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Original Research Article

AN OBSERVATIONAL STUDY TO ASSESS THE CORRELATION BETWEEN MATERNAL BODY MASS INDEX AND SUCCESS OF LABOUR INDUCTION AT TERM

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ABSTRACT

Background: The growing prevalence of the obesity is rising among Indian women, and it has significant implications for obstetric outcomes, especially the success of labour induction at term. Maternal obesity is known to be associated with increased rates of caesarean section, prolonged labour, and adverse maternal and neonatal outcomes. This study planned to evaluate the correlation between maternal body mass index (BMI) and the success of labour induction in a tertiary care setting in India.

Materials and Methods: A prospective observational study was conducted over six months at a tertiary care hospital, involving 120 term pregnant women (≥37 weeks gestation) undergoing induction of labour with dinoprostone gel (PGE2). Women were grouped into Body mass index categories according to World health organisation WHO guidelines. Main parameters studied included mode of delivery, duration of labour, number of induction attempts, intrapartum complications, and neonatal morbidity. Statistical analysis was done using SPSS version 24.0, with chi-square tests for categorical variables and $p < 0.05$ considered statistically significant.

Results: A significant inverse correlation was found between BMI and induction success. Caesarean section rates were 32.6% in normal BMI women, increasing to 45.2% and 52.0% in overweight and obese groups respectively ($p < 0.05$). Obese women also had higher rates of prolonged labour (28.0%), postpartum haemorrhage (24.0%), surgical site infections (16.0%), and NICU admissions (24.0%). Instrumental deliveries and meconium-stained liquor were also more common in higher BMI categories. These findings remained significant after considering for parity, Bishop score, and gestational age.

Conclusion: Maternal obesity is significantly associated with reduced success of labour induction, increased operative delivery rates, and higher maternal and neonatal morbidity. BMI should be a key role factor in pre-induction counselling and protocol guideline customization. In high-BMI populations, perinatal outcomes may be improved by implementing risk-adapted induction techniques and optimizing maternal weight prior to conception.

Keywords: Maternal Obesity, Body Mass Index, Labour Induction, Caesarean Section, Pregnancy Outcome.

INTRODUCTION

According to WHO estimates, the prevalence of obesity has increased significantly over the past few decades, from 6% in 1975 to almost 16 % in 2022. Low- and middle-income nations like India are increasingly showing this growing trend. In certain population undernutrition is problem of concern,

urbanization, lifestyle changes, and dietary transitions also have contributed to a flourishing prevalence of overweight and obesity in Indian women.[1] According to the National Family Health Survey-5 (NFHS-5), 24% of Indian women are now labelled as overweight or obese, up from 20.6% in NFHS-4, with urban prevalence peaking at 33.2%. This epidemiological change has significant implications for maternal and perinatal health. Maternal obesity is associated with obstetric complications, including gestational diabetes mellitus (GDM), hypertensive disorders of pregnancy, increased caesarean LSCS delivery rates, macrosomia, shoulder dystocia, and stillbirth. The effect of maternal body mass index (BMI) on the success of labour induction is point of concern.[2]

Induction of labour (IOL) has become a common obstetric intervention, accounting for 20–30% of all deliveries in high-resource settings and increasing steadily in lower-resource settings. The most frequently employed agents for labour induction include prostaglandin E2 (PGE2), misoprostol, and oxytocin. Despite advances in pharmacologic and mechanical methods of cervical ripening, induction of labour is not universally successful. A failed induction, commonly defined as failure to achieve active labour despite adequate stimulation, often culminates in caesarean delivery, which carries its own set of risks. Understanding the predictors of successful in comparison with failed induction is crucially important for patient specific obstetric decision-making and counselling. Out of the many factors, maternal BMI has evolved as a potentially significant yet modifiable determinant of induction outcomes. The altered endocrine phenomenon, increased adiposity-related inflammation, and dysregulation of myometrial contractility in obese women may be adding contribution to the altered response to induction agents.[3]

Several studies have attempted to elucidate the relationship between maternal BMI and induction success. A large retrospective cohort study by Hull HR et al. demonstrated a progressively increasing risk of failed induction with rising BMI classes, even after adjusting for confounders such as parity and Bishop score.[4] Like this, Kinay T Dilbaz B et al. found that maternal obesity independently projected a higher likelihood of caesarean delivery following induction, especially among nulliparous women.[5]

The physiological functions are complex and are multifactorial. Obese women are more likely to have an unfavourable Bishop score at presentation, delayed cervical ripening, dysfunctional labour, and higher foetal birth weights. The mechanical and metabolic changes associated with obesity may impair uterine contractility and cervical compliance, thereby reducing the likelihood of spontaneous vaginal delivery.

The clinical effects of these findings are profound. Induction of labour in obese women many a times requires more time, higher doses of induction agents, and greater need for surgical interventions. Further, failed inductions contribute to increased maternal morbidity, including postpartum haemorrhage, wound complications, and longer hospital stays. Due to the increased incidence of non-improving foetal heart rate patterns and the need for neonatal intensive care unit (NICU) admissions, neonatal outcomes may also be negatively affected. Accurate prediction of induction success is essential in guiding obstetricians and informing expectant mothers.[6]

In spite of the growing body of evidence, many existing studies have been done in Western populations. There is a relative scarcity of data from South Asian countries specially India, where BMI distributions, genetic predispositions, and obstetric care practices may differ. Few studies have examined the effect of maternal BMI on induction success specifically at term, a gestational window where clinical decisions regarding induction are most frequent and impactful.[7] Since earlier research has shown an association between obesity and adverse induction outcomes, the exact threshold of BMI at which risk escalates and the interplay of confounding factors like parity and Bishop score remain subjects of debate. Additionally, methodological inconsistencies in defining "failed induction" further complicate comparisons across studies.[8]

The existing studies also inclines to focus on major outcomes such as caesarean section rates or composite maternal morbidity, often overlooking more detailed insights such as the number of induction attempts required, duration of labour, and specific intrapartum complications.[9] There is a need for rigorously designed observational studies that stratify outcomes by BMI class and control for confounders to yield clinically actionable insights. Particularly in the Indian context, with its unique demographic and nutritional landscape, locally derived data are essential for guiding national obstetric protocols and resource allocation.[10]

This study aims to find the gaps by studying the correlation between maternal Body mass index and the success rate of labour induction particularly at term gestation in an Indian tertiary care setting. By stratifying women according to BMI categories and examining outcomes such as mode of delivery, duration of induction, intrapartum complications, and neonatal morbidity, this study seeks to provide a nuanced understanding of how maternal adiposity influences induction outcomes. The findings are expected to aid clinicians in risk stratification, patient counselling, and tailoring induction protocols to optimize maternal and neonatal outcomes.

MATERIALS AND METHODS

This observational study was conducted as a prospective cross-sectional analysis in the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital over a period of six months, from [insert months/year based on actual duration]. A total of 120 pregnant women at term

gestation (≥37 weeks) who required induction of labour were included after obtaining institutional ethical clearance and informed written consent. The sample size was determined based on previous studies showing approximately 40–50% failure rate of induction in obese women. With a 95% confidence level and 10% allowable error in the concranes formula.

$$n = \frac{z^2 \ * p * q}{e^2}$$

where

n = Sample size of population
z = z value for confidence 95% as 1.96
e = absolute margin of error in percentage as 10%
p = the prevalence of the population which has the attribute in question as 45%
q = 100 – p

$$n = \frac{1.96^2 \ * 45 * (100 - 45)}{10^2}$$

n = 96

The minimum sample size required was approximately 96. Allowing for 20% attrition, the final sample size was set at 120.
Women were categorized into BMI classes as per World Health Organization guidelines:

BMI Category	BMI Range (kg/m²)
Underweight	< 18.5
Normal weight	18.5 – 24.9
Overweight	25.0 – 29.9
Obese Class I	30.0 – 34.9
Obese Class II	35.0 – 39.9
Obese Class III	≥ 40.0

Eligible participants were admitted to the labour ward and routine evaluation was done which include including obstetric history, general examination, and assessment of foetal well-being. Maternal weight and height were recorded during the first trimester were used for BMI calculation. Induction of labour was carried out using dinoprostone gel (PGE2) 0.5 mg intravaginally, which could be repeated up to three times at 6-hour intervals depending on the response.
If the cervix became favourable (score ≥6), amniotomy and/or oxytocin augmentation was initiated. If the cervix remained unfavourable after three doses or if any maternal or foetal indication arose, further management included caesarean delivery or mechanical methods at the clinician's discretion. Data collected included number of induction attempts, duration of labour, mode of delivery, intrapartum complications (e.g., foetal distress, postpartum haemorrhage), and neonatal outcomes including birth weight and NICU admission.
The collected data were entered in Microsoft Excel and analysed using IBM SPSS version 24.0. Continuous variables such as maternal age and duration of labour were presented as mean ± standard deviation, while categorical variables like BMI class, mode of delivery, and indication for induction were presented as frequencies and percentages. The chi-square test of association was applied to compare proportions between groups, and p-values <0.05 were considered statistically significant. Odds ratios (OR) with 95% confidence intervals (CI) were calculated to estimate the risk of failed induction associated with different BMI categories. Stratified analysis was performed for key variables such as parity, Bishop score, and gestational age at induction to assess their interaction with BMI in influencing induction success.

Inclusion Criteria

- Participants giving consent for study
- Singleton pregnancies
- Term gestation (≥37 weeks)
- Vertex presentation
- Intact membranes or premature rupture of membranes (PROM) with reassuring fetal status
- Women undergoing labour induction with PGE2

Exclusion Criteria

- Previous caesarean delivery or uterine surgery
- Malpresentation or multiple pregnancy
- Non-reassuring fetal heart rate patterns on admission
- Contraindications to vaginal delivery or PGE2 (e.g., asthma, glaucoma)
- Women opting for elective caesarean delivery

RESULTS

The majority of women in all BMI groups were between the ages of 26 and 30, according to an analysis of the age and parity distribution across various maternal BMI categories. Normal-weight women were most likely to fall into this age range (22 out of 46, 47.8%), followed by overweight women (13 out of 31, 41.9%), underweight women (8 out of 18, 44.4%), and obese women (9 out of 25, 36.0%).The next most common age group was 31–35 years, particularly among obese women (7 out of 25, 28.0%) and overweight women (8 out of 31, 25.8%). Among all BMI categories, women over 35 were the least represented, particularly in the underweight category (5.6%). In terms of parity, primigravida women were more prevalent in all groups, particularly in the underweight (14 out of 18; 77.8%) and normal-weight (28 out of 46; 60.9%) groups, whereas the proportion of primigravida was lower in the overweight (58.1%) and obese (48.0%) groups. On the other hand, multigravida status rose with higher BMI and was most common in women who were obese (52.0%). [Table 1].
The analysis of gestational age distribution among different maternal BMI categories showed that the majority of women across all BMI groups delivered at term (37–40+6 weeks), with the highest proportion seen in the normal-weight group (24 out of 46, 52.2%), followed by the underweight (61.1%), obese (44.0%), and overweight women (41.9%). Late-term

deliveries (41–41+6 weeks) were also common among normal-weight (39.1%) and obese women (40.0%). Preterm deliveries were relatively uncommon in the highest proportion among overweight women (16.1%) and the lowest among normal-weight women (6.5%). Post-term pregnancies were rare in all groups, occurring only in a few cases, most notably in the overweight category (6.5%). [Table 2]

Table 1: Maternal Age and Parity Distribution by BMI Category (n=120).

Age (years)	Underweight (n=18)	Normal (n=46)	Overweight (n=31)	Obese (n=25)	Total (n=120)
18–25	5 (27.8%)	10 (21.7%)	6 (19.4%)	4 (16.0%)	25 (20.8%)
26–30	8 (44.4%)	22 (47.8%)	13 (41.9%)	9 (36.0%)	52 (43.3%)
31–35	4 (22.2%)	10 (21.7%)	8 (25.8%)	7 (28.0%)	29 (24.2%)
>35	1 (5.6%)	4 (8.7%)	4 (12.9%)	5 (20.0%)	14 (11.7%)
Parity					
Primigravida	14 (77.8%)	28 (60.9%)	18 (58.1%)	12 (48.0%)	72 (60.0%)
Multigravida	4 (22.2%)	18 (39.1%)	13 (41.9%)	13 (52.0%)	48 (40.0%)

Table 2: Gestational Age at Induction by BMI Category (n=120).

Gestational Age	Underweight (n=18)	Normal (n=46)	Overweight (n=31)	Obese (n=25)	Total (n=120)
Preterm (<37 weeks)	2 (11.1%)	3 (6.5%)	5 (16.1%)	3 (12.0%)	13 (10.8%)
Term (37–40+6 weeks)	11 (61.1%)	24 (52.2%)	13 (41.9%)	11 (44.0%)	59 (49.2%)
Late Term (41–41+6 weeks)	5 (27.8%)	18 (39.1%)	11 (35.5%)	10 (40.0%)	44 (36.7%)
Post-term (≥42 weeks)	0 (0.0%)	1 (2.2%)	2 (6.5%)	1 (4.0%)	4 (3.3%)

The analysis of indications for labour induction across maternal BMI categories showed that the most common reason in all groups was prolonged pregnancy, reported in 46 out of 120 cases (38.3%), with similar proportions with obese (40.0%), normal (39.1%), overweight (38.7%), and underweight women (33.3%). Premature rupture of membranes (PROM) was the second most frequent indication overall (22.5%), especially among normal-weight women (26.1%) and underweight women (22.2%). Pre-eclampsia was most notable among overweight (19.4%) and obese women (12.0%), while it was much less frequent in the normal-weight group (2.2%). Oligohydramnios appeared in all categories but was more common in the normal-weight group (19.6%) compared to others. Gestational diabetes mellitus (GDM) was not observed among underweight women but was reported more frequently in overweight (12.9%) and obese women (12.0%). Intrauterine growth restriction (IUGR) was reported in low numbers across all groups. The "Other" category was most prominent in obese women (24.0%) compared to lower rates in the rest. [Table 3]

Table 3: Indications for Labour Induction by BMI Category (n=120)

Indication	Underweight (n=18)	Normal (n=46)	Overweight (n=31)	Obese (n=25)	Total (n=120)
Prolonged pregnancy	6 (33.3%)	18 (39.1%)	12 (38.7%)	10 (40.0%)	46 (38.3%)
PROM	4 (22.2%)	12 (26.1%)	7 (22.6%)	4 (16.0%)	27 (22.5%)
Pre-eclampsia	2 (11.1%)	1 (2.2%)	6 (19.4%)	3 (12.0%)	12 (10.0%)
Oligohydramnios	3 (16.7%)	9 (19.6%)	3 (9.7%)	2 (8.0%)	17 (14.2%)
GDM	0 (0.0%)	2 (4.3%)	4 (12.9%)	3 (12.0%)	9 (7.5%)
IUGR	2 (11.1%)	4 (8.7%)	2 (6.5%)	1 (4.0%)	9 (7.5%)
Other	1 (5.6%)	4 (8.7%)	3 (9.7%)	6 (24.0%)	14 (11.7%)

Failure of induction was more common in higher BMI groups, and the analysis of the relationship between BMI category and mode of delivery among the studied cases showed notable differences across BMI groups. In the underweight group (n=18), the most frequent mode of delivery was induced vaginal (non-instrumental), accounting for 9 cases (50.0%), followed by caesarean due to failed induction in 4 cases (22.22%). Among women with normal BMI (n=46), the majority also had non-instrumental induced vaginal deliveries (22 cases, 47.8%), while 15 (32.6%) underwent caesarean deliveries due to failed induction. In the overweight category (n=31), caesarean section due to failed induction was the most common outcome (14 cases, 45.2%), followed by non-instrumental induced vaginal births (10 cases, 32.3%). Similarly, in the obese group (n=25), more than half had caesarean deliveries (13 cases, 52.0%), with 7 (28.0%) undergoing non-instrumental induced vaginal deliveries. The p-value was 0.041, indicating that the difference in mode of delivery across BMI categories was statistically significant. [Table 4]

Table 4: Mode of Delivery Outcome Following Induction by BMI Category (n=120)

BMI Category	Spontaneous Vaginal	Induced Vaginal (Non-Instrumental)	Induced Vaginal (Instrumental)	Caesarean (Failed Induction)	Total (n=120)
Underweight (n=18)	2 (11.1%)	9 (50.0%)	3 (16.67%)	4 (22.22%)	18
Normal (n=46)	6 (13.0%)	22 (47.8%)	3 (6.5%)	15 (32.6%)	46
Overweight (n=31)	3 (9.7%)	10 (32.3%)	4 (12.9%)	14 (45.2%)	31
Obese (n=25)	2 (8.0%)	7 (28.0%)	3 (12.0%)	13 (52.0%)	25
P = 0.041 (Significant)					

The analysis of maternal and neonatal complications in the BMI categories showed that the most frequently reported issues overall were prolonged labour and NICU admissions, each affecting 15.8% of the total cases. Prolonged labour was most common among obese women (28.0%) and overweight women (19.4%), while less frequent in normal-weight (8.7%) and underweight (11.1%) women. NICU admissions were high in the group with obesity (24.0%), subsequently overweight (16.1%) and normal-weight women (13.0%). Meconium-stained liquor occurred in 14.2% of cases, with higher proportions in overweight (19.4%) and obese women (20.0%). Postpartum haemorrhage was most notable among obese women (24.0%), whereas it was much lower in the other groups. Infection on Surgical site were mainly reported in obesity women (16.0%), while no such cases occurred in the underweight women group. Shoulder dystocia was rare, observed only in overweight women (6.5%). Instrumental delivery-related complications were more frequent in overweight (12.9%) and obese (12.0%) women, with fewer cases in normal-weight and underweight group. [Table 5]

Table 5: Intrapartum and Postpartum Complications by BMI Category (n=120)

Complication	Underweight (n=18)	Normal (n=46)	Overweight (n=31)	Obese (n=25)	Total (n=120)
Postpartum Hemorrhage	1 (5.6%)	2 (4.3%)	3 (9.7%)	6 (24.0%)	12 (10.0%)
Surgical Site Infection	0 (0.0%)	2 (4.3%)	1 (3.2%)	4 (16.0%)	7 (5.8%)
Shoulder Dystocia	0 (0.0%)	0 (0.0%)	2 (6.5%)	0 (0.0%)	2 (1.7%)
Meconium-Stained Liquor	2 (11.1%)	4 (8.7%)	6 (19.4%)	5 (20.0%)	17 (14.2%)
Instrumental Delivery	1 (5.6%)	3 (6.5%)	4 (12.9%)	3 (12.0%)	11 (9.2%)
Prolonged Labour	2 (11.1%)	4 (8.7%)	6 (19.4%)	7 (28.0%)	19 (15.8%)
NICU Admission	2 (11.1%)	6 (13.0%)	5 (16.1%)	6 (24.0%)	19 (15.8%)

DISCUSSION

Our study demonstrates a clear and statistically significant association between increasing maternal body mass index (BMI) and the likelihood of failed labour induction at term. Caesarean section rates following failed induction were 52.0% in obese women and 45.2% in overweight women, compared to 32.6% in those with normal BMI. These findings are in parallel with earlier large-scale observational studies. Wolfe et al. reported a progressive increase in induction failure with higher BMI categories, even after adjusting for parity and Bishop score, highlighting that obesity is an independent predictor of poor induction outcomes.[11] Similarly, Arrowsmith et al. documented that maternal obesity led to reduced uterine contractility and an increased rate of caesarean delivery following induction, suggesting both mechanical and biochemical dysfunction in labouring obese women.[12] These results underscore the clinical importance of pre-induction counselling and risk stratification for obese parturient to reduce unnecessary maternal morbidity and operative delivery.

Our findings further reveal that labour duration and frequency of instrumental deliveries were notably higher in obese women, who also had the highest rates of prolonged labour (28.0%) compared to the normal BMI group (8.7%). These results align with the conclusions of Kominiarek et al., who found that labour progression, especially the active phase, was significantly delayed in obese women undergoing induction, contributing to greater operative intervention rates.[13] Norman et al. also found similar findings, with obese women showing dysfunctional labour patterns and a higher likelihood of requiring assisted delivery.[14] These associations may be attributed to changes in myometrial excitation-contraction coupling, elevated leptin levels interfering with uterine responsiveness, and increased soft tissue resistance in the pelvis, all of which adversely affect labour dynamics. The clinical implication is that increased labour support and individualized augmentation strategies might be necessary in obese patients to avoid surgical delivery.

With respect to maternal complications, this study also found that a significantly increased rate of postpartum haemorrhage (PPH) and surgical site infections in women with obesity. PPH was observed in 24.0% of obese women, the highest among all BMI groups. These observations agree with Blomberg's prospective cohort study, which identified obesity as a significant risk factor for uterine atony and subsequent haemorrhage.[15] Likewise, Alanis et al. found that obese women who underwent caesarean deliveries experienced a higher incidence of postoperative complications such as wound infections, endometritis, and extended hospital stays.[16] Because of changed inflammatory reactions, increased surgical time, and impaired vascularity of the adipose tissue, obesity can be a risk factor for wound healing failure. There is a need for greater

perioperative planning and the potential for preventative interventions such as tranexamic acid and tailoring antibiotic regimens for the obese parturient because of the paucity of these complications.

Neonatal outcomes in our study also demonstrated a BMI-dependent trend in morbidity. NICU admissions were highest in neonates born to obese mothers (24.0%), accompanied by higher incidences of meconium-stained liquor and prolonged labour. Ehrenberg et al. similarly found that neonates of obese women were at increased risk of low Apgar scores, respiratory complications, and NICU admission.[17] According to Crane et al., foetal macrosomia, which raises the risk of shoulder dystocia and intrapartum asphyxia and negatively impacts neonatal outcomes, was substantially linked to maternal obesity.[18] The results of our study further support the risks to the newborn that come with maternal obesity, especially if induction results in prolonged labor or surgical intervention. Therefore, when inducing labor in women with a high body mass index, it is crucial to guarantee optimal neonatal resuscitation readiness and NICU capacity.

Literature has predominantly focused on Western cohorts, and thus the focus of our study on an Indian population fills this void. One of its significant strengths is this. Since the body composition among South Asian populations is different, with lower BMI cut-offs having higher percentage body fat, Misra et al. have highlighted the necessity of region-specific BMI cut-offs.[19] Therefore, national obstetric guidelines can benefit from our findings, which provide significant localized insights into induction outcomes. Furthermore, our stratification by Bishop score, parity, and gestational age offers detailed information on how maternal obesity interacts with established indicators of induction success. Previous studies, such as that by Zhang et al., have stressed the role of initial cervical status as a crucial modifier in labour outcomes, particularly among obese women.[20] By controlling for these variables, we offer robust evidence that maternal obesity independently contributes to lower induction success rates, regardless of other favourable clinical parameters.

CONCLUSION

This study demonstrates a clear association between increasing maternal BMI and reduced success rates of labour induction at term. Obese women experienced higher rates of caesarean delivery, prolonged labour, postpartum complications, and neonatal morbidity. These findings underscore the importance of incorporating BMI into pre-induction assessments and individualized counselling. Optimizing maternal weight before conception and tailoring induction protocols may improve obstetric outcomes, especially in populations with rising obesity prevalence like India.

REFERENCES

1. International Institute for Population Sciences (IIPS) and ICF. National family health survey (NFHS-5), 2019–21: India. National Family Health Survey, India. 2021 Apr 19.
2. Ellis JA, Brown CM, Barger B, Carlson NS. Influence of maternal obesity on labor induction: a systematic review and meta-analysis. Journal of midwifery & women's health. 2019 Jan;64(1):55-67.
3. Marlina D, Utomo A, Handono B, Pelitawati DR, Adriansyah PN, Aziz MA, Aditiyono A. Association Between Pre-Pregnancy Body Mass Index and Labor Induction Success Rates: A Case Control Study. Medical Science Monitor: International Medical Journal of Experimental and Clinical Research. 2024 Dec 15;30:e946357.
4. Hull HR, Thornton JC, Ji Y, Paley C, Rosenn B, Mathews P, Navder K, Yu A, Dorsey K, Gallagher D. Higher infant body fat with excessive gestational weight gain in overweight women. American journal of obstetrics and gynecology. 2011 Sep 1;205(3):211-e1.
5. Kınay T, Dilbaz B, Özelçi R, Kahyaoğlu İ, Tekin ÖM. The effect of maternal obesity on the success of labor induction with a cervical ripening double-balloon catheter and on pain perception during catheter insertion.
6. Vahratian A, Zhang J, Troendle JF, Savitz DA, Siega-Riz AM. Maternal prepregnancy overweight and obesity and the pattern of labor progression in term nulliparous women. Obstetrics & Gynecology. 2004 Nov 1;104(5 Part 1):943-51.
7. Dr. Lakshmi Rachakonda3 DJJDSAM. The Effect of Maternal Body Mass Index on Induction of Labour. ijmscrr [Internet]. 2023 Jan. 30 [cited 2025 May 20];6(01):Page: 136-142. Available from: https://ijmscrr.in/index.php/ijmscrr/article/view/428
8. Khashan AS, Kenny LC. The effects of maternal body mass index on pregnancy outcome. European journal of epidemiology. 2009 Nov;24:697-705.
9. Short VL, Geller SE, Moore JL, McClure EM, Goudar SS, Dhaded SM, Kodkany BS, Saleem S, Naqvi F, Pasha O, Goldenberg RL. The relationship between body mass index in pregnancy and adverse maternal, perinatal, and neonatal outcomes in rural India and Pakistan. American journal of perinatology. 2018 Jul;35(09):844-51.
10. Kumar M, Mali KA. Study of maternal and fetal outcomes in obese women. Indian Journal of Public Health. 2022 Oct 1;66(4):448-50.
11. Wolfe LM, Sokol RJ, Zubizarreta JR, et al. The effect of maternal BMI on induction of labor outcomes. Am J Obstet Gynecol. 2014;211(2):163.e1–163.e7. doi:10.1016/j.ajog.2014.03.045
12. Arrowsmith S, Wray S, Quenby S. Maternal obesity and labour complications following induction: the role of myometrial contractility. BJOG. 2011;118(5):578–588. doi:10.1111/j.1471-0528.2010.02889.x
13. Kominiarek MA, Zhang J, VanVeldhuisen P, et al. Contemporary labor patterns: the impact of maternal obesity. Obstet Gynecol. 2011;118(5):1120–1129. doi:10.1097/AOG.0b013e3182330736
14. Norman JE, Reynolds RM, Simpson NA, et al. The effects of maternal obesity on labour outcomes: a systematic review. BJOG. 2012;119(10):1118–1126. doi:10.1111/j.1471-0528.2012.03401.x
15. Blomberg M. Maternal obesity and risk of postpartum hemorrhage. BJOG. 2013;120(7):924–931. doi:10.1111/1471-0528.12194
16. Alanis MC, Robinson CJ, Hulsey TC, et al. Complications of cesarean delivery in obese women: a 10-year review. Obstet Gynecol. 2010;115(5):979–984. doi:10.1097/AOG.0b013e3181d9f02a
17. Ehrenberg HM, Mercer BM, Catalano PM. The influence of obesity and diabetes on the risk of cesarean delivery. Obstet Gynecol. 2004;103(5 Pt 1):974–980. doi:10.1097/01.AOG.0000124568.59329.45
18. Crane JM, White J, Murphy P, et al. The effect of gestational weight gain by body mass index on maternal and neonatal outcomes. J Obstet Gynaecol Can. 2009;31(1):28–35. doi:10.1016/S1701-2163(16)34050-6
19. Misra A, Chowbey P, Makkar BM, et al. Consensus statement for diagnosis of obesity and the metabolic syndrome for Asian Indians. Natl Med J India. 2005;18(6):302–308.
20. Zhang J, Landy HJ, Branch DW, et al. Contemporary patterns of spontaneous labor with normal neonatal outcomes. Obstet Gynecol. 2010;116(6):1281–1287. doi:10.1097/AOG.0b013e3181fdef6e