepregnancy body mass index (BMI). Therefore lesser the BMI, higher should be the GWG and vice-versa.[4] If the GWG is extremely low GWG (below 7 kg) this may be independent predictor for neonatal morbidity.[5] However, the incidences of low birth weight (< 2500 g) and thus neonatal morbidity decreases as the mean pregnancy weight gain increases. Nevertheless, excessive maternal weight gain is associated with large infants i.e., macrosomia (>4000 g) or large for gestational age infants who have higher risk of birth injuries and other problems like shoulder dystocia, fractures of the clavicles or limbs, and perinatal asphyxia.[6,7]

The total amount of weight gained in normal-term pregnancies varies considerably among women and the variance appears to be due to many maternal characteristics and pregnancy outcomes.[8] Several such studies have been carried out in different parts of the world but such studies in Nepal are lacking. In view of this, the present study was carried out with the following objectives to determine the weight gained by the mothers who delivered single normal weight babies at term and to correlate gestational weight gain and birth weight of the infant.

MATERIALS AND METHODS

This was a prospective and observational hospital based study conducted over the period of 60 days between July - December 2009 at Patan Hospital, Lagankhel Nepal. The study was undertaken with approval from the Patan hospital authority.

All the normal, full term, live, singleton deliveries without any complications were recorded. Pregnancies resulting in still births, preterm deliveries, those complicated by pregnancy induced hypertension,

Table-1: Descriptive statistics of important parameters on birth weight

Variables Background ariable VVariable	Categories	N	Mean Birth weight	Std. Deviation (SD)	P-value
Age of the mother (Age)*	>= 25	61	3062.54	358.59	< 0.01(0.001)
	< 25	37	2805.95	318.28	
Gender of Child*	Male	57	3019.39	375.06	> 0.05(0.085)
	Female	41	2890.98	339.39	
Place of residence*	Rural	20	2898.00	374.65	> 0.05(0.317)
	Urban	76	2990.46	363.81	
Parity (Parity at Birth)*	0	65	2885.15	353.48	< 0.01(0.002)
	1+	33	3124.24	336.83	
Birth Spacing*	>= 5	21	3157.14	377.92	> 0.05(0.332)
	< 5	3	2933.33	208.17	
Gestational Weight Gain	>= 11	31	3122.58	349.33	<0.01(0.004)
(GWG)	< 11	67	2893.06	350.34	
Dietary habit*	Vegetarian	5	2696.00	280.77	> 0.05(0.089)
	Non-vegetarian	93	2980.16	363.86	
Type of work*	Household only	67	2920.37	364.18	> 0.05(0.07)
	Household and others	31	3063.55	350.75	
Family Income	3000 - 5000	12	2960.42	431.36	
(in Nepalese Rupees)**	5000 - 10000	19	3105.26	422.26	> 0.05 (0.841)
	10000 - 15000	16	2951.88	333.45	
	15000 - 20000	11	2959.09	363.88	
	> 20000	19	2935.26	267.94	
Mother's Education**	No Education	4	3375.00	202.07	> 0.05 (0.142)
	Primary	8	2856.25	235.19	
	Secondary	21	3010.00	416.26	
	10+2	13	3000.38	422.10	
	University	33	2942.42	312.28	
Total	ALL	98	2965.66	364.37	NA

* T-test ** ANOVA NA=Not Applicable

diabetes in pregnancy and twin births were excluded. The details of the newborn and the history of the pregnant women were taken from the hospital records. The information about the family income, dietary habit, birth spacing and the type of work done by the pregnant women was obtained from the women themselves after taking their verbal consent. All the women were non-smoker and non-alcoholic. Out of the 200 antenatal records scanned, the final sample size was 98. Inadequate data entry in the hospital records contributed to this large-scale attrition. Descriptive (Mean, Standard Deviation) and inferential statistics (t-test, ANOVA, correlation and multiple regression analysis) were used in the analysis. SPSS software version 16.0 was used to analyze the data.

RESULTS

The mean birth weight of the infants during the study period in the Patan Hospital was found to be 2965.66 (SD=364.37) grams. The mean age of the mother was 25.88 (SD=3.89) years and the mean weight gain was 9.48 (SD=3.41) kilograms.

Table-1 shows the statistically significant difference in birth weight with respect to mother's age, parity and gestational weight gain (GWG) only. Thus the further

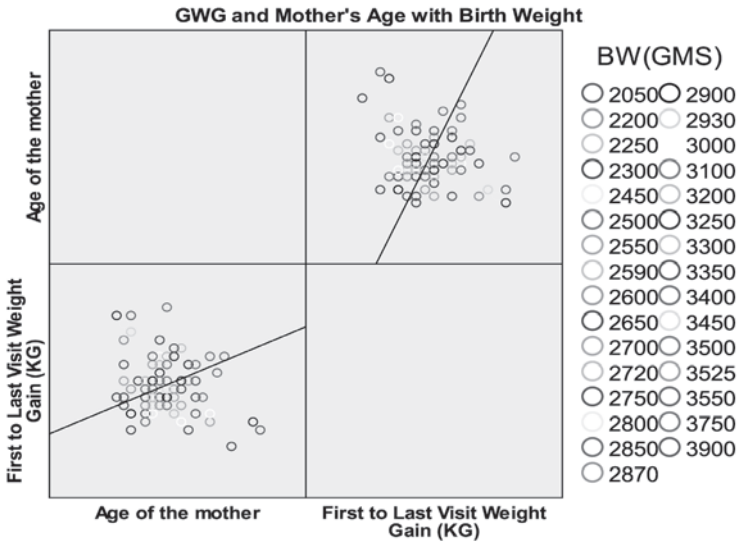

Fig. 1. Correlation Matrix

analysis on birth weight is focused on these three variables only (Fig. 1).

Fig. 1. shows that GWG and Mother's Age both have positive linear relationship (correlation) with the Birth Weight at Patan Hospital. Thus multiple linear regression models are applied and results are shown on Table-2.

Table-2 show results from the Multiple Liner Regression Models. Model 1 shows the effect of GWG, Age and Parity on birth weight of the infant at Patan Hospital. Parity was used as binary variable as shown in Table 1. Model 1 reveals that the parity is not statistically significant and found to be a confounder rather than predictor of the birth weight. Thus we applied step-wise multiple regression that gave rise to Model 2 and 3 suggesting two regression equations:

Model 2: Predicted Birth Weight = 1764.72 + (35.30) × (GWG) + (37.75) x (Age)

Model 3: Predicted Birth Weight (Grams) = 1901.43 + (30.18) x (GWG)

According to Model 2, if the GWG increases by 1 kg, the BW of the infant increase by a factor of 35.30 gms and if the age of the mother increases by 1 year the BW increases by a factor of 37.75. Ex- if the GWG is 11 kg and the age of the mother is 25 years then the predicted BW of the infant = 1764.72 +(35.30) × 11 + (37.75) × 25 = 3096.77 gms.

According to model 3, if the GWG increases by 1 kg, the BW of the infant increase by a factor of 30.18 gms. Ex- if the GWG is 11 kg then the predicted BW of the infant = 1901.43 + (30.18) × 11 = 2233.41 gms.

Model 2 implies that GWG and Age could explain nearly 21% and of variation but Model 3 reveals that GWG alone could explain nearly 11% of variation in the birth weight respectively. Thus, this study indicates that GWG is explaining highest and statistically significant variation for birth weight of the infants born at Patan Hospital during the study period. However, as the model 2 explains the greater percentage of the variation, it seems robust model to explain the birth weight of the infant born at Patan hospital.

DISCUSSION

The observed mean birth weight of the infants in our study was 2965.66 (SD=364.37) grams and was comparable to study conducted Rao *et al*[9]in India. This similarity could have been due to similar population and cultural backgrounds. In another study conducted by Thorsdottir *et al* the mean birth weight was 3778gm (SD= 496)[10] which was greater than our study. Yet another study by Nahar *et al* reported a birth weight of 2690gm (SD= 0.36)[11] which was lower than in our study. The two studies were carried out in Iceland and Bangladesh respectively and the differences in population and cultural backgrounds again could have made a difference in the results. A study by Hickey states that sociocultural dimensions, ethnicity, social support etc can also affect the gestational weight gain.[12] Similarly the mean weight gain during pregnancy or the gestational weight gain (GWG) was 9.48 (SD=3.41) kilograms in our study which was comparable to the study conducted Rao where it was 8 (SD= 2.6) kg. GWG in the study by Nahar was 5.69 (SD= 1.95) kg which was lesser and 16.8 (SD= 4.9) kg in the study by Thorsdottir which was much higher than in our study. These differences in the results could again have been due to the differences in population demographics and cultural values of the countries where the studies were carried out.

In our study, the birth weight of the infant increased with the increase in the maternal weight gain which is consistent with several other studies.[13-15]

Sally *et al* found that mean birth weight of infant increased by 20.2g per kilogram of weight gain during

Table-2: Estimated effect of gestational weight, age and parity on birth weight

Variables	Model 1	Model 2	Model 3
Weight gain	34.74**	35.30**	30.18**
Age	32.44**	37.75***	—
Parity	81.07	—	—
Constant	1654.142***	1764.716***	1901.430***
R^2	0.222***	0.206***	0.104***

*p < 0.05, * *p < 0.01, * * *p < 0.001

pregnancy.[13] In meta-analysis of 61 studies, mean birth weight increased by 20g/kg of weight gain in women with adequate weight for height[14] In study conducted by Abrams and Selvin too, the mean birth weight of the infant increased by 22.6g/kg GWG.[15] However, in our study the mean weight of the infant per kg weight gained by the mothers was higher than these studies. It was 35.30g per kg GWG in model 1 which was comparable to model 2 where it was 30.18g per kg GWG. The higher weight of the infant per kg GWG could be contributed to several factors like race/ ethnicity. Ulstein *et al* states that neither the growth pattern of the fetuses, nor which factors are most important in determining BW in Nepalese population is known. Racial and nutritional factors must both be assumed to play a role, and therefore physiological standards for Nepal, a developing country, are different from the industrialized countries.[16]

In our study, it was found that younger mothers gave birth to lighter babies than the older mothers, which is consistent with other studies.[17,18] Younger mothers have smaller babies for variety of reasons. One contributor is thought to be the competition for nutrients in the younger mothers who are themselves growing.[17] Newborn body dimensions increased significantly with increasing maternal age. Newborn body dimensions and especially birth weight are very important indicators for newborn health and maturity but also as predictors of potential survival of the newborn during the first months of the life. The most commonly hypothesized biological explanation for the reduced dimensions of the newborn of the adolescent mother is the biological immaturity of the young mothers.[18]

Limitation of our study is the sample size of the study. Had the sample size been greater, the models could have explained more percentage of the variation. Thus, a study in larger scale can be recommended to establish stronger relationship between the gestational weight gain and birth weight.

Gestational weight gain and age of the mother at the time of delivery played an important in determining the birth weight of the infant delivered at Patan hospital.

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