

Association of Neonate's Birth Weight with Maternal Weight Gain during Pregnancy

Syeda Surayya Jabeen¹, Shazia Iffet², Umber Imtiaz³, Faria Mumtaz⁴, Bushra Sultana⁵, Ayesha Arif⁶

Abstract

Objective: To establish a relationship between maternal weight gain during pregnancy and a newborn's birth weight.

Method: A total of 120 patients were selected for this study. The weight and height of all patients were recorded in the first month of pregnancy and at term. Weight gain during pregnancy was placed in three categories. Category 1, 2 and 3 included patients with weight gain of 4.9 kg or less, weight gain between 5 to 10 Kg and weight gain over 10 kg respectively. The weight of all newborns was also recorded. The association of maternal weight gain with neonate's birth weight was looked for.

Results: In our study, 4.16% of women were underweight, 49.17% of women were labelled normal weight, 45% were overweight and 2% were obese. Five per cent of women gained less than 5 kg weight during pregnancy, the majority (88.33%) gained between 5 to 10 kg and only 8% gained weight more than 10 kg. In our study, 9.17% of newborns were born with low birth weight, 90.83% had normal birth weight and no newborn fell into the category of macrosomia. Mean birth weight was 2.52±0.26 kg in mothers who gained less than 5 kg weight during pregnancy. Similarly, the mean birth weight was 2.92±0.23 in mothers who gained weight between 5 to 10 kg. Mean birth weight was 3.34±0.23 in mothers who gained weight more than 10 kg.

Conclusion: It is concluded in our study that maternal weight gain during pregnancy is strongly associated with the birth weight of the newborn.

Keywords: Birth weight, Gestational weight gain, Neonatal birth weight, Maternal weight gain.

¹HOD Gynae/Obs, CMH Kohat; ²Associate Professor, CMH Abbottabad; ³Consultant Gynaecologist, CMH, Rahim Yar Khan; ⁴Consultant Gynaecologist, CMH, Kohat; ⁵Assistant Professor, Fauji Foundation Hospital, Lahore; ⁶Consultant Gynecologist.

Correspondence: Dr. Syeda Surayya Jabeen, HOD Gynae/Obs, CMH Kohat. Email: surraya.jabeen@hotmail.com

Cite this Article: Jabeen SS, Iffet S, Imtiaz U, Mumtaz F, Sultana B, Arif A. Association of Neonate's Birth Weight with Maternal Weight Gain during Pregnancy. JRMC. 2024 Mar. 28;28(1). <https://doi.org/10.37939/jrmc.v28i1.2412>.

Received January 19, 2023; accepted July 31, 2023; published online March 15, 2024

1. Introduction

It's quite normal for pregnant ladies to gain weight during pregnancy. A combination of factors is involved in this weight change. The rapidly growing fetus needs a continuous supply of energy and nutrients for its proper growth.^{1,2} That's why the mother's body must gain weight to provide a continuous source of sugars, proteins, fats and other micronutrients. In addition to this, numerous hormonal changes like a surge of progesterone and estrogen occur in the mother's body leading to water retention and fat deposition.^{3,4} Furthermore, the growth of the fetus and the increasing size of the uterus and placenta also contribute to maternal weight gain. Undue weight gain during pregnancy may have several negative health impacts. Weight gain over what is recommended during the pregnancy may increase the risk of gestational diabetes, high blood pressure, difficulty in labour and delivery, and post-pregnancy weight retention.⁵ On the other hand, babies born to mothers with low weight gain during pregnancy have an increased risk of premature labour and delivery, respiratory distress syndrome, infection and sepsis, delayed developmental milestones,

anaemia and neural tube defects. Women who fail to acquire enough weight during pregnancy have a higher chance of caesarian deliveries.⁶

Birth weight in newborns serves as a very important predictor of health and survival. Newborns with a birth weight of 1500 grams or less have a higher risk of multiple complications later in adult life which include but are not limited to bronchial asthma, hyperglycemia, obesity, hyperlipoproteinemia, atherosclerosis, coronary heart disease, learning disabilities, retinopathy of prematurity, attention deficit hyperactivity disorder, depression and lower reproductive rates etc.⁷ On the other hand, newborns with a birth weight of 4000 grams or more, condition known as feta macrosomia have higher risk for obstetric brachial plexus injury, birth fractures, hypoglycemia, respiratory distress, jaundice and childhood obesity.⁸ Maternal complications of fetal macrosomia include increased rate of caesarian section, emergency caesarian, post-partum haemorrhage, obstetric anal sphincter injury and prolonged or difficult labour.⁹⁻¹⁰

Our study aimed to establish a relationship between maternal weight gain during pregnancy and the

newborn's birth weight. Several international studies have been conducted on this subject but this study will help us find a predictable relationship between maternal weight gain during pregnancy and newborn weight in the local population, if such a relationship exists. If such a relationship exists, it will serve as a very simple and important clinical tool for monitoring fetal well-being.

2. Materials & Methods

This prospective observational study was carried out at Combined Military Hospital, Kohat from 1st April 2021 till 30th September 2022. Prior approval from the Ethical Review Board (Certificate No. E/2005/A/9 dated 23rd February 2021) of the hospital was attained before starting this study. A total of 120 patients were selected for our study. All patients willing to participate in this study signed a consent form before recruitment. The sample size was calculated with the help of an online sample size calculator provided by Calculator.net. Sample size was calculated with a confidence level of 95%, a margin of 5% and a population proportion of 8%.¹¹ Sample size came out to be 114 and it was rounded off to 120. Non-probability consecutive sampling technique was followed for this study.

All healthy pregnant women with an age range between 20 to 40 years, reporting for antenatal checkups in the first month of pregnancy were recruited for this study.

Women with a history of diabetes mellitus, hypertension, pre-eclampsia, eclampsia, chronic kidney disease, moderate to severe valvular heart disease or any other chronic uncontrolled systemic disease were excluded from this study. Women who suffered from gestational diabetes, pre-eclampsia and eclampsia while recruited for the study were also excluded from this study. Women who had abortions, stillbirth or premature delivery were excluded from this study. Women who were lost to follow-up were also excluded from this study.

Demographic data including age, height, weight and place of residence (rural or urban) were recorded. The weight and height of all patients were recorded in the first month of pregnancy and at term with the help of a calibrated and tested weighing machine present in the obstetric outdoor patient department of the hospital. The height and weight of mothers were used to calculate their body mass index (BMI). Mothers were labelled underweight, normal weight, overweight and obese as per the criteria given by Centers for Disease Control and Prevention America for pregnant women as shown in Table 1.¹² Weight gain during pregnancy was placed in three categories i.e weight gain of 4.9 kg or less, weight

gain between 5 to 10Kg and weight gain of more than 10kg. The weight of all newborns was also recorded with the help of calibrated and tested weighing scales present in the labour room and operation theatre of the hospital. Newborns with birth weights less than 1500 grams were labelled as very low birth weight. Newborns with birth weight between 1500 to 2499 grams were labelled as low birth weight and those with birth weight between 2500 to 4200 grams were labelled as normal weight. Newborns with a birth weight of more than 4200 grams were labelled as macrosomia.

Table 1: Weight Categories of Pregnant Women Based On BMI

Weight Category	Body Mass Index (kg/m ²)
Underweight	<18.5
Normal Weight	18.5 - 24.9
Overweight	25 - 29.9
Obese	≥ 30

Data was collected on a specially designed data collection sheet. Collected data was computed with the help of Statistical Package for Social Sciences (SPSS) v. 23.00. Continuous variables are presented as mean and standard deviation. Categorical variables are presented as frequency and percentage. Maternal weight gain categories and newborn birth weight categories were compared using a chi-square test. A p-value of 0.05 or less was taken as significant.

3. Results

Our primary outcome measure in this study was the weight gain of mothers during pregnancy and the newborn's birth weight. Out of 120 patients selected for this study, 49 (40.83%) belonged to urban areas and 71 (59.17%) belonged to rural areas. The age range of the selected patients was from 21 to 37 years with mean age of 27.73±3.61 years. The mean and standard deviation of the selected patients was 24.62±2.78 kg/m². The distribution of the selected patients based on BMI categories is shown in Table 2.

Table 2: Distribution of patients based on BMI categories

BMI Category	Frequency (%)
Underweight	5 (4.16)
Normal Weight	59 (49.17)
Overweight	54 (45)
Obese	2 (1.67)

Weight gain during pregnancy ranged from 4 to 12 kg with a mean and standard deviation of 6.44±1.96 kg. The distribution of the selected patients based on weight gain categories is shown in Table 3 below.

Table 3: Distribution of patients based on weight gain categories and Birth Weight

Weight gain category	Frequency (%)	Birth weight in Kg (Mean±SD)
Category 1 (<5 kg)	6 (5)	2.52±0.26
Category 2 (5-10 kg)	106 (88.33)	2.92±0.23
Category 3 (>10 kg)	8 (6.67)	3.34±0.23

The birth weight of newborns ranged from 2.2 kg to 3.6 kg with a mean and standard deviation of 2.93±0.27 kg. The distribution of newborns based on birth weight categories is shown in Table 4 below.

Table 4: Distribution of newborns based on birth weight categories

Birth weight Category	Frequency (%)
Low Weight	11 (9.17%)
Normal weight	109 (90.83%)
Macrosomia	0 (0%)

A total of 11 newborns were born with low birth weight, out of these 11, 3 were born to mothers with less than 5 kg weight gain during the pregnancy, rest 8 belonged to mothers with weight gain category of 5-10 kg. Details of the relationship between the mother's weight gain during pregnancy and with newborn birth weight are shown in Table V. The Macrosomia category is omitted in the table as no newborn fell into that category.

Table 5: Maternal Weight Gain versus Fetal Birth Weight

Maternal Weight Gain Category	Birth Weight		p-value
	Low (Frequency %)	Normal (Frequency %)	
Category 1 (<5 kg) (n=6)	3 (50%)	3 (50%)	0.001
Category 2 (5-10 kg) (n=106)	8 (7.55%)	98 (92.45%)	
Category 3 (>10 kg) (n=8)	0 (0%)	8 (100%)	

Chi-square test; *Statistically significant (p <0.05)

4. Discussion

Weight gain by a mother during pregnancy is one of the important indicators of a healthy pregnancy.¹³⁻¹⁴ Achieving an appropriate weight during pregnancy is of utmost importance not only for the fetus but for the mother as well. During pregnancy, the mother's body

undergoes various physiological changes to cater for the rapidly growing fetus. Appropriate weight gain ensures that the mother's body has enough energy and nutrient stores to support the rapid and healthy growth of the fetus. Inadequate weight gain during pregnancy puts the fetus at many risks including impaired fetal growth, low birth weight and premature delivery. In our study, 4.16% of women were underweight, 49.17% of women were normal weight, 45% were overweight and 2% were obese. In 2012 and 2013, an organization named Pakistan Demographic and Health Survey, carried out a survey on the weight of ever-married women aged between 15 to 49 years, belonging to different parts of Pakistan and found that 13% of women are underweight, 48% are normal weight, 25% are overweight and 14% are obese.¹⁵ These observations are comparable to the results of our study. In our study we found out that 5% of women gained less than 5 kg weight during pregnancy, the majority (88.33%) gained between 5 to 10 kg and only 8% gained weight more than 10 kg. In a similar study conducted in Bangladesh by Shiffin Rijvi et al. only 4% of patients during pregnancy gained less than 5 kg of weight, the majority (68%) gained weight between 5 to 10 kg, whereas 28% gained weight over 10 kg.¹⁶ In our study, 9.17% of newborns were born with low birth weight, 90.83% had normal birth weight and no newborn fell into the category of macrosomia. A cross-sectional study conducted by Janjua NZ in an urban population of Karachi found that the incidence of low birth weight was 18.5% which is almost double what we observed in our results.¹⁷

Maternal weight gain in pregnancy is directly related to the birth weight of the newborn. In this study, the mean weight of the baby at birth was 2.52±0.26 kg in mothers who gained less than 5 kg weight during pregnancy. Similarly, the mean birth weight was 2.92±0.23 in mothers who gained weight between 5 to 10 kg. Mean birth weight was 3.34±0.23 in mothers who gained weight more than 10 kg. Tela FG et al. in a study found that weight gain during pregnancy has a significant effect on the birth weight of the newborns. They estimated that approximately one kg weight gain during pregnancy was associated with a 94 grams increase in birth weight.¹⁸ Several other studies have reached a similar conclusion.¹⁹

5. Conclusion

It is concluded in our study that maternal weight gain during pregnancy is strongly associated with the birth weight of the newborn. Therefore all pregnant women

should be provided with appropriate weight gain goals during pregnancy by their healthcare providers.

CONFLICTS OF INTEREST- None

Financial support: None to report.

Potential competing interests: None to report

Contributions:

S.S.J, S.I, U.I, F.M, B.S, A.A - Conception of study

S.S.J, F.M - Experimentation/Study Conduction

S.S.J, S.I, U.I, F.M, B.S, A.A -

Analysis/Interpretation/Discussion

S.S.J, S.I, U.I, F.M, B.S, A.A - Manuscript Writing

S.S.J, S.I, U.I, A.A - Critical Review

S.S.J, S.I, B.S - Facilitation and Material analysis

All authors approved the final version to be published & agreed to be accountable for all aspects of the work.

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