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Original Article

Influence of Body Mass Index (BMI) on Mother's Health during Pregnancy and Fetal Outcomes

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ABSTRACT

Objective: To compare the influence of body mass index in obese and normal weight mothers regarding pregnancy and fetal outcomes and to study the predicting factors.

Study Design: Case-control study.

Place and Duration of Study: Department of Gynaecology and Obstetrics, Pak Emirate Military Hospital, Rawalpindi Pakistan, from Jul to Dec 2023.

Methodology: Pregnancy outcomes, medical and obstetric history, and demographic information of the mother were gathered. Weight at last prenatal appointment minus weight before pregnancy or self-reported data at delivery were used to determine gestational weight gain (GWG). Obese women were placed in Group-A, whereas normal weighted women were placed in Group-B.

Results: A total of four hundred (n=400) pregnant women were included in this study, out of which, 2(0.5%) were underweight, 320(80.0%) were normal weight, 16(4.0%) were overweight, 62(15.5%) were obese. Mean age was 32.87±6.77 years. Group-A had more gestational diabetes (n=12, 19.3%). Similarly, gestational hypertension, preeclampsia, dystocia were seen more in Group-A as compared to Group-B (p<0.05). Moreover, induced labor (32.3% vs 16.3%), failed induction of labor (11.3% vs 1.6%), augmentation of labor (33.9% vs 29.1%), Cesarean delivery (40.3% vs 28.1%) rates were significantly increased in Group-A. Six (9.7%) obese women delivered babies that had APGAR score ≤7 after 5 minutes.

Conclusion: The risks of prenatal hypertension, preeclampsia, gestational diabetes, labour dystocia, labour induction, unsuccessful induction of labour, large-for-gestational-age infants, and Cesarean birth are greatly elevated in mothers who are overweight during their pregnancies.

Keywords: Body mass index (BMI), Gestational weight gain, Obesity.

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INTRODUCTION

Overweight and obesity have become epidemic in the last quarter of a century, affecting both the general public and women of reproductive age.[1] In countries with a middle- or high-income bracket, over a third of reproductive-age women are overweight or obese. These women are more likely to experience complications during pregnancy, including greater rates of infertility and newborn morbidity.[2,3] Furthermore, the nutritional environment during fetal development may directly affect the onset of obesity in adulthood.[4] No healthcare system should underestimate the substantial impact that obesity poses.[5] By examining the correlation between obesity and unfavourable pregnancy outcomes, we may gain a clear picture of the risks involved and target our interventions to the population that may show the greatest impact.[6]

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In Pakistan, maternal and fetal health remains a significant public health concern, with various factors influencing pregnancy outcomes. Understanding the impact of body mass index (BMI) on maternal and fetal well-being is crucial in this context.[7] With the nation grappling with both undernutrition and a rising trend of obesity, investigating how maternal weight status affects pregnancy and fetal outcomes becomes imperative.[8] By undertaking this comparative analysis, we aspire to uncover critical insights that can inform targeted interventions and healthcare policies tailored to the unique needs of Pakistani mothers. Such research not only contributes to the global discourse on feto-maternal health but also holds the potential to enhance the efficacy of maternal healthcare initiatives in Pakistan, ultimately ensuring better outcomes for mothers and their infants.[9]

The study aimed to investigate the contrasting impacts of body mass index (BMI) on pregnancy and fetal outcomes between obese and normal-weight mothers thus shedding light on predictive factors.

METHODOLOGY

This case-control study was conducted at the Department of Obstetrics and Gynecology Pak Emirates Military Hospital from July to December 2023, after obtaining approval from Ethical Review Committee (IERB No. ERC/546/23).

Inclusion Criteria: The study included pregnant women of any age, with a gestational age of 22 weeks or more.

Exclusion Criteria: The study excluded women with multiple pregnancies or previous history of lower segment Caesarean section (LSCS).

Sample size was estimated using WHO calculator, which came to 380 when using standard prevalence.[10] All the patients who gave birth at a hospital were considered for inclusion during the study period, with those not meeting the defined criteria being excluded. Non-probability consecutive sampling was used, and informed consent was taken from each respondent. During the study period 400 women were considered, all with a gestational age of 22 weeks or more. Pregnancy outcomes, medical and obstetrical history, and demographic information on the mother were gathered. Prenatal data or self-reporting during delivery were used to get height and pre-pregnancy weight. Respondents were divided into two groups: Group-A included women who were obese before pregnancy (BMI ≥30 kg/m^2), and Group-B included women who were of normal weight (BMI 18.5-24.9 kg/m^2), which can be seen in Figure-1. Women who were underweight or overweight were not included in the final analysis. Weight at last prenatal appointment minus weight before pregnancy or self-reported data at delivery were used to determine gestational weight gain (GWG).

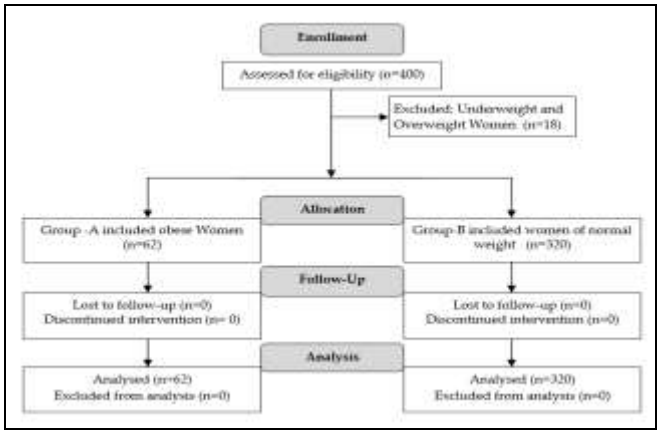

Figure-1: Patient Flow Diagram (n=382)

Between women of normal weight and those who were overweight or obese, we looked at a variety of maternal variables, including as age, parity, marital status, degree of education, GWG, and effects of pregnancy. Pregnancy outcomes were compared between normal weight women and obese women.

Hypertension throughout pregnancy, preeclampsia, gestational diabetes, labour induction, augmentation, unsuccessful induction, dystocia, and the rate of caesarean section were among the maternal outcomes of interest. Birthweight, gestational age at delivery, preterm delivery, stillbirth, and poor APGAR score at 5 minutes were neonatal outcomes of interest. Early ultrasonography and the day of the last menstrual cycle were used to determine the gestational age at delivery. A score of 7 or lower at 5 minutes following birth was considered a low APGAR score. Any foetal death that occurs during pregnancy or after the 22nd week of gestation was considered a stillbirth. Babies whose birthweights were higher than the 90th percentile after adjusting for gestational age and gender were considered to have macrosomia, or large-for-gestational-age. If a baby's weight was below the 10th percentile when corrected for both gender and gestational age, we say that they were little for their gestational age. The nursery began weighing newborns as soon as they were born. In women who were previously considered to have normal blood pressure, gestational hypertension was defined as a rise in blood pressure of 140 mm Hg or 90 mm Hg diastolic, measured twice within 6 hours of each other after 20 weeks of gestation.

The diagnosis of pre-eclampsia was made when a woman experienced gestational hypertension together with proteinuria equal to or greater than 300 mg in a 24-hour urine sample. The first appointment during pregnancy included a fasting glucose check. Anyone who was overweight before becoming pregnant had to have an oral glucose tolerance test. Institutional policy mandated the use of oral glucose tolerance tests (OGTT) in women with normal body mass index (BMI) in cases where the following risk factors were present: age of 35 years or older, a history of diabetes in the family, a history of gestational diabetes (GDM), glycosuria, a history of stillbirths without an explanation, and a history of low birth weight (LGA) babies. OGTT was performed between the 24th and 28th weeks of gestation with a 75 g loading

glucose dose. The determination of GDM was based on a plasma glucose level of 7.8 mmol/L or above after 2 hours. Diagnosis of Class A1 GDM was made when dietary changes were shown to be adequate in controlling blood glucose levels. When extra insulin medication was necessary, class A2 GDM was identified. When medical and pharmaceutical interventions failed to induce labour by the use of regular uterine contractions and subsequent vaginal delivery, the diagnosis was of failed induction of labour. A misalignment of the fetus's head with the delivery canal, pelvic contractions, or a dysfunctional uterus were the three main causes of dystocia, which halted the progress of labour.

Statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) version 23. Qualitative factors were summarised as frequency and percentages, whereas quantitative variables were presented as Mean±SD. Chi-square test and the independent sample t-test were utilised to check for association and to compare means, respectively. A *p*-value ≤0.05 was conserved statistically significant.

RESULTS

A total of 400 pregnant women were included in this study. Mean age was 32.87±6.77 years. Of these, 2 (0.5%) were underweight, 320(80.0%) were of normal weight, 16(4.0%) were overweight, and 62(15.5%) were obese. We removed underweight and overweight women from our analysis. Obese women were placed in Group-A, while women with normal weight were placed in Group-B. The association of different patient characteristics with weight of study participants is shown in Table-I. Association with maternal age (p=0.049), weight (p<0.001) and BMI (p<0.001) were statistically significant.

Table-I: Demographic and Clinical Characteristics of the Study Participants (n=382)

Parameters	Group-A (n=62) n(%)	Group-B (n=320) n(%)	*p*-value
Nulliparous	22 (35.5%)	115 (35.9%)	0.945
Multiparous	40 (64.5%)	205 (64.1%)	
Maternal age in years (Mean±SD)	31.45±4.97	29.87±5.92	0.049
Weight gain during Pregnancy in kilograms (Mean±SD)	10.65±5.68	13.46±4.87	< 0.001
BMI during Pregnancy (Mean±SD)	36.81±2.99	22.63±1.02	<0.001
Area of Residence			
Urban	34(54.8%)	246(76.8%)	0.003
Rural	28(45.2%)	74(23.2%)	
Education			
Secondary	44 (70.9%)	192(60.0%)	0.192
Higher Education	18(29.1%)	128(40.0%)	

Women in Group-A had more Gestational diabetes (n=12;19.3%) as compare to normal weight (n=13; 4.1%) of women (odds ratio;95% CI = 0.176;0.076 – 0.409) and *p*-value <0.001. Similarly, gestational hypertension, preeclampsia, dystocia were more seen in Group-A compared to Group-B (p<0.05). Moreover, induced labor (32.3% vs 16.3%), failed induction of labor (11.3% vs 1.6%), augmentation of labor (33.9% vs 29.1%), Cesarean delivery (40.3% vs 28.1%) rates were significantly increased in Group-A (Table-II).

Table-II: Association of Maternal Outcomes across Groups (n=382)

Parameters	Group-A (n=62) n (%)	Group-B (n=320) n(%)	OR (95% CI)	*p*-value
Gestational diabetes	12(19.3%)	13 (4.1%)	0.176 (0.076 – 0.409)	<0.001
Gestational Hypertension	10(16.1%)	8 (2.5%)	0.133 (0.050 – 0.353)	<0.001
Preeclampsia	6 (9.7%)	11 (3.4%)	3.00 (1.06 – 8.46)	0.029
Dystocia	11 (17.7%)	29 (9.1%)	0.462(0.217 – 0.983)	0.041
Induced Labor	20 (32.3%)	51 (16.3%)	0.407 (0.221 – 0.750)	0.003
Failed Induction of labor	7 (11.3%)	5 (1.6%)	0.125 (0.038 – 0.407)	< 0.001
Augmentation of labor	21(33.9%)	93 (29.1%)	o.579 (0.330 – 1.017)	0.044
Cesarean Delivery	25 (40.3%)	90 (28.1%)	o.125 (0.338 – 0.407)	0.050

Six (9.7%) obese women delivered babies that had APGAR score ≤7 after 5 minutes. Preterm birth was more seen in normal weight of women (n=37:11.6%). Furthermore, rate of stillbirth was increased in Group-A (p=0.019). Large-for-gestational-age newborns were most common in obese women (p<0.001). There was no statistically significant difference across groups in incidence of Small-for-gestational-age newborn (p=0.139), as shown in Table-III.

Table-III: Association of Neonatal Outcomes for different Groups (n-382)

Parameters	Group-A (n=62) n (%)	Group-B (n=320) n (%)	OR (95% CI)	*p*-value
APGAR score ≤7 after 5 min	6(9.7%)	10(3.1%)	0.301 (0.105 – 0.862)	0.018
Preterm birth	5(8.1%)	37(11.6%)	1.22 (0.492 – 3.028)	0.667
Stillbirth	8(12.9%)	16(5.0%)	0.355 (0.145 – 0.871)	0.019
Small-for-gestational-age newborn	2(3.2%)	28(8.8%)	2.877 (0.667 – 12.402)	0.139
Large-for-gestational-age newborn	20(32.3%)	42(13.1%)	2.45 (1.55 – 3.885)	<0.001

DISCUSSION

Understanding the impact of body mass index (BMI) on pregnancy outcomes between obese and normal-weight mothers is crucial. This comparison helps identify predictive factors influencing maternal and fetal health, informing targeted interventions. Such insights facilitate personalized care strategies, ultimately improving maternal and fetal outcomes.[11]

Hypertensive illnesses and gestational diabetes mellitus (GDM) are more common in obese women. In the pregnant population, GDM is typically identified in 4-7% of cases. Compared to pregnant women of normal weight, the risk of gestational diabetes mellitus (GDM) is three to eight times higher in obese women according to previous study.[12] Our study found that 19.3% of obese women were diagnosed with GDM. Among women with a pre-pregnancy BMI of 35 kg/m^2 or more, the Odds Ratio jumped significantly. We also found that hypertension problems are more common in women with higher body mass indices before pregnancy. The Odds Ratio for prenatal hypertension was 0.133 and for preeclampsia it was 3 in our obese patient group. It is possible that the discrepancy in definitions, and the fact that the current study's data came from tertiary referral centres, where a greater number of pregnant women with complications are sent, contributed to the higher risk of hypertensive disorders and GDM compared to the data published in the literature.

Pregnancy complications in obese women include longer labour times, more frequent induction procedures, and a higher risk of complications during and after the labour process as described by Teshome *et al*.[13] Our study found that women with a pre-gestational BMI more than 30 kg/m^2 were more likely to have their labour induced. Wang *et al*., described that women whose BMIs were 30–34.9 kg/m^2 had a considerably greater ratio of failed induction of labour (17.2%) compared to women whose body mass indices were 35 kg/m^2 or higher (19.8%).[14] Obese pregnant women are more likely to need a caesarean section or operational vaginal delivery due to complications such as dystocia (a narrowing of the birth canal caused by the mother's enlarged pelvic soft tissue), foetal macrosomia, and cephalopelvic disproportion. Our study's 40% rate of caesarean sections for obese women is consistent with previous studies.[15] Even after accounting for other variables, the chance of caesarean delivery is nearly twice as high in obese women. Among both normal-weight and obese patients, our research found that dystocia and foetal distress were the leading causes of caesarean sections. The risk of having a macrosomic baby is higher in obese mothers. Our study found an even higher proportion of LGA babies, surpassing prior findings by Gonzalez-Ballano *et al*.[16]

According to literature, foetal macrosomia is more likely to occur in mothers with higher body mass index.3 In a similar vein, we discovered higher odds of live births were identified in women with a body mass index (BMI) of 30–34.9 kg/m^2 and BMI of 35 kg/m^2 or higher, compared to women of normal weight. Shoulder dystocia, delivery trauma, and meconium aspiration are more common in LGA infants. Babies whose mothers are overweight are more likely to be admitted to the intensive care unit and have a lower APGAR score. Deliveries of infants with an APGAR score of 7 or lower at 5 minutes of gestation were more common in women whose body mass index was 35 kg/m^2 or higher. While being overweight greatly raised a woman's risk of practically every labour and delivery issue, it had no effect on major, urgent neonatal complications like the stillbirth rate.[17] Obesity in the mother is associated with a compromised metabolic environment, which in turn affects the health of the baby and its development during the first few months of life. The risk of problems like preeclampsia, gestational diabetes mellitus (GDM), gestational hypertension (GH), and premature delivery (PTD) can be significantly reduced by maintaining a healthy weight throughout pregnancy through dietary and exercise changes. Hypertensive diseases, gestational diabetes mellitus, foetal macrosomia, and childhood obesity are all less likely to occur after bariatric surgery.[18] Women of childbearing age with a body mass index (BMI) of 40 kg/m^2 or more are currently advised to undergo the expensive bariatric surgery. Obese pregnant women should get counselling on healthy eating and regular exercise from the tertiary perinatal referral centres in addition to treatment for obstetric difficulties caused by obesity. A better understanding of how to optimise pregnancy outcomes and enhance maternal and newborn health requires the identification of the safest and most effective interventions.

LIMITATIONS OF STUDY

Lack of information on neonates' long-term follow-up and the mother's post-pregnancy health, were our main limitations.

CONCLUSION

A higher incidence of complications during pregnancy, such as high blood pressure, preeclampsia, gestational diabetes, dystocia, premature labour, babies delivered with low birth weight, and caesarean sections, is linked to maternal obesity.

Conflict of Interest: None.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MA & TY: Data acquisition, data analysis, critical review, approval of the final version to be published.

NS & HC: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

IM & ZT: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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