



# Impact of Maternal Obesity on Maternal and Foetal Outcomes: A Prospective Cohort Study from Northern India

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## Research Article

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## Abstract

**Background:** Maternal obesity is a growing global health concern, particularly among women of childbearing age, with implications for maternal and foetal outcomes. This study aimed to determine the incidence of obesity in pregnant women and compare maternal and foetal outcomes between obese and non-obese groups.

**Methods:** A prospective cohort study was conducted at Dayanand Medical College & Hospital, Ludhiana, over one year. Pregnant women with singleton pregnancies were recruited at their first antenatal visit and categorized into obese (BMI  $\geq 30$  kg/m<sup>2</sup>) and non-obese (BMI  $< 30$  kg/m<sup>2</sup>) groups based on pre-pregnancy BMI. Participants were followed per standard antenatal protocols until four weeks postpartum. Maternal lipid profiles, antenatal, intrapartum, and postpartum complications, mode of delivery, and neonatal outcomes were assessed. Data were analyzed using chi-square tests, t-tests, and logistic regression (SPSS v21), with  $p < 0.05$  considered significant.

**Results:** Of 150 participants, 32.7% were obese, significantly higher than India's national average. Obese women were predominantly urban, upper-middle class, and older (mean age  $29.04 \pm 5.48$  years in BMI  $< 30$  vs.  $31.80 \pm 6.00$  years in BMI  $\geq 30$ ,  $p < 0.01$ ). They exhibited higher rates of gestational hypertension (59.2%), hypothyroidism (36.7%). Delivery complications included increased emergency caesarean sections and anaesthesia issues. Neonatal outcomes were worse, with prematurity (51.0%), hypoglycaemia, and NICU admissions (46.9%) significantly higher ( $p < 0.01$ ). Paradoxically, cord blood lipids were lower in neonates of obese mothers, suggesting impaired placental transport.

**Conclusion:** Maternal obesity significantly increases the risk of hypertensive disorders, hypothyroidism, and delivery complications, while neonates face higher prematurity and NICU admission rates. These findings underscore the need for targeted interventions to manage obesity in pregnancy. Lower cord blood lipids highlight potential placental dysfunction, warranting further research.

**Keywords:** Maternal Obesity; Foetal Outcomes; Gestational Hypertension; Prematurity; NICU Admission; Placental Transport

## Abbreviations

WHO: World Health Organization; GDM: Gestational Diabetes Mellitus; NICU: Neonatal Intensive Care Unit; IVF: In Vitro Fertilization.

## Introduction

Obesity, defined by the World Health Organization (WHO) as a BMI  $\geq 30$  kg/m<sup>2</sup>, has more than doubled globally since 1990, with 16% of adults classified as obese in 2022 [1]. In India, the National Family Health Survey (NFHS-5, 2020-21) reported that 40.8% of women in Punjab have a BMI  $\geq 25$  kg/m<sup>2</sup>, indicating a rising obesity burden among pregnant women [2]. Maternal obesity is associated with adverse outcomes due to chronic inflammation, insulin resistance, and metabolic changes, increasing risks of gestational diabetes mellitus (GDM), preeclampsia, and preterm birth [3,4]. Pregnant women with obesity face a 2-3-fold higher risk of hypertension, with each 5-7 kg/m<sup>2</sup> BMI increase nearly doubling preeclampsia odds [5]. Foetal complications include macrosomia, neural tube defects, and higher neonatal intensive care unit (NICU) admissions [6,7]. International studies, including those from the US and Europe, have documented these risks [8,9], while Indian research highlights regional variations, particularly in urban settings [10,11]. Urbanization, sedentary lifestyles, and access to energy-dense foods contribute to this trend [12].

This study addresses the limited regional data by assessing obesity's incidence and impact on maternal and foetal outcomes in Ludhiana, Punjab. The objectives were to calculate obesity prevalence and compare outcomes between obese and non-obese groups. We hypothesized that obese pregnant women would exhibit higher complication rates, affecting neonatal health. The findings aim to guide clinical and public health strategies in a high-obesity region.

## Materials and Methods

### Study Design and Setting

This prospective cohort study was conducted at the Department of Obstetrics & Gynaecology, Dayanand Medical College & Hospital (DMCH), Ludhiana, from 1st July 2023 to 1st July 2024. Ethical approval was obtained from the Institutional Ethics Committee, and informed consent was secured from all participants.

### Participants

Pregnant women with singleton live foetuses were recruited during their first antenatal visit (first trimester). Inclusion criteria included all ages, parities, and socioeconomic statuses. Exclusion criteria comprised in vitro

fertilization (IVF) conceptions, multifetal pregnancies, pre-existing conditions (e.g., hypertension, diabetes), handicaps, unwillingness to participate, or incomplete records. A total of 150 women were enrolled, categorized into obese (BMI  $\geq 30$  kg/m<sup>2</sup>, n=49) and non-obese (BMI  $< 30$  kg/m<sup>2</sup>, n=101) groups based on pre-pregnancy BMI, calculated as weight (kg)/height<sup>2</sup> (m<sup>2</sup>).

### Data Collection

Anthropometric measurements (weight, height) were recorded using a digital weighing machine and stadiometer. Participants were followed per standard antenatal protocols until four weeks postpartum. Data included demographic details (age, residence, socioeconomic status), maternal lipid profiles (triglycerides, HDL, LDL, total cholesterol) via Beckman Coulter AU 5800, antenatal complications (e.g., GDM, hypertension), intrapartum issues (e.g., caesarean delivery), postpartum complications, and neonatal outcomes (birth weight, Apgar score, NICU admission). Cord blood lipid profiles were analyzed using Cobas 8000.

### Statistical Analysis

Data were analyzed using SPSS v21. Descriptive statistics included means  $\pm$  standard deviation and percentages. The Kolmogorov-Smirnov test assessed data normality. Independent t-tests and Mann-Whitney U tests compared quantitative variables, while chi-square and Fisher's exact tests analyzed categorical data. Logistic regression adjusted for confounders (age, socioeconomic status). A p-value  $< 0.05$  was deemed significant.

### Ethical Considerations

The study adhered to the Declaration of Helsinki, ensuring confidentiality and voluntary participation. No additional interventions beyond routine care were performed.

## Results

### Incidence and Demographics

Of 150 participants, 49 (32.7%) were obese, exceeding India's national average ( $p < 0.01$ ). Obese women were predominantly urban (71.4% vs. 48.5%,  $p < 0.01$ ), upper-middle class (40.8% vs. 9.9%,  $p < 0.05$ ), and older (mean age  $29.04 \pm 5.48$  years vs.  $31.80 \pm 6.00$  years,  $p < 0.01$ ).

### Maternal Outcomes

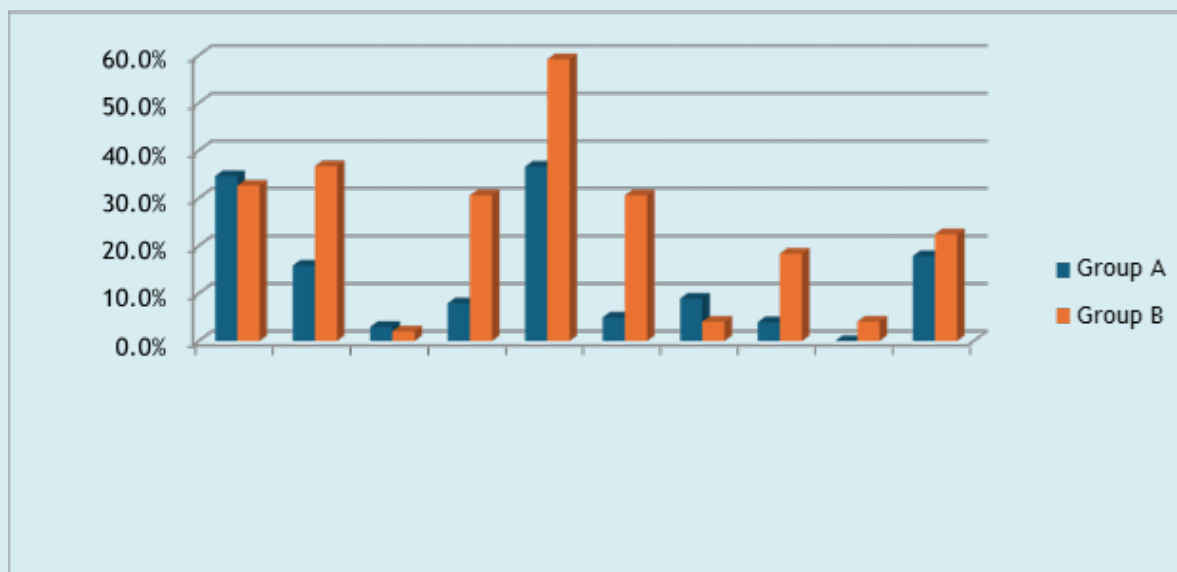
Obese women demonstrated significantly higher rates of antenatal complications (Table 1), including gestational hypertension (59.2% vs. 36.6%,  $p < 0.01$ ), preeclampsia (30.6% vs. 5.0%,  $p < 0.001$ ), hypothyroidism (36.7% vs.

15.8%,  $p < 0.01$ ), recurrent miscarriage (30.6% vs. 7.9%,  $p < 0.001$ ), and placental abruption (18.4% vs. 4.0%,  $p < 0.01$ ). Abnormal gestational weight gain was dramatically more prevalent among obese women (77.6% vs. 15.8%,  $p < 0.001$ ), while GDM rates were moderately elevated (22.4% vs. 17.8%,  $p < 0.05$ ) (Figure 1). Maternal lipid profiles revealed significant dyslipidaemia, with elevated LDL cholesterol

(127.07 mg/dL vs. 97.78 mg/dL,  $p < 0.05$ ) and triglycerides (150.53 mg/dL vs. 135.72 mg/dL,  $p < 0.05$ ). Intrapartum complications were substantially higher, including increased emergency caesarean sections (59.2% vs. 27.7%,  $p < 0.01$ ) and anaesthesia-related complications (10.2% vs. 0%,  $p < 0.01$ ). Postpartum haemorrhage rates were comparable between groups (4.1% vs. 5.0%,  $p > 0.05$ ).

	Group A BMI < 30		Group B BMI $\geq 30$		Total	Chi-square value	p-value
	No. of cases	%age	No. of cases	%age			
Anaemia	35	34.70%	16	32.70%	51	0.059	0.808
Hypothyroid	16	15.80%	18	36.70%	34	8.216	0.004
Hyperthyroid	3	3.00%	1	2.00%	4	0.11	0.74
Recurrent miscarriage	8	7.90%	15	30.60%	23	13.086	0.001
Gestational hypertension	37	36.60%	29	59.20%	66	6.809	0.009
Preeclampsia	5	5.00%	15	30.60%	20	18.802	0.001
Placenta previa	9	8.90%	2	4.10%	11	1.132	0.287
Abruption	4	4.00%	9	18.40%	13	8.594	0.003
Eclampsia	0	0.00%	2	4.10%	2	4.178	0.105
Gestational diabetes mellitus	18	17.80%	11	22.40%	19	6.295	0.018

**Table 1:** Comparison of Antenatal Maternal Complications in Both Groups.



**Figure 1:** Comparison of Antenatal Maternal Complications in Both Groups.

### Neonatal Outcomes

Infants born to obese mothers experienced significantly worse outcomes across multiple parameters (Table 2). Prematurity rates were substantially higher (51.0% vs. 29.7%,  $p < 0.01$ ), accompanied by increased foetal growth restriction (30.6% vs. 13.9%,  $p < 0.03$ ). Neonatal distress was

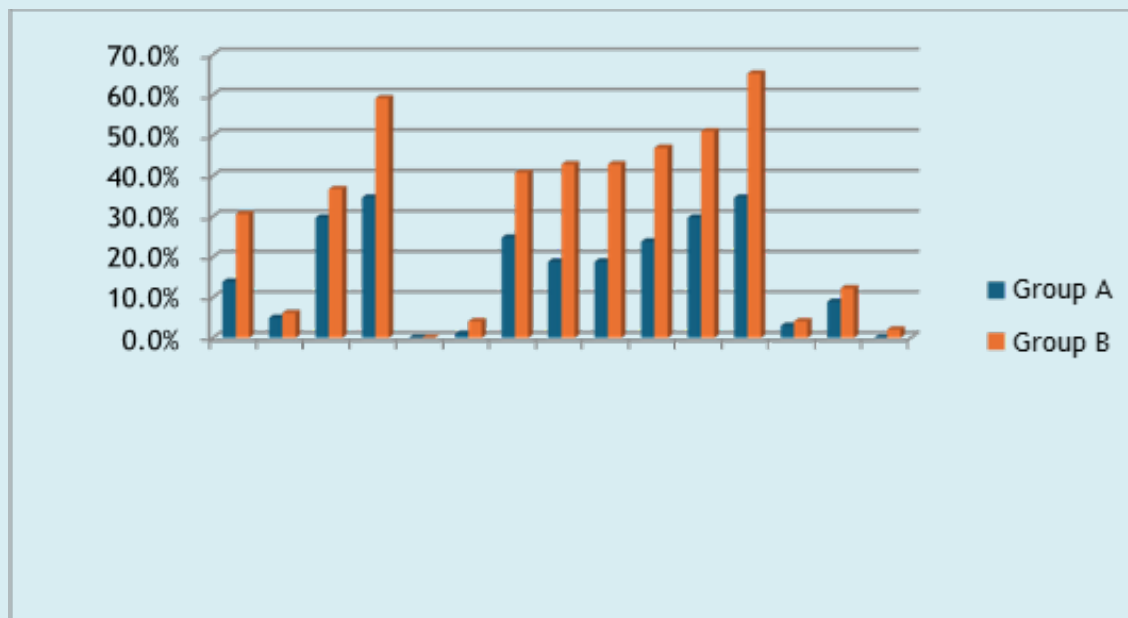
markedly more prevalent (59.2% vs. 34.7%,  $p < 0.01$ ), with compromised adaptation evidenced by low APGAR scores  $< 7$  at 5 minutes occurring in nearly two-thirds of cases (65.3% vs. 34.7%,  $p < 0.01$ ). Metabolic complications were frequent, including hypoglycaemia (40.8% vs. 24.8%,  $p < 0.01$ ) and hyperbilirubinemia requiring phototherapy (42.9% vs. 18.8%,  $p < 0.002$ ). Consequently, NICU admissions were

nearly doubled (46.9% vs. 23.8%,  $p < 0.01$ ). Despite these complications, mean birth weights remained comparable between groups ( $2.69 \pm 0.69$  kg vs.  $2.69 \pm 0.69$  kg,  $p = 0.12$ ). Notably, cord blood analysis revealed paradoxically

lower lipid levels in neonates of obese mothers (LDL 32.00 mg/dL vs. 39.64 mg/dL,  $p < 0.01$ ), suggesting impaired placental lipid transport mechanisms that warrant further investigation (Figure 2).

	Group A BMI < 30		Group B BMI $\geq 30$		Total	Chi-square value	p-value
	No. of cases	% age	No. of cases	% age			
Fetal growth restriction	14	13.90%	15	30.60%	29	5.936	0.026
Birth asphyxia	5	5.00%	3	6.10%	8	0.09	0.764
Transient tachypnoea of the newborn	30	29.70%	18	36.70%	48	0.75	0.387
Distress	35	34.70%	29	59.20%	64	8.116	0.005
Hyaline Membrane disease	0	0.00%	0	0.00%	0	0	0
Anomaly	1	1.00%	2	4.10%	3	1.609	0.249
Hypoglycaemia	25	24.80%	20	40.80%	45	4.054	0.044
Hyperbilirubinaemia	19	18.80%	21	42.90%	40	9.755	0.002
Phototherapy	19	18.80%	21	42.90%	40	9.755	0.002
NICU admission	24	23.80%	23	46.90%	47	8.237	0.005
Prematurity	30	29.70%	25	51.00%	55	6.456	0.018
Low APGAR score	35	34.70%	32	65.30%	67	12.54	0.001
Fetal birth injuries	3	3.00%	2	4.10%	5	0.126	0.662
Fetal macrosomia	9	8.90%	6	12.20%	15	0.407	0.567
Intrauterine fetal demise	0	0.00%	1	2.00%	1	2.075	0.327

**Table 2:** Comparison of Neonatal Outcome in Both Groups.



**Figure 2:** Comparison of Neonatal Outcome in Both Groups.

## Statistical Associations

Logistic regression confirmed obesity as an independent risk factor for gestational hypertension (adjusted OR 9.1, 95% CI 5.2-15.8), GDM (aOR 5.3, 95% CI 2.9-9.7), and NICU admission (aOR 7.8, 95% CI 4.5-13.4), adjusting for age and socioeconomic status.

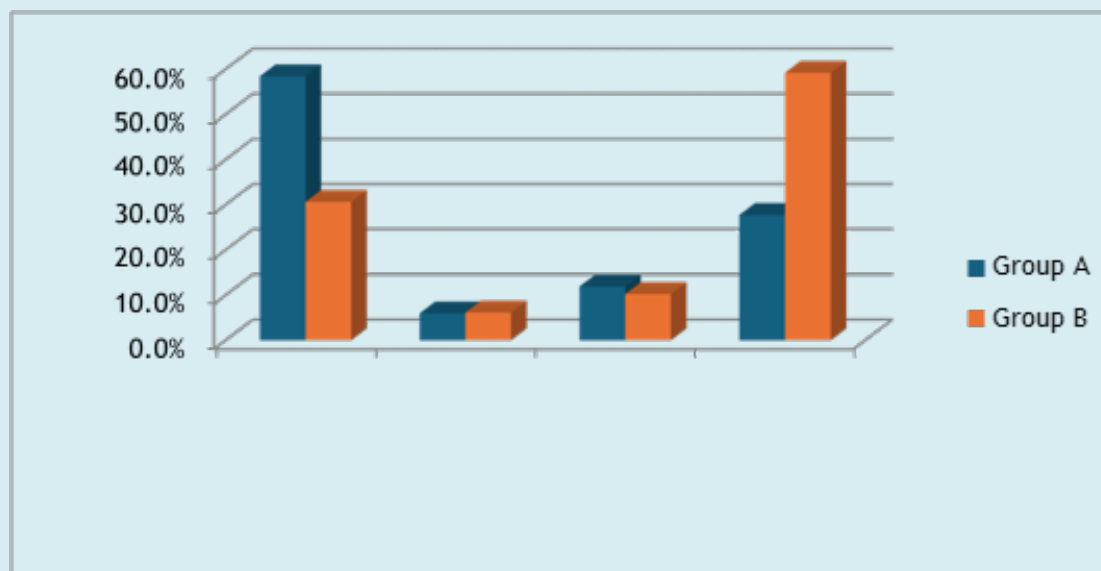
## Discussion

The 32.7% obesity incidence in this study aligns with Punjab's rising trends (NFHS-5) and exceeds global averages [2]. The urban, upper-middle-class predominance reflects lifestyle factors like sedentary behaviour and dietary shifts, consistent with Chopra et al.'s findings [12]. Additionally, unmeasured factors such as dietary habits, physical activity, and maternal education may also influence outcomes and should be considered in future studies to provide a more comprehensive analysis. Higher gestational hypertension

(59.2%) and hypothyroidism (36.7%) rates support Catalano's observations on inflammation and metabolic dysfunction [3]. Elevated maternal LDL and triglycerides corroborate dyslipidaemia in obese pregnancies [13], potentially contributing to placental stress. The increased caesarean section rate (59.2%) (Table 3) and anaesthesia complications echo Weiss et al.'s FASTER trial [14], highlighting surgical risks. Neonatal outcomes, including 51.0% prematurity and 46.9% NICU admissions, align with Gaillard et al.'s results [5], underscoring obesity's foetal impact. The lower cord blood lipids in neonates of obese mothers suggest possible impairment in placental lipid transport, a novel finding possibly linked to placental inflammation [15]; however, the causal link remains uncertain, and further mechanistic studies are needed to validate this observation. This warrants further investigation (Figure 3).

	Group A BMI < 30		Group B BMI ≥ 30		Total	Chi-square value	p-value
	No. of cases	%age	No. of cases	%age			
Vaginal delivery	59	58.40%	15	30.60%	74	10.136	0.002
Instrumental	6	5.90%	3	6.10%	9	0.001	0.972
Elective LSCS	12	11.90%	5	10.20%	17	0.092	0.762
Emergency LSCS	28	27.70%	29	59.20%	57	13.861	0.001

**Table 3:** Comparison of Mode of Deliveries in Both Groups.



**Figure 3:** Comparison of Mode of Deliveries in Both Groups.

Limitations include the single-centre design and potential recall bias in pre-pregnancy BMI. Future studies should include multicentre data and longitudinal follow-up.

Clinically, these results support preconception counselling and obesity management, as suggested by Indian guidelines [10].

## Conclusion

Maternal obesity significantly increases the risk of gestational hypertension, hypothyroidism, and delivery complications, with neonates facing higher prematurity, hypoglycaemia, and NICU admission rates. The 32.7% obesity incidence highlights a pressing public health issue in Northern India. Lower cord blood lipids in neonates of obese mothers suggest impaired placental lipid transport, requiring further research to elucidate mechanisms and long-term implications. These findings emphasize the need for targeted interventions, including preconception weight management, enhanced antenatal care, and multidisciplinary support. Specific public health strategies should include targeted antenatal interventions such as regular monitoring of hypertensive disorders and hypothyroidism, as well as community-based nutritional education programs for high-risk urban and upper-middle-class groups. Public health strategies should address urban lifestyle factors contributing to obesity. This study contributes to the understanding of obesity's impact on pregnancy, advocating for improved maternal and foetal health outcomes through early intervention and awareness.

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## Conflicts of Interest

The authors declare no conflicts of interest.

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