STUDENTS' CORNER
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Association of maternal obesity and gestational weight gain with adverse maternal and perinatal outcomes

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Abstract

Objective: To determine the association of maternal obesity and gestational weight gain with adverse maternal and perinatal outcomes.

Method: The prospective, cross-sectional study was conducted from April 2023 to February 2024 at the Combined Military Hospital, Lahore, Pakistan, and comprised adult pregnant females carrying singleton pregnancy of any gestational age who had record available for weight at the first antenatal visit in the first trimester. Maternal body mass index at the first antenatal visit was calculated and the subjects were categorised as underweight, normal-weight, overweight and obese. Total weight gain during pregnancy was calculated at the last antenatal visit before delivery. Maternal and neonatal outcomes were observed for obese, overweight and those with >10kg gestational weight gain. Data was analysed using SPSS 26.

Results: Of the 151 female subjects with a mean age of 27.48±5.001 years, 102(67.5%) were either underweight or normal-weight, and 49(32.5%) were either overweight or obese. Besides, gestational weight gain was <10kg in 83(55%) cases and >10kg in 68(45%). Preeclampsia had a significant association with body mass index (p=0.003), while gestational age at delivery (p=0.049), neonatal birthweight (p=0.042) and Appearance-Pulse-Grimace-Activity-Respiration score at 5 minutes (p=0.003) were significantly associated with gestational weight gain.

Conclusion: Increased maternal body mass index and gestational weight gain were found to be associated with pre-eclampsia, gestational age at delivery, neonatal birthweight and Appearance-Pulse-Grimace-Activity-Respiration score.

Key Words: Gestational weight gain, Obesity, Pre-eclampsia, Pregnancy complications.
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Introduction

Maternal obesity and excessive gestational weight gain (GWG) have emerged as significant public health concerns globally, with a rising prevalence in low- and middle-income countries (LMICs), including Pakistan. Adverse pregnancy outcomes are more common in obese pregnant women. Various maternal and neonatal outcome variables can be associated with increased body mass index (BMI).[1] The recommended weight gain by Mayo Clinic guidelines is 5-9kg for obese women, 7-11kg for overweight, 11-16kg for normal weight and 13-18kg for underweight women.[2] Obese and overweight pregnant women, at risk of poor maternal and child health, present to obstetricians with prolonged hospitalisation.[3] Excessive GWG leads to adverse outcomes for maternal and neonatal health.[4] The adverse maternal outcomes include gestational diabetes mellitus (GDM), hypertensive disorders (preeclampsia, superimposed gestational hypertension), fever, postpartum haemorrhage (PPH) and prolonged surgery.[5]

Adverse perinatal/neonatal outcomes include increased admission in neonatal intensive care unit (NICU), neonatal mortality, hypoglycaemia, hyperbilirubinaemia, jaundice, and poor 1-minute and 5-minute Appearance-Pulse-Grimace-Activity-Respiration (APGAR) score after birth.[6] In case of increased pre-pregnancy BMI or excessive GWG, there is an increased likelihood of caesarean section (CS).[7] There is also increased risk of infections of the urinary tract, uterus and lower genital tract in overweight pregnant women.[8] In obese pregnant women, there are more complications of postpartum infections, that include wound infection, endometritis, perineal tears or episiotomy, and PPH.[9]

Despite the well-documented evidence from western countries, limited data is available on the impact of

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maternal obesity and GWG on pregnancy outcomes in the Pakistani population. The current study was planned to fill the gap in literature by determining the association of maternal obesity and GWG with adverse maternal and perinatal outcomes.

Patients and Methods

The prospective, cross-sectional study was conducted from April 2023 to February 2024 at the Combined Military Hospital, Lahore, Pakistan. After approval from the institutional ethics review committee, the sample size was calculated using the Cochran formula n = 2 ($Z\alpha/2$ + Zβ)2 (Sd)2 (μ1−μ2)2 with 6% margin of error and 95% confidence level.[10] The sample was raised using non-probability consecutive sampling technique.

Those included were adult pregnant females carrying singleton pregnancy of any gestational age who had record available for weight at the first antenatal visit in the first trimester and the last antenatal visit pre-delivery. Women with pre-existing hypertension and pre-existing DM were excluded.

After taking informed verbal consent from the participants, data regarding age, BMI, parity, previous CS, education and smoking history was noted along with comorbidities (hypertension, DM and preeclampsia) from medical records. The BMI was calculated, and they were categorised as underweight (<18.5kg/mm2), normal-weight (18.5-24.5kg/m2), overweight (24.9-30kg/m2) and obese (>30kg/m2).[11] Total GWG at the last antenatal visit before delivery was calculated. Maternal outcomes considered were gestational hypertension, GDM, preeclampsia, fever, prolonged surgery time and PPH. Perinatal outcomes considered were gestational age at delivery, onset of labour, type of labour, and duration of labour. The APGAR score after birth of the neonate was calculated at 1 minute and 5 minutes. The neonates were observed for their weight, admission in NICU, neonatal mortality and hypoglycaemia. The newborns were followed for 48 hours, and any mortality as well as prolonged stay (>2 days) in NICU were noted.

Data was analysed using SPSS 26. Quantitative variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Maternal and perinatal outcomes were compared in underweight/normal-weight group versus overweight/obese group. The outcomes were then compared for those who gained <10kg and >10kg. Chi-square test was used to assess the significance of association among the variables. P<0.05 was considered statistically significant.

Results

Among the 167 female subjects enrolled, 151(90.4%) completed the study. There were 102(67.5%) subjects who were either underweight or normal-weight, and 49(32.5%) were either overweight or obese. Besides, gestational weight gain was <10kg in 83(55%) cases and >10kg in 68(45%). The overall mean age of the sample was 27.48±5.001 years, with 129(85.4%) aged 20-34 years. Mean parity was 2.81±1.589 and 57(37.7%) were multiparous (Table 1).

Mean gestational age at first visit was 11.029±1.599 weeks. There were 42(27.8%) overweight women and 7(4.6%) obese women on their first antenatal visit. Overall mean BMI was 23.397±3.981kg/m2. Among perinatal outcomes, 7(14.3%) women with high BMI delivered

Table-1: Demographic characteristics.

Characteristic	N=151 (n,%)	Underweight/Normal N= 102 (n,%)	Overweight N= 42 (n,%)	Obese N= 7 (n,%)
Age				
Up to 19 years	2 (1.3)	2 (1.32)	0	0
20-34 years	129 (85.4)	93(61.5)	33(21.8)	3(1.98)
35-39 years (advanced)	18 (11.9)	6(3.97)	9 (5.96)	3(1.98)
40-45 years (very advanced)	2 (1.3)	1(0.66)	0	1(0.66)
Parity				
Primiparous	32(21.2)	23(15.2)	9(5.96)	0
Para 1	44(29.1)	33(21.8)	10 (6.62)	1(0.66)
Multiparous (2-3 children)	57(37.7)	36(23.8)	17(11.2)	4(2.64)
Multiparous (4 or more children)	18(11.9)	10 (6.62)	6 (3.97)	2(1.32)
Planned Pregnancy				
Yes	77(51)	61 (40.3)	13(8.6)	3(1.98)
No	74(49)	41(27.1)	29(19.2)	4(2.64)
Previous Caesarean section				
Yes	69(45.7)	41(27.1)	22(14.5)	6(3.97)
No	82(54.3)	61(40.3)	20(13.2)	1(0.66)
Smoking History				
Yes	0(0)	0	0	0
No	151(100)	102(67.5)	42(27.8)	7(4.63)
Education				
Illiterate	12(7.9)	8(5.29)	3(1.98)	1(0.66)
Matric/O levels	37(24.5)	26(17.2)	10(6.62)	1(0.66)
Intermediate/A levels	24(15.9)	11(7.28)	10(6.62)	3(1.98)
Graduate	49(32.5)	34(22.5)	15(9.93)	0
Postgraduate	29(19.2)	23(15.2)	4(2.64)	2(1.32)

Table-2: Association of body mass index (BMI) with maternal and perinatal outcomes.

Maternal outcome	Underweight + normal weight N = 102 (n,%)	Overweight + Obese N = 49 (n,%)	Chi Square value	P value*
Preeclampsia				
Yes	8 (7.84)	15(30.61)	13.290	0.0003**
No	94(92.16)	34(69.39)		
Gestational diabetes				
Yes	19(18.63)	14(28.57)	1.916	0.166
No	83(81.37)	35(71.43)		
Gestational hypertension				
Pre-eclampsia	5(4.90)	9(18.37)	7.723	0.021**
Mild	12(11.76)	7(14.29)		
Absent	85(83.34)	33(67.34)		
Fever				
Yes	27(26.47)	18(36.73)	1.667	0.197
No	75(73.53)	31(63.27)		
Postpartum haemorrhage				
Yes	26(25.49)	14(28.57)	0.161	0.688
No	76(74.51)	35(71.43)		
Prolonged surgery time				
Yes	12(11.76)	13(26.53)	5.224	0.022**
No	90(88.24)	36(73.47)		
	Perinatal outcome			
Mode of delivery				
Vaginal	41(40.12)	16(32.65)	3.150	0.207
Forceps Assisted	4(3.90)	0(0)		
Caesarean section	57(55.88)	33(67.35)		
Gestational age at delivery				
Extreme preterm (<28 weeks) 2(1.96)	0(0)	1.559	0.450	
Preterm (<37 weeks)	10(9.80)	3(6.12)		
Term (≥37 weeks)	90(88.24)	46(93.88)		
Duration of labour				
More than 3 hr	31(30.39)	5(10.20)	8.525	0.074
Less than 3 hr	16(15.69)	11(22.45)		
Absent	55(53.92)	33(67.35)		
Birth weight				
<4000g	99(97.06)	42(85.71)	6.889	0.009**
>4000g (Macrosomia)	3(2.94)	7(14.29)		
APGAR at 1 min				
≤7	21(20.59)	15(30.61)	1.832	0.176
>7	81(79.41)	34(69.39)		
APGAR at 5 mins				
≤7	5(4.90)	5(10.20)	1.505	0.220
>7	97(95.1)	44(89.80)		
Birth condition				
Live birth	101(99.01)	46(93.88)	3.774	0.152
Still birth	0(0)	1(2.04)		
Foetal Death	1(0.99)	2(4.08)		
Admission in NICU				
Yes	16(15.69)	14(28.57)	3.452	0.063
No	86(84.31)	35(71.43)		
Neonatal mortality				
Yes	1(0.98)	2(4.08)	1.635	0.201
No	101(99.01)	47(95.92)		
Neonatal hypoglycaemia				
Yes	3(2.94)	0(0)	1.470	0.225
No	99(97.05)	49(100)		

APGAR: Appearance-Pulse-Grimace-Activity-Respiration. *Chi-square test, ** Statistically significant

Table-3: Association of gestational weight gain with maternal and neonatal outcomes.

Maternal Outcomes	Weight gain >10kg N=83 (n,%)	Weight gain <10kg N=68 (n,%)	P value*
Mode of delivery			
Vaginal	33(39.76)	24(35.29)	0.134
Forceps Assisted	4(4.82)	0(0)	
C section	46(55.42)	44(64.71)	
Gestational age			
Extreme preterm (<28 wee ks)	0(0)	2(2.94)	0.049**
Preterm (<37 weeks)	4(4.82)	9(13.24)	
Term (≥37 weeks)	79(95.18)	57(83.82)	
Onset of Labour			
Spontaneous	23(27.71)	14(20.59)	0.563
Induced	15(18.07)	12(17.65)	
Absence	45(54.22)	42(61.76)	
Type of Labour			
Normal	34(40.96)	22(32.35)	0.550
Instrumental	4(4.82)	4(5.88)	
C section	45(54.22)	42(61.76)	
Preeclampsia			
Yes	15(18.07)	8(11.76)	0.283
No	68(81.93)	60(88.24)	
Gestational Diabetes			
Yes	17(20.48)	16(23.53)	0.652
No	66(79.52)	52(76.47)	
Gestational Hypertension (140/90 mm Hg)			
Chronic	9(10.84)	5(7.36)	0.713
Mild	11(13.25)	8(11.76)	
Absent	63(75.91)	55(80.88)	
Neonatal Outcomes()()			
Birth weight			
Very low (1500 g)	0(0)	3(4.41)	0.042**
Low(<2500 g)	7(8.43)	11(16.18)	
Normal (2500 g)	68(81.93)	52(76.47)	
Macrosomia (>4000g)	8(9.64)	2(2.94)	
Birth condition			
Live birth	82(98.8)	65(95.59)	0.401
Still birth	0()	1(1.47)	
Foetal Death	1(1.20)	2(2.94)	
Admission in neonatal intensive care unit			
Yes	20(24.1)	11(16.18)	0.307
No	63(75.9)	57(83.82)	
Neonatal Mortality			
Yes	1()	2(2.94)	0.447
No	82()	66(97.06)	
Neonatal hypoglycaemia			
Yes	4(4.8)	0(0)	0.05**
No	79(95.2)	68(100)	
APGAR at 1 min			
≤7	17()	19(27.94)	0.285
>7	66()	49(72.06)	
APGAR at 5 min			
≤7	1()	9(13.24)	0.003**
>7	82()	59(86.76)	
Maternal Complications			
Fever			
Yes	24()	21(30.88)	0.793
No	59()	47(69.12)	
Duration of labour			
More than 3 hours	37()	26(38.24)	0.864
Absent	46()	42(61.76)	
Postpartum haemorrhage			
Yes	23()	17(25)	0.707
No	60()	51(75)	
Prolonged surgery time			
Yes	14()	11(16.18)	0.910
No	69()	57(83.82)	

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macrosomic (>4kg) babies (p=0.009) compared to 3(2.9%) women with normal BMI (Table 2).

Preeclampsia had a significant association with BMI (p=0.003). Gestational age at delivery (p=0.049), neonatal birth weight (p=0.042), neonatal hypoglycaemia (p=0.05) and APGAR score at 5 minutes (p=0.003) had a significant association with GWG >10 kg (Table 3).

Discussion

In the current study, majority (85.4%) of the subjects were aged 20-34 years. Pre-pregnancy overweight was 27.8% and pre-pregnancy obesity was 4.6%. Increased BMI and excessive GWG increase the risk of multiple adverse outcomes related to pregnancy, including those that seriously endanger the lives of pregnant women and their babies. The American College of Obstetricians and Gynaecologists (ACOG) guidelines recommend weight gain during pregnancy for obese women to be between 5kg and 9.1kg, with a maximum 10.5kg).[11]

Zehravi et al. reported an increased likelihood of CS in overweight and obese women.[12] Similar findings were seen in the current study where 67.35 women with high BMI underwent CS, with all 7 obese women undergoing elective CS. More than the recommended GWG is also related to increased incidence of CS[13], but in the present study, there was no significant difference in the results of mode of delivery among women who gained <10kg weight during pregnancy and those who gained >10kg. A possible explanation for this is that high-risk cases, like placenta previa, repeated scar pregnancies and other obstetric complications, are referred from different medical centres to the tertiary care hospital where the current study was conducted. That explains the increased frequency of CS irrespective of BMI and GWG.

Gestational hypertension and preeclampsia are common complications in pregnancy and are linked to pre-pregnancy weight and GWG.[14]The current study also

observed a significant association of preeclampsia (p=0.003) in overweight and obese women. Preeclampsia was seen in 18.07% in women who gained >10kg compared to 11.76% in those who gained <10kg.

GDM is another chronic condition associated with multiple adverse consequences, including preterm birth, labour induction, instrumental delivery, CS, preeclampsia, PPH, stillbirth, neonatal death, macrosomia, neonatal hypoglycaemia, poor APGAR score and NICU admission.[15] This highlights the need to minimise the risk factors of GDM, and obesity is one of them.[16] In the current study, GDM was not significantly associated with increased BMI or weight gain. Significant association of GDM has been observed in studies conducted in Indonesia (12.6%)[17] and Spain (20.3%).[18]

Gestational age at delivery was significantly associated with GWG in the current study (p=0.049). Preterm delivery was observed in 4.82% women with >10kg GWG. No significant association was found between gestational age at delivery and BMI on first antenatal visit in the study. Similar results were reported by a 2021 study.[19]

The onset of labour was not found to have a significant association with obesity in the current study, which may be due to the fact that all obese and most overweight women underwent elective CS. Similar results were reported earlier.[5]

In line with literature,[20] PPH and prolonged surgery time were also included in the outcomes currently studied. There was no significant difference between the study groups. This might be due to a small number of obese women included in the present study.

It has been indicated in several studies that maternal obesity is an independent risk factor for foetal macrosomia.[21] Increased BMI and excessive GWG cause hyper-insulinism and insulin resistance (IR) which results in increased risk of macrosomia.[22,23] In the current study, majority of women (81.9%) with GWG >10kg had babies with normal birthweight and 9.6% women had macrosomic babies (p=0.042). A significant association was observed between maternal BMI and macrosomia (0.009).

Maternal obesity is linked to a higher rate of NICU admission as well as neonatal hypoglycaemia due to significantly low APGAR score. The current study's findings were consistent with earlier studies that showed that increased risk of newborn hypoglycaemia was correlated with maternal obesity.[21]

In previous studies, a dose-response association was reported between APGAR score and increased risk of neonatal mortality in regard to gestational age at delivery. Neonatal death rate is higher in neonates with low APGAR score. Health of neonates can be significantly evaluated using APGAR score.[22] In the current study, a low 5-minute APGAR score[7] was significant in women who had gained <10kg compared to women who had gained >10kg (p=0.003).

In line with a Chinese prospective cohort analysis[23], the current study found that the risk of stillbirth was not increased with increased BMI or more than the recommended GWG. This may be attributed to the smaller sample size of obese women in the current study, which may have been insufficient to assess the risks to the foetus and newborn. The risk of stillbirth in obese pregnant women is less in LMICs compared to those in high-income countries (HICs) where there is a significant association of stillbirths with maternal weight.[23]

The current study has limitations of a small sample size. Besides, the study was conducted in a tertiary care hospital where more women come mostly from lower socioeconomic class with an increased chance of being not well-nourished. This explains the rather small number of obese women in the sample. Further, the study only focussed on univariate analysis of data, while multivariate analysis was not done to adjust for the various confounding factors. All these limitations may have affected the generalisability of the findings. However, the current study to our knowledge, is the first such attempt in Pakistan.

Conclusion

Increased maternal body mass index and gestational weight gain were found to be associated with pre-eclampsia, gestational age at delivery, neonatal birthweight and APGAR score. Maternal obesity was found to be an indicator of high-risk pregnancy.

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NM: Data analysis, interpretation and final approval.
HT: Data analysis and interpretation.
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