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THE HEAVY TOLL: ASSOCIATION OF MATERNAL OBESITY WITH FETOMATERNAL OUTCOMES– A CROSS-SECTIONAL STUDY IN KASHMIR

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Abstract:
Obesity, a chronic disease recognised by WHO, is rising globally and linked to adverse maternal and neonatal outcomes. In pregnancy, it increases the risk of gestational diabetes, hypertension, caesarean delivery, wound infections, and NICU admissions. Despite its growing impact, Indian data are limited. This study aims to assess and compare the impact of maternal BMI on GDM, PIH, and IHCOP, mode of delivery, intrapartum complications, and neonatal outcomes like birth weight, APGAR score, and NICU admission in a tertiary care centre in Kashmir. A cross-sectional comparative study was conducted over 18 months at SKIMS, Srinagar, including 224 gravid singleton women meeting the inclusion criteria.
Data were analysed using SPSS Version 20.0. Obese women (Group A) had higher rates of GDM (37.5% vs. 11.1%, p<0.001), PIH (34.6% vs. 16.7%, p=0.003), and IHCOP (30.8% vs. 18.5%, p=0.038). LSCS was more frequent (77.9% vs. 54.6%, p<0.001), with macrosomia and failed induction exclusive to this group. Preterm birth (<35 weeks) occurred in 12.5% vs. 2.8% (p=0.002). Neonates of obese mothers had higher birth weights (p<0.001), lower APGAR scores (<7: 23.6% vs. 10.7%, p=0.021), and greater NICU admissions (25% vs. 11.1%, p=0.008). Wound infections (13.6% vs. 3.4%, p=0.041) and shoulder dystocia (5.8%, p=0.013) were also more frequent. No significant differences were found in eclampsia, abruptio placentae, PPH, or stillbirth. Thus, maternal obesity is strongly associated with pregnancy complications and adverse neonatal outcomes, stressing the importance of early weight management and tailored interventions in low-resource settings.

Keywords: Obesity, BMI, Adverse Fetomaternal outcomes, Pre-eclampsia, Gestational Diabetes Mellitus

INTRODUCTION

Obesity is a chronic disorder defined by the Obesity Medicine Association as "a chronic, relapsing, multi-factorial, neurobehavioral disease characterised by an increase in body fat that leads to adipose tissue dysfunction and abnormal physical forces from excess fat mass, resulting in adverse metabolic, biomechanical, and psychosocial health consequences."[1] The World Health Organization identifies obesity as a major contributor to numerous noncommunicable diseases, including cardiovascular conditions, stroke, type 2 diabetes, osteoarthritis, and various carcinomas such as breast, ovary, endometrium, colon, liver, gallbladder, and kidney.[2]

Obesity, now considered a global pandemic, affects approximately 1 in 8 individuals worldwide.2 As per WHO, it is characterized by a Body Mass Index (BMI) exceeding 30 kg/m² and is categorised into: Class I (BMI 30-34.9), Class II (BMI 35-39.9), and Class III (BMI ≥ 40).[3] According to the data from the NCD Risk Factor Collaboration, Obesity rates have risen across all countries from 1975 to 2016, with the most significant rises occurring in South Asia, Southeast Asia, the Caribbean, and Southern Latin America.[3] At the current pace, almost 50% of the world's population is expected to be obese or overweight by 2030.[4]

Pregnant women with obesity face an elevated risk of several complications, such as gestational diabetes, hypertension, preeclampsia, venous thromboembolism, postpartum haemorrhage, and a higher likelihood of caesarean delivery. They also face increased rates of preterm labour and delivery, anaemia, urinary tract infections, wound infections, and maternal mortality.[5–7]

Additionally, they are more likely to experience anaesthesia-related complications, such as difficult endotracheal intubation, longer procedure times, respiratory suppression in response to opioids, aspiration of gastric contents, and challenging intravenous access.[8]

Various studies indicate that maternal obesity poses adverse risks to neonates, including miscarriage, congenital abnormalities, macrosomia or microsomia with glycaemic disorders, foetal growth retardation, preterm birth, stillbirth, and increased rates of shoulder dystocia, perinatal death, foetal birth defects, and neonatal intensive care unit admissions.[7–9]

Furthermore, postpartum risks include wound infection, wound dehiscence, postpartum depression, and lower breastfeeding rates compared to the general population. Obese females are also at higher risk of developing chronic hypertension and metabolic syndrome later in life.[10] Moreover, maternal obesity is linked with greater chances of type 2 diabetes and obesity in their children and adolescents.[11]

In light of the global rise in obesity and its profound implications for maternal and foetal health, investigating its effects during pregnancy is of critical importance. A comprehensive understanding of the complications—ranging from gestational diabetes and preeclampsia to neonatal risks such as stillbirth and congenital anomalies—can help healthcare providers implement evidence-based interventions. Furthermore, examining these outcomes can inform public health strategies aimed at mitigating the effects of obesity on both mothers and their children, ultimately enhancing long-term health outcomes for families. Addressing this public health challenge is vital for fostering healthier pregnancies and future generations. However, a significant gap exists in the literature regarding these outcomes in the Indian subcontinent. This study aims to address this gap in the literature. by evaluating the influence of maternal obesity on both foetal and maternal outcomes. The aim of this study is to explore and compare the effects of maternal BMI on

1. Complications in pregnancy: GDM, PIH, and IHCOP
2. Mode of delivery
3. Intrapartum Complications
4. Neonatal outcomes: Birth weight, APGAR score at birth, and NICU admission

MATERIAL AND METHODS

This cross-sectional comparative study was conducted at the Department of Obstetrics and Gynaecology, SKIMS Soura, Srinagar, over 18 months. Eligible and consenting patients were enrolled. A total of 224 pregnant women with singleton pregnancies were enrolled in the study based on the inclusion and exclusion criteria.

Inclusion Criteria:

- Women with BMI >25kg/m², irrespective of parity and a control group of women with a healthy BMI of 18.5 to 24.99.
- Women with a singleton pregnancy.
- Women presenting to the antenatal clinic in the first trimester.
- Women willing to give written informed consent.

Exclusion Criteria:

- Women with BMI <18.5kg/m².
- Women with multiple pregnancies
- Women who are known cases of chronic illnesses such as diabetes mellitus, chronic hypertension, and hypothyroidism.

Enrolled patients were equally distributed into two groups: Group A (n=112) and Group B (n=112). Group A included pregnant females with a BMI >30kg/m². Group B consisted of pregnant females with a normal BMI of 18.5- 24.9kg/m².
Height and weight were recorded using standard protocols. Height was measured with a measuring tape while the participant stood upright with heels, buttocks, shoulders, and occiput against the wall. Weight was noted during the first antenatal visit using a standard scale, with the participant in light clothing and barefoot.

BMI was calculated using the formula: Quetlet Index / BMI = Weight (in kg) / Height² (m²)
WHO categorises BMI as under:

- Underweight: Less than 18.5
- Healthy weight: 18.5 to less than 25
- Overweight: 25 to less than 30
- Obesity: 30 or greater
- Obesity Class 1: 30 to <35
- Obesity Class 2: 35 to <40
- Obesity Class 3: ≥40

This study was conducted in accordance with the ethical standards laid down in the Declaration of Helsinki. Institutional Ethics Committee approval was obtained from the Ethics Committee of Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar prior to commencement of the study. Written informed consent was obtained from all participants before inclusion in the study.

Statistical methods

Data were compiled in Microsoft Excel and subsequently imported into SPSS Version 20.0 (SPSS Inc., Chicago, IL, USA) for analysis. Continuous variables were presented as mean ± standard deviation, while categorical variables were summarised as frequencies and percentages. Independent t-tests were used to compare continuous variables, and Chi-square or Fisher's exact tests were applied for categorical data, as appropriate. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 224 patients were included in the study, equally divided into two groups: Group A, including females with a BMI >30kg/m² (n=112) and Group B, including females with a healthy BMI (18.5 to 24.99) (n=112).

Table 1 presents the age and parity distribution. Most participants were aged 26–30 years, with comparable mean ages and parity across groups ($p>0.05$).

Table 1: Age Distribution and Parity in Group A and Group B						
Parameter	**Category**	**Group A (n=112)**		**Group B (n=112)**		**p-value**
		No.	%	No.	%	
Age (years)	≤ 25	17	15.2%	21	18.8%	0.168
	26–30	58	51.8%	60	53.6%	
	31–35	37	33%	31	27.7%	
	Mean ± SD	29.1±2.85		28.5±2.87		
Parity	Primiparous	55	49.1%	53	47.3%	0.789
	Multiparous	57	50.9%	59	52.7%	

Table 2 shows the comparison between two groups regarding rate of abortion, maternal comorbidities such as Pregnancy Induced Hypertension (PIH), Eclampsia, Gestational Diabetes Mellitus (GDM), Intrahepatic cholestasis of pregnancy (IHCP), abruptio placentae, foetal outcomes like birth weight, APGAR score at birth, NICU admissions, gestation at termination, mode of delivery, indication for LSCS, PPH, wound infections and intrapartum complications.

Table 2: Comparison of Maternal and Neonatal Outcomes in Group A and Group B						
Outcome	**Category**	**Group A**		**Group B**		**p-value**
		No.	%	No.	%	
Abortion Rate	Early Pregnancy Failure	8	7.1%	4	3.6%	>0.05
	Threatened Abortion	7	6.3%	3	2.7%	
Gestational Diabetes Mellitus		39	37.5%	12	11.1%	<0.001
Gestational Hypertension		36	34.6%	18	16..7%	0.003
Eclampsia		2	1.9%	0	0	0.239
Intrahepatic Cholestasis of Pregnancy (IHCP)		32	30.8%	20	18.5%	0.038
Abruptio Placentae		2	1.9%	0	0	0.239
Gestation Age at Termination	< 35 weeks	13	12.5%	3	2.8%	0.002
	35–37 weeks	15	14.4%	9	8.3%	
	> 37 weeks	76	73.1%	96	88.9%	
	Mean ± SD	**36.7±1.53**		**37.5±1.61**		
Mode of Delivery	LSCS	81	77.9%	59	54.6%	<0.001
	NVD	23	22.1%	49	45.4%	
Indications of LSCS	AFD	40	49.4%	31	52.5%	0.059
	CPD	26	32.1%	25	42.4%	
	Foetal Macrosomia	7	8.6%	0	0	
	Failure of Induction	4	4.9%	3	5.1%	
	Non-descent of Head (NDOH)	4	4.9%	0	0	
	Total	**81**	**100%**	**59**	**100%**	
Birth Weight (kg)	< 2.5 kg	14	13.5%	15	13.9%	<0.001
	2.5–3.4 kg	54	51.9%	90	83.3%	
	3.5–4.4 kg	36	34.6%	3	2.8%	
	> 4.5 kg	7	6.7%	0	0	
	Mean±SD	**3.4±0.571**		**2.8±0.381**		
APGAR Score	< 7	26	23.6%	12	10.7%	0.021
	≥ 7	84	76.4%	100	89.3%	
NICU Admissions		26	25%	12	11.1%	0.008
Wound Infections in LSCS patients		11	13.6%	2	3.4%	0.041
Intrapartum Foetal Complications	Shoulder dystocia	6	5.8%	0	0	0.013
	Still birth	2	1.9%	0	0	0.244
	Total	8		0		
Postpartum Haemorrhage (PPH)		7	6.7%	4	3.7%	0.197

Early pregnancy failure and threatened abortion were slightly higher in Group A but not statistically significant (p>0.05). GDM (37.5% vs. 11.1%, p<0.001). A difference of statistical significance was seen in the prevalence of gestational hypertension in the two groups (A: 34.6% vs. B: 16.7%, p=0.003), while no significant difference was noted in eclampsia.
IHCOP was significantly more common in Group A (30.8%) than Group B (18.5%) (p = 0.038), whereas the difference in abruptio placentae (1.9% vs. 0%) was not significant (p = 0.239).
Figure 1 shows the comparison of the development of various maternal comorbidities between the two groups.

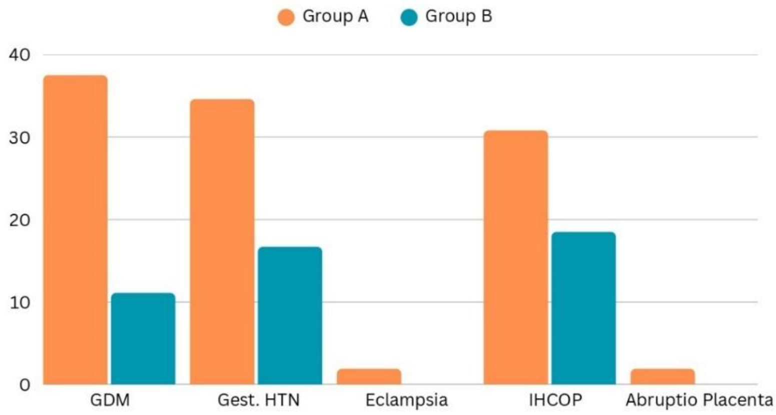

FIGURE 1: Comparison of development of comorbidities between Group A and B

Preterm termination (<35 weeks) was more frequent in Group A (12.5%) than Group B (2.8%), with a lower mean gestational age in Group A (36.7 ± 1.53 weeks vs. 37.5 ± 1.61 weeks); a statistically significant difference (p=0.002). There was a significant increase in LSCS procedures among Group A (77.9%) than Group B (54.6%) (p < 0.001).
LSCS due to acute foetal distress and cephalopelvic disproportion was comparable between groups, while foetal macrosomia, failed induction, and non-descent of head were noted only in Group A, though the overall difference was statistically insignificant. Neonates of obese mothers had significantly higher birth weights (mean 3.4 ± 0.571 kg vs. 2.8 ± 0.381 kg; p<0.001), with more cases of macrosomia and births >4.5 kg reported exclusively in Group A. A higher proportion of neonates in Group A had APGAR scores <7 (23.6% vs. 10.7%; p=0.021), and NICU admissions were also significantly higher (25% vs. 11.1%; p=0.008).
Group A had a higher wound infection rate (13.6%) than Group B (3.4%) (p=0.041). Shoulder dystocia occurred exclusively in Group A (5.8%) with statistical significance (p=0.013), while rates of PPH (6.7% vs. 3.7%, p=0.197) and stillbirth (1.9% vs. 0%, p=0.244) showed no significant differences between groups.

DISCUSSION
Obesity rates have escalated globally, reaching near-pandemic levels, with a higher prevalence in females (WHO). NFHS-5 reports an increase in overweight/obese Indian women (15–49 years) from 21% in 2015–16 to 24% in 2019–21, with urban rates (33%) exceeding rural (20%). Though urbanisation reflects national progress, its association with rising obesity and related health risks is concerning.[12]
In this study, 224 patients were distributed equally into Group A (n=112) and Group B (n=112). Most participants were aged 26–30 (51.8% in Group A, 53.6% in Group B), with mean ages of 29.1 ± 2.85 and 28.5 ± 2.87 years, respectively. Deshmukh VL et al. (2016) reported similar trends, with mean ages of 23.2–24.1 years across BMI categories. Jacob AT et al. (2021) noted peak overweight prevalence in the 20–39 age group, while Rokade J and Darekar Y (2018) found the 26–30 group most affected (51%).[13-15]

In our study, multigravida women were slightly more common (50.9% in Group A, 52.7% in Group B (p=0.789). Similar trends were reported by Rokade J and Darekar Y (2018) (63%).[15]
In our study, abortion rates between the groups did not vary significantly (p>0.05), aligning with Jacob AT et al. (2021), who reported a non-significant fourfold increase in obese women. In contrast, Candeloro (2020) reported significantly higher abortion rates in obese women (64.3% vs. 29.3%, OR 4.41, 95% CI 1.41–13.81). Similarly, Bellver et al. (Spain) found higher abortion rates post–oocyte donation in obese women (38.1%) vs. normal-weight (13.3%) and overweight (15.5%) women.[14,16-17]
GDM was more commonly observed in the obese group (A: 37.5% vs B: 11.1%) (p<0.001), a significant difference, consistent with findings by Deshmukh VL, Jacob AT, and Dasgupta A et al., who reported increased GDM rates in obese (17%) and morbidly obese (26%) women (OR 5 and 8.5, respectively).[13-14,18] Similar trends were observed by Awan S et al. (2015).[19] This can be attributed to the well-established link between obesity and insulin resistance, which worsens during pregnancy, highlighting the critical need to attain a normal BMI before or early in pregnancy to reduce foetal and maternal complications.[20]
Our study revealed a significant association between obesity and PIH, which affected 36 women (34.6%) in the obese cohort versus 18 (16.7%) in the normal BMI cohort (p=0.003), while showing no significant variation in eclampsia (p=0.239). According to Awan S et al. (2015), 24% of the cases with PIH were linked to maternal overweight.[19] These findings align with a study by Seeniammal P et al. (2017) in North Kerala and other studies.[21-22] This connection is significant, as PIH can lead to serious complications, including liver and kidney injury, blurred vision, HELLP syndrome, eclampsia, and foetal colour doppler changes. Consequently, weight management during pregnancy is essential to reduce PIH and related complications, fostering healthier pregnancies.
Based on our data, there was a significant association between intrahepatic cholestasis of pregnancy (IHCP) and obesity, with IHCP occurring in 30.8% of patients in Group A and 18.5% in Group B (p=0.038). IHCP was one of the reasons for induction in these patients. However, in contrast, a study conducted in China found no significant associations between overweight, obesity, and the risk of intrahepatic cholestasis of pregnancy.[23]
In our study, the mean gestational age at termination was 36.7 ± 1.53 weeks in obese women and 37.5 ± 1.61 weeks in women with normal BMI (p=0.002). Though most women in both groups delivered after 37 weeks (73.1% in Group A vs. 88.9% in Group B), early termination in Group A was often due to comorbidities, a statistically significant difference. Vanlalfeli and Zosangpuii (2020) similarly reported more term deliveries in controls (76.71%) than cases (72.73%).[22] Similarly, Kumari P et al. (2014) found most deliveries occurred between 37–41+ weeks, with higher BMI linked to earlier deliveries: 124 women (BMI 20–24.9), 131 (BMI 25–29.9), and 25 (BMI >30), further corroborating our findings.[24] These results underscore the need for close monitoring and timely intervention in obese pregnancies to improve pregnancy outcomes.
We observed that acute foetal distress (AFD) was the leading indication for LSCS in both the groups (A: 49.4% and B: 52.5%), followed by cephalopelvic disproportion (CPD) (A: 32.1% and B: 42.4%). Foetal macrosomia led to LSCS in 7 women (8.6%) in Group A, none in Group B, highlighting the challenges posed by abnormal foetal positioning and excessive foetal size. Notably, no case of foetal macrosomia was reported in Group B. Common indications for LSCS include CPD due to macrosomia, foetal distress, and failed labour induction. Obese women showed higher LSCS rates, which are linked to greater perioperative morbidity—higher risks of anaesthetic complications, postoperative infections, blood loss, and longer hospital stays, which can further complicate recovery and impact overall maternal health.[5,11-12]
Induction failure occurred in 4 patients (4.9%) in Group A, while no cases were observed in Group B among those who underwent the full course of induction.
Regarding neonatal parameters, there was a difference of statistical significance in the mean neonatal birth weights in each group. The mean weight at birth for neonates in Group A was 3.4 ± 0.571 kg, in comparison to 2.8 ± 0.381 kg for neonates in Group B (p<0.001). Additionally, 51.9% of neonates in Group A fell within the birth weight range of 2.5-3.4 kg, while a higher percentage of 83.3% in Group B were in this category. A study by Rokade J and Darekar Y (2018) found that 41% of cases

had birth weights between 2.5-4.0 kg, compared to 78% in the control group, with 32% of cases and 14% of controls weighing less than 2.5 kg.[15] These findings align with the observations of Schrauwers C et al. (2009).[25]

We observed low APGAR scores (<7) in 23.1% of neonates of obese mothers vs. 11.1% in mothers with normal BMI. Previous research has established a connection between maternal obesity and low APGAR scores, as well as preterm and post-term deliveries, and an increased risk of intrapartum complications, including failed trials of labour and postpartum haemorrhage (PPH). We also noted shoulder dystocia in 6 foetuses (5.8%) in the study group, none in control group—a significant difference (p=0.013). Stillbirth was seen in 2 cases (1.9%) in the study group, none in control group (p=0.244). Usha Kiran TS et al. (2005) also reported increased shoulder dystocia with higher BMI, largely attributed to a greater risk of macrosomia.[9,26]

We found that 25% of neonates in Group A required NICU care, in contrast to only 11.1% in Group B, representing a statistically significant difference (p=0.008). Similar trends were noted by Rokade J and Darekar Y (56%) and Awan S et al.[15,19] This rise is likely due to lower APGAR scores and maternal comorbidities like GDM and hypertension. Kumari P et al. (2014) also reported a linear increase in NICU admissions with rising maternal BMI, noting lower APGAR scores in higher BMI groups, though not statistically significant at 1 minute.[24]

We found in our study that wound infection among LSCS patients was significantly linked to obesity, with 11 (13.6%) patients in obese cohort compared to just 2 (3.4%) in women with normal BMI (p=0.041), with one severe case in the obese cohort requiring multiple sittings of wound debridement followed by abdominoplasty. Postpartum haemorrhage (PPH) was noted in 6 (6.7%) patients in Group A and 4 (3.7%) in Group B; however, the difference was statistically insignificant (p=0.197), contrasting with findings from other studies. Deshmukh VL et al. (2016) also confirmed a significant correlation between maternal obesity and both wound infection and PPH. Various studies indicate that the risk of postpartum haemorrhage is indeed heightened in women with obesity.[13,27]

CONCLUSION

This analysis contributes to the expanding body of research emphasizing the substantial risks linked to obesity in pregnancy. Our findings underscore the strong association between obesity and serious comorbidities such pregnancy-induced hypertension (PIH) and as gestational diabetes mellitus (GDM), various intrapartum and postpartum complications, including failed trials of labour, postpartum haemorrhage (PPH), and surgical site infections.

Given these serious implications, it is essential to counsel patients about effective weight management strategies during the preconception period and early stages of pregnancy. Policies should prioritise weight control initiatives that begin well before conception, including access to dietary consultations and promotion of a healthy lifestyle- measures that are often lacking in developing countries.

To fully understand the complexities of obesity in pregnancy, further studies are essential to assess the myriad risks associated with increasing body mass index (BMI) throughout gestation. Subsequent research should aim to understand the prolonged impact of different BMI levels on mothers and their newborns, particularly as they relate to complications such as metabolic disorders, cardiovascular health, and psychological well-being. Additionally, examining the role of socio-economic conditions, cultural practices, and access to healthcare services on weight management during pregnancy will provide a more comprehensive understanding of this public health issue. Conducting these studies will enable us to refine clinical practices and public health policies, thereby improving the health and well-being of both mothers and their children.

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