

Evaluating Gestational Weight Gain and Its Maternal and Fetal Outcomes at Tertiary Care Hospital, Abbottabad

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ABSTRACT

Background: Maternal weight gain during pregnancy has a significant impact on both maternal and fetal health outcomes. This study aimed to determine the frequency and variety of GWG patterns among pregnant women residing in Abbottabad, along with their assessment of associations between these patterns and unfavorable maternal (cesarean delivery) and fetal (LBW) outcomes.

Methods: A six-month descriptive study (May-November 2022) at the Department of Gynecology and Obstetrics, Combined Military Hospital (CMH) in Abbottabad was conducted that involved 199 pregnant women ranging from age 20-40 years. The sample population was included using a consecutive non-probability sampling method. GWG was categorized according to IOM guidelines, with outcomes measured as cesarean delivery rates and incidence of low birth weight (LBW <2500g). The researchers analyzed the data using SPSS version 20 through quantitative measures by applying means and standard deviations to confounders.

Results: Key findings demonstrated a 30.2% cesarean delivery rate and 35.2% LBW incidence. Neonatal weight distribution revealed 30.7% underweight, 19.1% normal weight, and 30.7% overweight infants. Statistical analysis showed significant associations between underweight neonates and younger maternal age (20-30 years), rural residence, and lower education levels ($p < 0.05$). Overweight neonates were associated with maternal secondary education and vaginal deliveries.

Conclusion: The bimodal distribution of neonatal weights highlighted that there were significant nutritional disparities in this population. These findings underscored that there was an urgent need for targeted interventions, including enhanced maternal education, nutritional support programs, and improved healthcare access, in order to optimize pregnancy outcomes in resource-limited settings.

Keywords: Gestation, Weight Gain, BMI, Underweight, Cesarean, Delivery, Birth Weight.

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Doi: <https://doi.org/10.36283/ziun-pjmd14-3/004>.

How to cite: Yahya W, Hammad R, Sadia H, Bibi T, Khan N, Kouser M, Ahmed E Evaluating Gestational Weight Gain and Its Maternal and Fetal Outcomes at Tertiary Care Hospital, Abbottabad. Pak J Med Dent. 2025 July ;14(3): 17-23. Doi: <https://doi.org/10.36283/ziun-pjmd14-3/004>.

Received: Thu, April 10, 2025 **Accepted:** Fri, June 20, 2025 **Published:** Mon, July 21, 2025

INTRODUCTION

The health of both pregnant women and their fetuses depends heavily on maternal weight status before and during pregnancy. Gestational weight gain (GWG) has received significant attention in developed countries, as it is strongly associated with risks such as preterm birth, caesarean delivery, and neonatal morbidity risks¹. In lower- and middle-income countries like Pakistan, a combination of cultural along economic conditions and healthcare factors creates unique challenges in managing GWG, especially since data collection initiatives in these regions remain limited². This research investigated the occurrence rate of weight gain patterns among pregnant mothers, together with its impact on maternal and newborn health outcomes at a tertiary hospital facility in Abbottabad, Pakistan. This facility reflected healthcare conditions typical of resource-restricted settings, where maternal nutritional deficiencies and obstetric complications are common.

The World Health Organization describes obesity among women during childbearing years as a pandemic, as it continues to show a rising trend worldwide³. Gestational diabetes mellitus (GDM), along with hypertensive disorders, macrosomia, and higher rates of delivery by caesarean section, are medical complications associated with pregnancy obesity. For underweight pregnant women, inadequate GWG increases the risk of intrauterine growth restriction (IUGR) and low birth weight (LBW)⁴. Current research shows that global GWG recommendations, as defined by the 2009 Institute of Medicine (IOM) guidelines, fail to achieve sufficient adherence among population groups worldwide. Populations in LMICs face management challenges for GWG due to prevailing malnutrition conditions, rising obesity rates, and barriers such as limited access to prenatal care, food scarcity, and low literacy rates^{5,6}. The reported incidence of inadequate gestational weight gain ranges between 30–40% among South Asian pregnant women, with considerable social class distinctions reflected in healthcare records⁷.

The worldwide significance of proper pregnancy weight gain remains under-researched in Pakistan's health records. Research studies primarily focus on urban areas and often overlook GWG patterns among the vast obstetric patient population

residing in rural and semi-urban regions of the country. Abbottabad, a city in Khyber Pakhtunkhwa, is a region with a diverse population characterized by high poverty rates and limited access to healthcare. The Combined Military Hospital (CMH) Abbottabad functions as a tertiary care facility and serves people from across the region, offering a representative patient population for the review of GWG patterns. Research in similar settings, including one specific study, has shown that between 30% and 40% of women fail to meet the weight targets specified by the Institute of Medicine (IOM) guidelines^{8,9}.

This study aimed to determine the frequency and variety of GWG patterns among pregnant women residing in Abbottabad, along with their assessment of associations between these patterns and unfavorable maternal (caesarean delivery) and fetal (LBW) outcomes.

METHODS

A descriptive research analysis was conducted at the Department of Gynecology and Obstetrics, Combined Military Hospital (CMH) Abbottabad, over six months from May 6, 2022, to November 6, 2022, in Khyber Pakhtunkhwa, Pakistan. Before the commencement of the study, ethical approval was obtained from the Institutional Ethical Review Committee, CMH Abbottabad, and the College of Physicians and Surgeons, Pakistan (CMH-ETH-12-Gynae-22). Pregnant women with a gestational age of ≤ 13 weeks, confirmed through last menstrual period and ultrasound, who had singleton pregnancies and were between 20 and 40 years of age, were included in the study using a consecutive non-probability sampling method. This approach yielded a total of 199 participants. Women were excluded from the study if they had diabetes mellitus, hypertension, thyroid disorders, twin pregnancies, any form of uterine anomaly, or consumed uncooked items. Based on calculations using the WHO sample size calculator, a sample of 199 participants was determined, using a 9.1% prevalence of low birth weight among below-range GWG groups, with 95% confidence and a 4% margin of error¹⁰.

At the first antenatal session, the research team measured the mothers' height using wall-mounted measuring tools and recorded their weight with

standardized weighing machines to calculate Body Mass Index (BMI) using the formula:

weight /height squared (kg/m²)

The data were classified according to World Health Organization standards: underweight (BMI <18.5), normal weight (18.5–24.9), overweight (25.0–29.9), and obese (≥30.0). Mothers' gestational weight gain was calculated by subtracting their pre-pregnancy weight from their delivery weight, and this change was categorized according to the 2009 Institute of Medicine (IOM) recommended ranges. The study defined maternal delivery as a caesarean birth if it occurred through surgical procedures after the onset of labor, and fetal outcomes were evaluated by identifying birth weights less than 2500 grams.

The researchers analyzed the data using SPSS version 20 through quantitative measures by applying means and standard deviations to describe maternal age, gestational age, and birth weight. These results were compared with qualitative variables such as residence, parity, and education, which were expressed in terms of frequency and percentage. Maternal age stratification, along with other demographic variables including neonatal gender, residence,

parity, gravida, income, occupation, and education level, was conducted before applying chi-square tests for assessment. A p-value of ≤0.05 was taken as statistically significant. All participants gave written informed consent, and the study took place under the Declaration of Helsinki with approval granted by the Institutional Review Board of CMH Abbottabad. Operational definitions, which were acceptable to the Food and Drug Administration (FDA), were used to determine gestational age based on the last menstrual period (LMP), which was confirmed by ultrasound, and to identify low birth weight infants through post-delivery neonatal weight measurements.

RESULTS

This study included 199 mother-infant pairs. Most of the mothers (62.8%) were aged between 31–40 years. A majority of the neonates were male (65.3%) and resided in urban areas (92%). More than half of the mothers were unemployed (65.3%), had primary education (61.8%), and had a family income below PKR 50,000 per month (54.8%). Cesarean delivery was reported in 30.2% of the cases, and low birth weight was observed in 35.2% of the neonates **Table 1**.

Table 1: Study Population Characteristics (n = 199)

Variable	Category	Frequency (%)
Maternal Age	20–30 years	74 (37.2%)
	31–40 years	125 (62.8%)
Neonatal Gender	Male	130 (65.3%)
	Female	69 (34.7%)
Residence	Rural	16 (8.0%)
	Urban	183 (92.0%)
Parity	≤3	85 (42.7%)
	>3	114 (57.3%)
Gravida	≤3	101 (50.8%)
	>3	98 (49.2%)
Family Income (PKR)	≤50,000	109 (54.8%)
	>50,000	90 (45.2%)
Occupation	Employed	69 (34.7%)
	Unemployed	130 (65.3%)
Education	Illiterate	8 (4.0%)
	Primary	123 (61.8%)
	Secondary	30 (15.1%)
	Higher	38 (19.1%)
Cesarean Delivery	Yes	60 (30.2%)
	No	139 (69.8%)
Low Birth Weight	Yes	70 (35.2%)
	No	129 (64.8%)

The nutritional status of neonates revealed that 61 (30.7%) were underweight, 38 (19.1%) had normal weight, and 61 (30.7%) were overweight. The remaining 39 (19.6%) were classified as within other or unspecified ranges. Factors that influenced each group are presented below.

Among neonates born to mothers aged 20–30 years (42.1%, $p = 0.01$), underweight status was significantly more prevalent, as well as in those who were residing in rural areas (50.0%, $p = 0.04$). Educational level and cesarean delivery also showed that there were statistically significant associations **Table 2**.

Table 2: Factors Associated with Underweight Neonates

Factor	Category	Underweight (%)	P-value
Maternal Age	20–30 years	42.1%	0.01*
	31–40 years	24.0%	
Residence	Rural	50.0%	0.04*
	Urban	28.9%	
Parity	≤3	27.0%	0.18
	>3	34.6%	
Education	Illiterate	0.0%	0.01*
	Primary	25.2%	
	Secondary	48.7%	
	Higher	30.4%	
Cesarean Delivery	Yes	5.0%	0.01*
	No	43.5%	

Normal weight neonates were more frequently male (29.2%, $p = 0.01$) and born to mothers with secondary education (36.7%, $p = 0.02$). Low birth weight was also significantly associated with normal weight status ($p = 0.01$). Factors associated with normal-weight neonates are shown in **Table 3**.

Table 3: Factors Associated with Normal Weight Neonates

Factor	Category	Normal Weight (%)	P-value
Maternal Age	20–30 years	20.3%	0.74
	31–40 years	18.4%	
Neonatal Gender	Male	29.2%	0.01*
	Female	0.0%	
Education	Illiterate	0.0%	0.02*
	Primary	15.4%	
	Secondary	36.7%	
	Higher	21.1%	
Low Birth Weight	Yes	32.9%	0.01*
	No	11.6%	

Overweight status also showed that this factor is associated with maternal age, education, and delivery method. Mothers aged 20–30 had a higher frequency (35.5%, $p = 0.03$), and the highest proportion was among those with secondary education (46.0%, $p = 0.02$). No overweight neonates were delivered by cesarean section ($p = 0.01$). Factors associated with overweight neonates are shown in **Table 4**.

Table 4: Factors Associated with Overweight Neonates

Factor	Category	Overweight (%)	P-value
Maternal Age	20–30 years	35.5%	0.03*
	31–40 years	27.2%	
Education	Illiterate	0.0%	0.02*
	Primary	28.0%	
	Secondary	46.0%	
	Higher	31.2%	
Cesarean Delivery	Yes	0.0%	0.01*
	No	41.0%	
Occupation	Employed	27.5%	0.66
	Unemployed	33.0%	

Underweight and overweight neonates each accounted for 31%, normal weight for 19%, and other or unclassified categories also comprised 19% of the total sample. The study showed that both excessive and insufficient weight gain during pregnancy resulted in dual weight-related problems that impacted newborns' birth weights (30.7% underweight and 30.7% overweight). There was a direct correlation between these results and the maternal characteristics, such as age, level of education, and the delivery method. Underweight neonates were more common among the mothers aged 20–30 years ($p = 0.01$), those residing in rural areas ($p = 0.04$), and the mothers with lower levels of education ($p = 0.01$). In this Abbottabad-based cohort, these findings supported that there is a strong correlation between maternal weight gain and unfavorable pregnancy outcomes.

DISCUSSION

This study investigated how maternal socio-demographic variables together with obstetric factors have an influence the classification of neonatal birth weights (underweight, normal, or overweight). The findings supported the previous researches by demonstrating that maternal age, educational background, and mode of delivery have a direct impact neonatal weight outcome^{11,12}.

The birth weight distribution exhibited a bimodal pattern, with 31% of neonates who were classified as underweight and 31% classified as overweight, while 19% had normal birth weights. Research indicated that this distribution pattern has demonstrated maternal nutritional deficiencies and inadequate prenatal support, which aligns with findings that linked extreme newborn weights to maternal health issues^{13,14}. Neonates born to mothers aged between 20–30 years faced higher risks of being underweight or overweight. Literature has mentioned that both young and advanced maternal ages are associated with unfavorable birth outcomes that often result in abnormal birth weights^{15,16}. The research suggests that even within the traditionally favorable reproductive age, some maternal factors can still lead to negative outcomes for newborns¹⁷.

Research data indicated that birth weight was directly related to maternal education levels. Mothers who completed secondary education tended to give birth to healthy weight or overweight babies, while mothers with only primary education were more likely to have underweight infants. Previous studies have shown that higher educational levels lead individuals towards the better understanding of their health and nutritional needs that helps in improved birth outcomes^{18,19}.

The choice between vaginal delivery and caesarean section had a significant impact on the results of this study. Delivery data revealed that caesarean sections never resulted in underweight infants, while all cases of underweight neonates were delivered through spontaneous vaginal birth. Research evidence supports the idea that obstetric professionals perform caesarean sections only after predicting complications, especially with large newborns^{20,21}. The analyzed factors, such as residence status, maternal parity, and occupational

status, had failed to establish any significant associations with newborn weight measurements in this study sample population. However, the research design might have limitations as it restricted the ability to observe rural residence and high parity as risk factors for low birth weight because it primarily analyzed an urban-dominant population, with 92% of subjects from urban areas^{22,23}.

The data confirmed that birth weight in neonates was influenced by multiple contributing factors^{24,25}. The rate of abnormal birth weights could potentially be lowered through maternal health programs that provide not only education but also help in improving the diet of pregnant women as well as offer additional support for younger mothers.

CONCLUSIONS

This study highlighted a significant association between maternal factors, especially age, education, mode of delivery, and outcomes of neonatal birth weight. The relatively high prevalence of both underweight and overweight neonates underscores the fact that there is a need for targeted maternal health interventions. By enhancing maternal education, providing nutritional counseling, and ensuring comprehensive antenatal optimal birth weights can be promoted and neonatal complications can be reduced. These findings emphasized the importance of a holistic approach to maternal and child health, particularly in urban settings, as not much rural settings were taken into consideration.

LIST OF ABBREVIATIONS

GWG: Gestational Weight Gain
LBW: Low Birth Weight
IOM: Institute of Medicine
GDM: Gestational Diabetes Mellitus
IUGR: Intrauterine Growth Restriction
LMICs: Low- and Middle-Income Countries
BMI: Body Mass Index

ACKNOWLEDGEMENT

None

FUNDING

None

CONFLICT OF INTEREST

None

ETHICAL APPROVAL

The ethical approval for the study was obtained from the Department of Gynecology and Obstetrics, Combined Military Hospital (CMH) Abbottabad (CMH-ETH-12-Gynae-22).

AUTHORS' CONTRIBUTIONS

All contributed equally as per ICMJE.

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