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Maternal obesity (BMI ≥25 kg/m² by Asian Indian criteria) and fetomaternal outcomes: A prospective comparative study

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Abstract

Background: Maternal obesity is increasingly common and is associated with adverse pregnancy outcomes. Asian Indian BMI criteria classify obesity at a lower cut-off (BMI ≥25 kg/m²), which may better reflect metabolic risk in this population.

Objective: To compare maternal, obstetric, postpartum, and neonatal outcomes between obese pregnant women (BMI ≥25 kg/m²) and non-obese pregnant women (BMI 18.5-24.9 kg/m²) using Asian Indian BMI criteria.

Material and Methods: A prospective comparative observational study was conducted at Apollo Hospitals International Ltd., Gandhinagar, Gujarat, India over an 18-month period. A total of 100 antenatal women were enrolled and grouped as obese (n=50) and non-obese (n=50). Maternal outcomes assessed included Pregnancy-Induced Hypertension (PIH), gestational diabetes mellitus (GDM), PROM, preterm labour, postpartum haemorrhage, induction of labour, and mode of delivery (LSCS). Postpartum wound status was evaluated. Neonatal outcomes included gestational age at birth, birth weight, APGAR scores at 1 and 5 minutes, and NICU admission. Categorical variables were compared using Chi-square/Fisher's exact test and continuous variables using independent t-test, with $p<0.05$ considered significant.

Results: Obese women had significantly higher rates of PIH (8% vs 2%; $p<0.001$) and GDM (10% vs 2%; $p=0.002$). PROM (4% vs 2%; $p=0.841$), preterm labour (32% vs 22%; $p=0.129$), induction of labour (22% vs 20%; $p=0.505$), and LSCS (68% vs 52%; p=0.166) were higher in obese women but not statistically significant. Booking SBP and DBP after 20 weeks were significantly higher in obese women. Postpartum stitch line was healthy in most participants (92% obese vs 98% non-obese). Neonatal outcomes were comparable for gestational age, birth weight, and APGAR; NICU admission was higher in the obese group (18% vs 4%) but not statistically significant ($p=0.238$).

Conclusion: Using Asian Indian BMI criteria, maternal obesity was strongly associated with increased risk of PIH and GDM, while most neonatal outcomes remained comparable. Early risk identification and intensified antenatal surveillance for hypertensive disorders and dysglycaemia are recommended for obese gravidas.

Keywords: Maternal obesity, Asian Indian BMI, pregnancy outcomes, fetomaternal outcomes, pregnancy-induced hypertension, gestational diabetes mellitus, caesarean section, blood pressure, NICU admission, neonatal outcomes

Introduction

Maternal obesity has emerged as a major non-communicable disease challenge worldwide and is increasingly prevalent in South Asian populations, including India, where national surveys document a rising burden of abdominal and general adiposity among women of reproductive age [1, 2]. Obesity is now recognized not only as excess weight but as a chronic disease state with complex metabolic and inflammatory consequences that can begin before conception and track through pregnancy [3, 4]. At a population level, long-term global increases in Body-Mass Index (BMI) since 1980 highlight why pregnancy care systems are encountering more women entering gestation with elevated BMI and related cardiometabolic risk [5]. Importantly, Asian Indians demonstrate higher metabolic risk at lower BMI levels than many Western populations, prompting consensus recommendations that define obesity using lower cut-offs (BMI ≥25 kg/m²) and emphasize abdominal obesity and metabolic syndrome risk even at "moderate" BMI values [10]. Mechanistically, obesity is closely linked with insulin resistance [9], which can worsen the physiological insulin resistance of pregnancy, thereby increasing susceptibility to gestational dysglycaemia and related complications [7]. Clinical guidance for obesity in

pregnancy underscores the need for structured risk assessment, appropriate counselling, and vigilant antenatal surveillance in obese gravidas [11, 12]. Prior literature has consistently shown that higher BMI is associated with adverse maternal outcomes particularly hypertensive disorders and pre-eclampsia, gestational diabetes, labour induction, and increased caesarean delivery rates [13-15, 19, 20] as well as perinatal risks including stillbirth and infant death [16], and broader short-term resource implications for obstetric services [13]. Even when focusing on specific cohorts, observational evidence in nulliparous singleton pregnancies suggests that increasing BMI materially alters pregnancy outcomes [5], while meta-analytic data demonstrate a clear association between maternal obesity and caesarean delivery risk [20]. In parallel, gestational weight gain guidance has evolved to help clinicians frame achievable targets and counsel patients to reduce preventable complications without compromising fetal growth [15]. Despite these established associations, there remains a critical problem in many Indian clinical settings: available evidence is often extrapolated from Western BMI thresholds (e.g., ≥30 kg/m²), which may underestimate risk in Asian Indians who develop metabolic complications at lower BMI, and prospective comparative data using BMI ≥25 kg/m² (Asian Indian criteria) are still relatively limited for explaining local fetomaternal risk patterns and guiding context-appropriate counselling.

Objectives

Therefore, the objective of this prospective comparative study is to evaluate and compare key maternal outcomes (e.g., hypertensive disorders, dysglycaemia, labour and delivery interventions) and neonatal outcomes (e.g., perinatal morbidity and mortality indicators) between pregnant women with BMI ≥25 kg/m² (Asian Indian criteria) and non-obese counterparts, to generate clinically actionable evidence for risk stratification and antenatal care planning [10-12, 16, 20]. We hypothesize that, compared with non-obese women, maternal obesity defined by Asian Indian BMI criteria (≥25 kg/m²) is associated with significantly higher rates of adverse maternal complications and obstetric interventions, and may also increase the likelihood of adverse perinatal outcomes in the study population [5, 13-16, 19, 20].

Material and Methods

Material

Study design and setting: This prospective comparative observational study was conducted in the Department of Obstetrics and Gynaecology at a tertiary care centre in Gujarat, India, to examine fetomaternal outcomes among women stratified by BMI using Asian Indian criteria, which identify obesity at lower BMI thresholds due to higher cardiometabolic risk at comparatively lower BMI levels [10]. The rationale for using BMI-based risk stratification and focusing on obesity in pregnancy is supported by global epidemiological trends and the recognition of obesity as a chronic disease with important reproductive implications [3-6, 11].

Study population and grouping: Pregnant women receiving antenatal care and planned delivery at the study centre were enrolled and categorized into two groups:

- Obese group with BMI ≥25 kg/m² (Asian Indian cut-off) and
- Non-obese group with BMI 18.5-24.9 kg/m² [10].

Sample size and eligibility: A total sample of 100 participants (50 per group) was recruited as per the thesis protocol, with inclusion at early booking and allowance for enrolment later in pregnancy if first-trimester anthropometry was documented. Exclusion criteria included underweight BMI, multifetal gestation, pregnancy loss, referral for emergency delivery from outside, and inability to complete follow-up.

Variables/materials recorded: Baseline demographic details, anthropometry (height/weight for BMI calculation), and clinical parameters (including serial blood pressure measures and antenatal investigations performed as per institutional protocol) were documented to evaluate obesity-associated risks such as insulin resistance and cardiometabolic complications [9, 13]. Selection of key maternal outcomes (hypertensive disorders, gestational diabetes, labour interventions, and caesarean birth) and perinatal outcomes was guided by prior evidence linking elevated BMI to adverse obstetric resource utilization and pregnancy complications [5, 14, 16-20].

Methods

Enrollment, follow-up, and care protocol: Participants were followed prospectively from enrolment through delivery and the immediate postpartum period, with postpartum follow-up as per the thesis schedule. Routine antenatal management and surveillance were provided according to institutional standards informed by major guidance on obesity in pregnancy and non-communicable disease risk reduction in pregnancy [7, 12]. Counselling regarding healthy gestational weight gain and pregnancy care was aligned with established recommendations emphasizing appropriate weight gain targets and risk mitigation [15].

Outcome assessment: Maternal outcomes included development of hypertensive disorders of pregnancy and gestational diabetes, occurrence of PROM/preterm labour, postpartum haemorrhage, induction/augmentation of labour, mode of delivery (including caesarean delivery), and postpartum wound status; neonatal outcomes included gestational age at birth, birth weight, APGAR scores, and NICU admission. These outcomes were chosen because previous cohort studies and meta-analyses have demonstrated consistent associations between increasing BMI and risks of pre-eclampsia/hypertensive disorders, gestational diabetes, caesarean delivery, and adverse perinatal outcomes including fetal death and stillbirth [5, 13, 14, 16-18, 20].

Statistical analysis: Data were entered in the thesis database and analyzed using standard comparative statistics: continuous variables were summarized as mean ± SD and compared using independent t-test, while categorical variables were expressed as proportions and compared using Chi-square/Fisher's exact test as appropriate; statistical significance was set at $p<0.05$.

Ethical considerations: Ethical approval and informed consent were obtained as per institutional requirements, and participant confidentiality was maintained; the study approach is consistent with international and professional guidance emphasizing responsible management of obesity in pregnancy [7, 11, 12].

Results

Statistical analysis approach

Comparisons between obese (BMI ≥25 kg/m²; n=50) and non-obese (BMI 18.5-24.9 kg/m²; n=50) groups were interpreted using the thesis-reported tests (Chi-square for categorical outcomes and independent t-test for continuous outcomes).
Where appropriate, I additionally report risk ratios (RR) with

95% CI for key binary outcomes to quantify effect size (useful for clinical interpretation and recommended in reporting of comparative pregnancy outcome studies) [14, 20].

Table 1: Clinical examination at booking and delivery

Variable	Obese (n=50)	Non-obese (n=50)	p-value
Height at booking (cm)	154.73	157.80	0.001
Weight at booking (kg)	68.69	56.33	>0.05
BMI at booking (kg/m²)	28.698	22.58	
Weight gain during pregnancy (kg)	10.64	10.96	0.530
Weight at delivery (kg)	79.14	67.28	>0.05

Obese women had significantly lower mean height; weight gain during pregnancy was comparable between groups

The groups were comparable in gestational weight gain, suggesting that the observed differences in outcomes are more plausibly linked to baseline adiposity/metabolic risk rather than differential pregnancy weight gain alone [15, 18].

Table 2: Blood pressure comparisons across pregnancy

Time point	Parameter	Obese (mean ± SD)	Non-obese (mean ± SD)	p-value
Booking	SBP (mmHg)	113.84±7.79	110.70±7.47	0.023 2 Dr. Kelina Thesis (28 Feb) - 1
Booking	DBP (mmHg)	75.38±5.13	74.54±6.32	0.746
20 weeks	SBP (mmHg)	116.50±11.56	113.10±7.74	0.524
20 weeks	DBP (mmHg)	77.08±9.63	74.06±7.50	0.246
After 20 weeks	SBP (mmHg)	116.48±10.72	116.46±9.35	0.702
After 20 weeks	DBP (mmHg)	77.96±8.14	76.94±6.83	0.042

SBP at booking and DBP after 20 weeks were significantly higher in obese women

The statistically significant SBP elevation at booking and DBP elevation after 20 weeks suggests an obesity-associated hypertensive tendency during pregnancy, which aligns with broader evidence linking maternal adiposity to hypertensive disorders and future cardiometabolic risk [13, 14, 17].

Table 3: Maternal outcomes by BMI group

Maternal outcome	Obese (n=50)	Non-obese (n=50)	p-value (reported)
PIH	4 (8.0%)	1 (2.0%)	<0.001
GDM	5 (10.0%)	1 (2.0%)	0.002
PROM	2 (4.0%)	1 (2.0%)	0.841
Preterm labour	16 (32.0%)	11 (22.0%)	0.129
PPH	1 (2.0%)	0 (0.0%)	
Induction of labour	11 (22.0%)	10 (20.0%)	0.505
LSCS	34 (68.0%)	26 (52.0%)	0.166

PIH and GDM were significantly higher in obese women; other obstetric outcomes were numerically higher but not significant

Effect size (additional, clinically useful)

- **PIH:** RR ≈ 4.00 (obese vs non-obese)
- **GDM:** RR ≈ 5.00
- **LSCS:** RR ≈ 1.31 (Computed from thesis counts; use alongside p-values for magnitude interpretation.)

The significantly higher rates of PIH and GDM in obese women are consistent with the biologic link between adiposity, insulin resistance, and pregnancy metabolic stress [9] and are supported by prior observational and meta-analytic evidence that maternal obesity increases risks of hypertensive disorders and gestational dysglycaemia [5, 14, 18].

Table 4: Delivery details and mode of delivery

Delivery variable	Obese (n=50)	Non-obese (n=50)	p-value
Induction of labour (Yes)	11 (22.0%)	10 (20.0%)	0.505
Augmentation of labour (Yes)	14 (28.0%)	23 (46.0%)	0.786
Elective LSCS	18 (36.0%)	18 (36.0%)	0.433
Emergency LSCS	16 (32.0%)	8 (16.0%)	0.433
Normal delivery	16 (20.0%)	24 (48.0%)	0.433

Emergency LSCS was higher in obese women; normal delivery was higher in non-obese women

Although overall mode-of-delivery association was not statistically significant in the thesis table, the higher emergency LSCS proportion in obese women is clinically important and aligns with evidence that obesity increases the likelihood of caesarean delivery and intrapartum intervention [14, 20].

Table 5: Foetal/perinatal outcomes and APGAR

(A) Foetal/perinatal outcomes

Outcome	Obese	Non-obese	p-value
NICU admission	9 (18.0%)	2 (4.0%)	0.238
Gestational age at birth (weeks)	37.59±1.58	37.53±1.16	0.707
Birth weight (kg)	2.95±0.47	2.99±0.35	0.889

(B) APGAR score

APGAR	Obese (mean ± SD)	Non-obese (mean ± SD)	p-value
At 1 min	8.52±0.76	8.56±0.64	0.680
At 5 min	9.24±0.62	9.00±0.64	0.154

Neonatal outcomes were comparable; NICU admission was higher in obese group but not significant

Despite numerically higher NICU admissions in neonates of obese mothers, the lack of statistical significance suggests limited power for this endpoint in the present sample. Nonetheless, prior evidence indicates maternal obesity is associated with increased perinatal risks (including stillbirth/infant death) and can elevate neonatal morbidity in some settings [16]. The comparable birth weight and APGAR values suggest that, in this cohort, short-term neonatal status was broadly similar, even as maternal metabolic complications were more prominent [5, 14, 18].

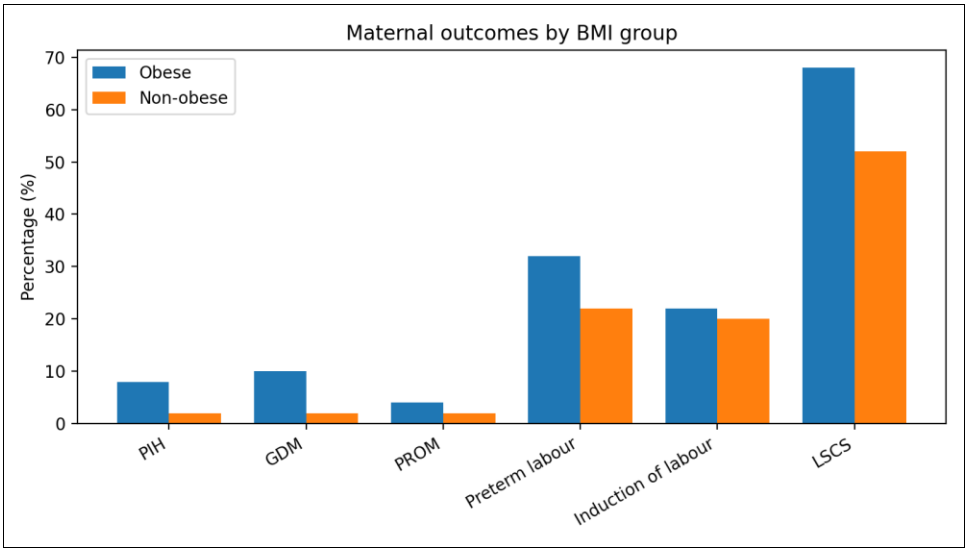

Fig 1: Maternal outcomes in obese vs non-obese women

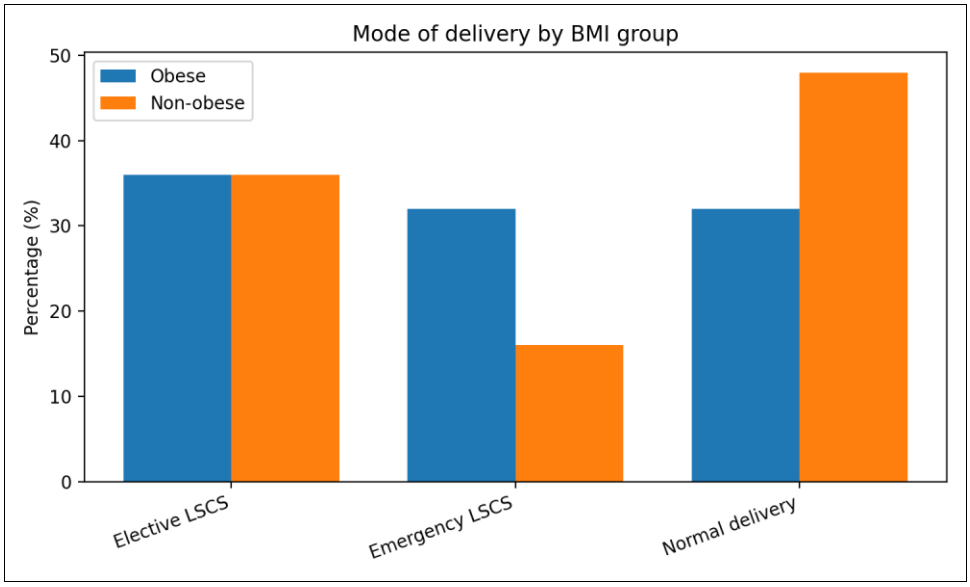

Fig 2: Mode of delivery distribution

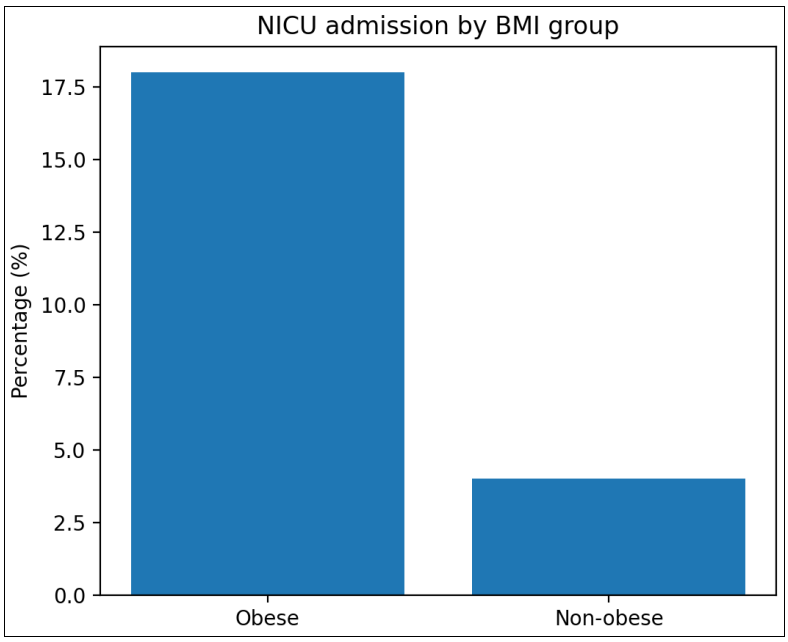

Fig 3: NICU admission percentage

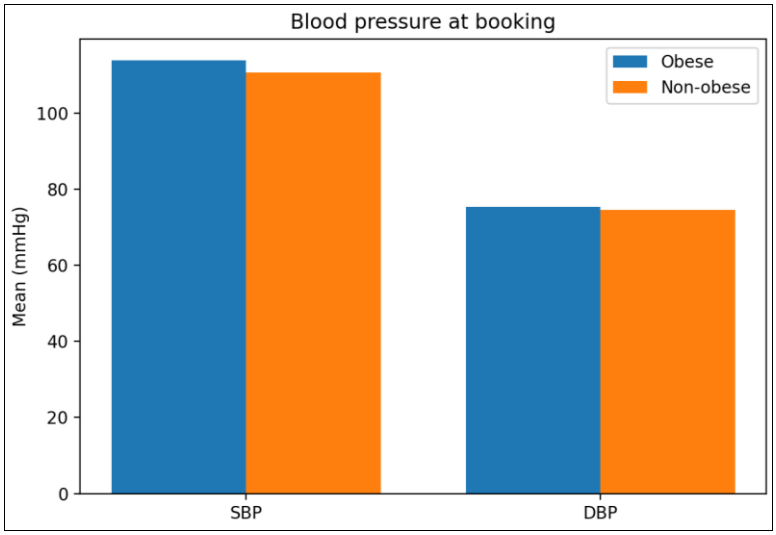

Fig 4: Mean blood pressure at booking

Comprehensive interpretation of findings

Overall, the study demonstrates a clear obesity-associated increase in metabolic and hypertensive complications, with PIH (8% vs 2%) and GDM (10% vs 2%) showing statistically significant differences.

These findings are biologically plausible given the central role of insulin resistance and chronic low-grade inflammation in obesity [9], and are consistent with prior clinical and meta-analytic evidence linking elevated maternal BMI to hypertensive disorders and GDM [5, 14, 17, 18]. Blood pressure patterns further reinforce this, showing significantly higher SBP at booking and DBP after 20 weeks among obese women, reflecting an early and persistent vascular/metabolic burden during gestation [13, 14].

Although LSCS (68% vs 52%) and emergency LSCS (32% vs 16%) were higher in obese women, these differences were not statistically significant in the thesis analysis, likely due to sample size and the multifactorial nature of delivery decisions.

Nevertheless, the direction of effect is consistent with established evidence that maternal obesity increases obstetric interventions and caesarean risk [14, 20].

For neonatal outcomes, gestational age, birth weight, and APGAR scores were comparable; NICU admission was numerically higher in obese women (18% vs 4%) but not statistically significant.

This pattern suggests that, in this cohort, obesity's strongest measurable impact was on maternal complications (PIH/GDM) rather than immediate neonatal condition. However, given broader evidence that maternal obesity can increase fetal and infant risk in larger datasets [16], NICU differences may warrant confirmation in larger multicentric studies.

Overall conclusion from Results: Using Asian Indian BMI criteria, maternal obesity in this thesis cohort was most strongly associated with hypertensive and glycaemic complications, with trends toward higher intervention at delivery but broadly similar short-term neonatal parameters [10, 14, 20].

Discussion

This prospective comparative study using Asian Indian BMI criteria (BMI ≥25 kg/m²) demonstrates that maternal obesity is associated with a clinically and statistically meaningful increase in Pregnancy-Induced Hypertension (PIH) and Gestational Diabetes Mellitus (GDM), while several other adverse outcomes (PROM, preterm labour, induction, LSCS, NICU admission) showed higher proportions among obese women but did not reach statistical significance in this sample. The significant elevation in PIH (8% vs 2%) and GDM (10% vs 2%) in the obese group

supports the central pathophysiologic role of adiposity-driven insulin resistance and metabolic dysregulation in pregnancy [9], and aligns with prior observational evidence that increasing maternal BMI is associated with higher risk of hypertensive disorders and dysglycaemia in pregnancy [5, 14, 17, 18]. Importantly, the current work applies lower BMI cut-offs recommended for Asian Indians, reflecting the well-recognized phenomenon that cardiometabolic risk appears at lower BMI thresholds in this population [10]. This approach is clinically relevant because reliance on Western thresholds (e.g., BMI ≥30 kg/m²) may underestimate risk and delay targeted surveillance, counselling, and early screening in Indian settings [10-12].

The blood pressure findings add mechanistic coherence to the observed PIH association. Obese women had significantly higher booking SBP and higher DBP after 20 weeks, suggesting an early vascular/metabolic vulnerability that may persist as pregnancy progresses.

Such patterns are consistent with the broader concept that pregnancy can act as a "stress test" for later-life cardiovascular risk, and that hypertensive pregnancy disorders cluster with metabolic risk factors including obesity [13]. From a clinical perspective, these results support guideline-driven recommendations that obese pregnant women require structured risk assessment and closer antenatal monitoring for hypertensive disorders and metabolic complications [7, 12].

Although LSCS rates were higher in obese women (68% vs 52%) and emergency LSCS occurred more frequently in obese women (32% vs 16%), statistical significance was not demonstrated in the thesis analysis.

Nonetheless, the direction of effect is consistent with extensive evidence that obesity increases obstetric intervention and caesarean delivery risk, including meta-analytic findings showing higher caesarean probability among obese mothers [14, 20]. Several mechanisms may explain the observed trend: altered labour physiology, hher prevalence of comorbidities (e.g., hypertensive disorders and GDM), fetal monitoring concerns, and prior caesarean history patterns. While the present cohort size may limit the ability to detect statistically significant differences for delivery outcomes, even a non-significant increase in emergency LSCS can be clinically important for resource planning and counselling, particularly in tertiary care

settings where operative delivery and anaesthetic risks are relevant considerations [14].

Regarding other maternal outcomes, PROM and preterm labour were more frequent in obese women but not statistically significant.

This may reflect heterogeneity in etiologic pathways, confounding by obstetric history, and insufficient power for outcomes with multifactorial causation. Additionally, gestational weight gain was broadly comparable between groups in the thesis, which suggests that baseline BMI-related metabolic risk, rather than differential pregnancy weight gain, may be a primary driver of the observed PIH/GDM differences in this cohort.

This interpretation also aligns with the emphasis in weight-gain guidelines on individualized counselling and monitoring, while recognizing that baseline BMI itself remains an independent risk marker [15].

Neonatal findings were largely reassuring: gestational age at birth, birth weight, and APGAR scores were comparable between groups, while NICU admission was numerically higher among neonates born to obese mothers (18% vs 4%) but not statistically significant.

This pattern suggests that, in this cohort, maternal obesity manifested most clearly as maternal metabolic and hypertensive morbidity rather than immediate neonatal compromise. However, the observed NICU admission difference despite non-significance should not be dismissed, because larger systematic reviews have linked higher maternal BMI to adverse perinatal outcomes including fetal death, stillbirth, and infant death [16]. In smaller single-centre cohorts, the absence of statistical significance may arise from limited events and variability in NICU admission thresholds, which are influenced by institutional protocols, neonatal observation policies, and the presence of maternal conditions such as PIH/GDM [14, 16]. Therefore, the neonatal findings here are best interpreted as "no clear difference detected" rather than definitive equivalence, highlighting the need for larger multicentre studies using Asian Indian cut-offs to clarify neonatal risk profiles at BMI ≥25 kg/m² [10, 16].

The study's focus on Asian Indian BMI cut-offs is a key strength, enhancing local applicability and addressing a major gap where evidence is often extrapolated from Western BMI categories [10]. Prospective follow-up and standardized outcome comparisons further strengthen internal validity. Nevertheless, certain limitations should be considered when interpreting the findings. First, the sample size (50 per group) may not be sufficient to detect modest differences in relatively less frequent outcomes (e.g., PPH, PROM, some neonatal endpoints). Second, delivery mode is shaped by multiple factors previous LSCS, clinician preference, intrapartum course which may dilute the measurable independent contribution of BMI in a single-centre design. Third, residual confounding by parity, socioeconomic variables, and comorbidities may persist. Despite these constraints, the consistent signal for PIH and GDM aligns with established biological plausibility (obesity-insulin resistance axis) [9] and the broader evidence base emphasizing the obstetric resource implications of high maternal BMI [14].

Clinically, these results support pragmatic recommendations: early identification of obese gravidas using Asian Indian criteria, targeted counselling, and intensified surveillance for hypertensive disorders and gestational dysglycaemia in line with recognized guidance for obesity in pregnancy [7, 12]. Given that gestational weight gain was comparable, counselling may need to prioritize preconception and early pregnancy risk reduction strategies and individualized antenatal monitoring rather than focusing solely on weight gain during pregnancy [15, 18]. Future research should expand sample size and incorporate multivariable modelling to estimate adjusted risk for PIH/GDM and to clarify whether the observed trends in emergency LSCS and NICU admission reach significance in larger Indian cohorts, thereby improving risk stratification and service planning in tertiary obstetric settings [14, 16, 20].

Conclusion

In conclusion, this prospective comparative study using Asian Indian BMI criteria (BMI ≥25 kg/m²) demonstrates that maternal obesity is not merely a numerical classification but a clinically meaningful risk state that measurably alters pregnancy health, particularly by increasing the likelihood of hypertensive disorders and gestational diabetes. The findings reinforce that even at BMI levels that might be considered "moderate" by older or Western thresholds, women in the obese group experienced a higher burden of cardiometabolic complications during pregnancy, while most short-term neonatal parameters such as gestational age, birth weight, and APGAR scores remained broadly comparable between obese and non-obese groups. This pattern suggests that the most immediate and consistent impact of maternal obesity in the studied cohort was concentrated on maternal physiology and obstetric risk especially blood pressure trends and glucose intolerance rather than uniform deterioration in early neonatal condition; however, the observed trends toward higher intervention at delivery and greater neonatal care utilization warrant attention because they have direct implications for clinical workload, operating theatre planning, and neonatal support capacity in tertiary care settings. Based on these results, practical recommendations should begin with early identification and structured risk stratification: all women should have BMI documented at booking (or confirmed by reliable first-trimester measurements), and those with BMI ≥25 kg/m² should be flagged as a higher-risk group for intensified surveillance. Antenatal care pathways should incorporate earlier and more frequent blood pressure assessment with clear thresholds for escalation, along with timely screening for gestational diabetes and proactive nutrition counselling tailored to local dietary patterns; counselling should be framed as risk reduction rather than weight-focused messaging, emphasizing achievable lifestyle actions such as balanced meal planning, appropriate physical activity where medically safe, adequate sleep hygiene, and stress management. Clinicians should implement individualized gestational weight gain goals and monitor weight trajectory consistently to avoid excessive gain while ensuring fetal growth remains appropriate, supported by dietitian involvement where feasible. Given the tendency toward higher operative deliveries and emergency interventions, intrapartum planning should include anticipatory counselling about the possibility of induction or caesarean delivery, early anaesthesia review for women with higher BMI, careful labour monitoring, and readiness for complications that may accompany hypertensive disorders or dysglycaemia. Postpartum care should include continued blood pressure monitoring, counselling on long-term cardiometabolic risk, and structured follow-up for glucose status, along with family-centred guidance on nutrition and activity to support healthy recovery and future pregnancy planning. At a service level, hospitals should standardize protocols for obese gravidas covering screening timelines, referral criteria, dietetic support, and coordinated obstetric-medicine pathways to reduce variability in care and improve outcomes. Overall, applying Asian Indian BMI criteria in routine practice can help clinicians identify at-risk women

earlier, target surveillance where it matters most, and implement practical interventions that reduce preventable maternal morbidity while maintaining safe neonatal outcomes.

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