



ORIGINAL ARTICLE

MATERNAL BODY MASS INDEX AS A METABOLIC DETERMINANT OF OBSTETRIC OUTCOMES IN PRIMIGRAVIDA WITH UNENGAGED HEAD AT TERM

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Background: Unengaged foetal head at term in primigravida women is associated with adverse obstetric outcomes. Maternal body mass index (BMI) can also influence labour and delivery. Limited information is available on the relationship between BMI and outcomes in women with unengaged foetal head. The objective of this study was to determine the association of maternal BMI with obstetric and neonatal outcomes among primigravida women with unengaged foetal head at term. **Methods:** This analytical study included 139 primigravida women aged 18–40 years with singleton, vertex pregnancies at 38–41 weeks and unengaged foetal head. Participants were recruited with non-probability consecutive sampling. BMI was categorized as ≤ 25 and > 25 Kg/m². Maternal and neonatal outcomes included caesarean section (CS), postpartum haemorrhage (PPH), foetal distress and low Apgar score. Data were analysed using SPSS-24, and $p < 0.05$ was considered statistically significant. **Results:** Among women with BMI ≤ 25 Kg/m², 44 (47.3%) underwent caesarean section compared with 16 (34.8%) with BMI > 25 Kg/m² ($p = 0.161$). PPH occurred in 11 (11.8%) women with BMI ≤ 25 Kg/m² and 4 (8.7%) with BMI > 25 Kg/m² ($p = 0.575$). Foetal distress occurred in 33 (35.5%) and 10 (21.7%), respectively ($p = 0.099$), while low Apgar score occurred in 4 (4.3%) and 6 (13.0%) respectively ($p = 0.061$). None of these associations was statistically significant. **Conclusion:** Maternal BMI was not significantly associated with caesarean section, PPH, foetal distress or low Apgar score among primigravida women with an unengaged foetal head at term.

Keywords: Body mass index, Caesarean section, Foetal distress, Foetal head engagement, Maternal outcome, Neonatal outcome, Postpartum haemorrhage, PPH, Pregnancy, Primigravida

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INTRODUCTION

Foetal head engagement is an important event in the progress of labour, especially in primigravida women, in whom engagement is traditionally expected at term. At term an unengaged or high foetal head shows the altered foetopelvic adaptation and has been associated with prolonged labour. It then needs augmentation of labour and operative delivery.¹ However, unengaged foetal head alone is not an absolute indication for caesarean delivery. A careful intrapartum assessment is required to determine the appropriate mode of delivery. Previous studies have reported variable rates of deliveries by caesarean section (CS) with maternal and neonatal complications among primigravida women with an unengaged foetal head at term.²

The course and outcome of labour are influenced by maternal nutritional and anthropometric status. Body mass index (BMI) calculated from maternal weight and height, is a simple indicator of nutritional and metabolic status and is widely used to assess maternal adiposity. Increased maternal BMI has been associated with several physiological and obstetric changes,

including altered labour progression, increased need for obstetric intervention and higher rates of caesarean delivery.³ A multicentre cohort study reported a progressive increase in caesarean delivery with increasing maternal BMI, while higher BMI was also associated with increased neonatal complications. Therefore, maternal adiposity influences pregnancy and delivery through metabolic, endocrine and inflammatory mechanisms.⁴ Increased adipose tissue is associated with altered insulin sensitivity, inflammatory signalling and changes in uterine contractility which can contribute to dysfunctional labour and operative delivery. Elevated BMI has also been associated with postpartum haemorrhage (PPH), particularly haemorrhage caused by uterine atony.⁵

The coexistence of an unengaged foetal head and altered maternal BMI can therefore have important clinical implications. Previous research has examined the obstetric consequences of an unengaged foetal head, and independently evaluated the relationship between maternal BMI and pregnancy outcomes.⁶ Limited information is available regarding association of BMI with delivery and neonatal outcomes specifically among

primigravida women presenting with an unengaged foetal head at term. The existing evidence regarding this relationship is also inconsistent, particularly for foetal distress, PPH and low Apgar scores.

This study was conducted to determine the association of maternal BMI with obstetric and neonatal outcomes among primigravida women with an unengaged foetal head at term, with particular emphasis on caesarean delivery, PPH, foetal distress and low Apgar score.

METHODOLOGY

This analytical cross-sectional study was conducted in the Department of Anatomy, CMH Kharian Medical College, in collaboration with Department of Biochemistry, CMH Kharian Hospital, over a period of 6 months from Feb to Jul 2025 after obtaining approval from the Institutional Ethical Review Board Ref. No. CKMC/IERB/AC-00292 dated 3rd Jan 2025.

Written informed consent was obtained from all participants before enrolment. The sample size was calculated by a non-probability consecutive sampling technique, assuming an expected prevalence of 10%, a 5% margin of error and a 95% confidence level, yielding a minimum sample size of 139 participants. The expected prevalence was based on previously reported literature on primigravida women with an unengaged foetal head at term.⁷ Women aged 18–40 years with a singleton pregnancy, vertex presentation and full-term gestation of 38–41 weeks were included. Women with a previous history of abortion, diabetes mellitus, hypertension, foetal growth restriction or malpresentation were excluded.

Maternal demographic characteristics, including age and gestational age, were recorded. Maternal body mass index (BMI) was calculated from weight and height and categorized as ≤ 25 Kg/m² and > 25 Kg/m² for analysis.⁶ Ultrasound examination was performed to confirm gestational age, singleton pregnancy, vertex presentation and the presence of an unengaged foetal head. An unengaged foetal head was defined as 5/5 of the foetal head remaining mobile above the pelvic brim, with the lowermost portion of the head remaining above the pelvic brim.⁸

Participants were followed until delivery. Women with inadequate uterine contractions were augmented with oxytocin when required and the final mode of delivery was determined by the consultant gynaecologist. Maternal and neonatal outcomes included CS, PPH, foetal distress and low Apgar score. Postpartum haemorrhage was defined as blood loss $> 1,000$ mL following CS, or ≥ 500 mL following vaginal delivery within 24 hours.⁹ Foetal distress was defined as an abnormal foetal heart-rate pattern identified by intermittent auscultation or continuous electronic foetal

monitoring.¹⁰ A low Apgar score was defined as an Apgar score < 5 at 5 minutes after birth.¹¹

Data were analysed on SPSS-24. Continuous variables, including age and gestational age, were expressed as Mean $\pm$ SD, whereas categorical variables, including BMI category, mode of delivery, PPH, foetal distress and low Apgar score, were presented as frequencies and percentages. Chi-square test was used to assess associations between BMI categories and obstetric outcomes. Multivariable binary logistic regression analysis was subsequently performed to assess the independent association of BMI category with each obstetric outcome while adjusting for potential confounding variables, including maternal age and gestational age. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were reported. Stratification was performed according to maternal age and gestational age where appropriate. A p -value of ≤ 0.05 was considered statistically significant.

RESULTS

A total of 139 primigravida women with unengaged foetal head at term were included. There were 93 (66.9%) women having BMI ≤ 25 Kg/m², and 46 (33.1%) had BMI > 25 Kg/m². The anthropometric and demographic characteristics of the patients are presented in Table-1.

The mode of delivery (vaginal or caesarean) was not statistically different ($p > 0.05$) (Table-2). Association of maternal BMI with PPH or foetal distress was also not significant ($p > 0.05$) (Table-3).

Overall, adverse maternal and neonatal outcomes were observed in the study population. Maternal BMI was not significantly associated with CS, PPH, foetal distress, or low Apgar score.

Table-1: Demographic and anthropometric characteristics of the study population (n=139)

Variables	Values
Age (Years, Mean $\pm$ SD)	28.45 $\pm$ 2.32
Gestational age (Weeks, Mean $\pm$ SD)	38.82 $\pm$ 0.85
BMI (Kg/m ² , Mean $\pm$ SD)	24.9 $\pm$ 3.6
BMI ≤ 25 Kg/m ²	93 (66.9%)
BMI > 25 Kg/m ²	46 (33.1%)
Age 18–30 Years	120 (86.3%)
Age 31–40 Years	19 (13.7%)

Table-2: Association of maternal BMI with mode of delivery [n (%)]

BMI category	Vaginal delivery	Caesarean section	p
≤ 25 Kg/m ²	49 (52.7)	44 (47.3)	0.161
> 25 Kg/m ²	30 (65.2)	16 (34.8)	
Total	79 (56.8)	60 (43.2)	

Statistical test: Chi-square test

Table-3: Association of maternal BMI with maternal and intrapartum outcomes (n=139) [n (%)]

BMI Kg/m ²	Postpartum haemorrhage n (%)			Foetal distress n (%)		
	Present	No	p	Present	No	p
≤ 25	11 (11.8)	82 (88.2)	0.575	33 (35.5)	60 (64.5)	0.099
> 25	4 (8.7)	42 (91.3)		10 (21.7)	36 (78.3)	
Total	15 (10.8)	124 (89.2)		43 (30.9)	96 (69.1)	

Statistical test: Chi-square test.

Table-4: Stratification of caesarean section, foetal distress and low Apgar score according to maternal age and BMI [n (%)]

Category	Caesarean section	<i>p</i>	Foetal distress	<i>p</i>	Low Apgar score	<i>p</i>
Age (Years)						
18–30	51 (42.5)	0.691	36 (30.0)	0.549	8 (6.7)	0.545
31–40	9 (47.4)		7 (36.8)		2 (10.5)	
BMI (Kg/m ²)						
≤25	44 (47.3)	0.161	33 (35.5)	0.099	4 (4.3)	0.061
>25	16 (34.8)		10 (21.7)		6 (13.0)	

Statistical test: Chi-square test.

Table-5: Multivariable logistic regression analysis of maternal BMI and obstetric and neonatal outcomes

Outcome	aOR	95% CI	p
Caesarean section	0.60	0.29–1.24	0.166
PPH	0.68	0.20–2.29	0.537
Foetal distress	0.50	0.22–1.15	0.102
Low Apgar score	3.36	0.90–12.60	0.073

Statistical test: Multivariable binary logistic regression

DISCUSSION

Foetal head engagement represents the descent of the biparietal diameter through the pelvic inlet and indicates that the foetal head has entered the maternal pelvis. In primigravida women, failure of engagement at term reflects the differences in relationship between foetal head size, foetal position and maternal pelvic dimensions.¹² An unengaged head therefore requires closer assessment during labour because continued failure of descent can affect the progress in labour and the eventual mode of delivery. However, an unengaged head at term does not necessarily indicate pelvic inadequacy or predict caesarean delivery in every woman. Its clinical significance should be considered together with labour progress, foetal position and maternal and foetal conditions.²

This study observed that BMI is not significantly associated with the studied obstetric and neonatal outcomes. The caesarean section rate was comparable with previous studies on primigravida women with an unengaged or high foetal head. Haroon *et al*¹³ reported a similar occurrence of caesarean delivery among term primigravida women with an unengaged foetal head. The relationship between BMI and pregnancy outcome has been demonstrated in larger populations. Khalifa *et al*¹⁴ found that caesarean delivery was more frequent in high maternal BMI. The present study focused specifically on primigravida women with an unengaged foetal head at term, which may explain differences between the findings. The predominance of younger women in the present study is also consistent with previous studies of primigravida women with an unengaged foetal head. Hussain *et al*² reported a relatively young maternal age in their study.

Maternal BMI was not significantly associated with mode of delivery in the present cohort. This finding differs from previous studies, which have generally reported increasing caesarean rates with increasing BMI. Dalbye *et al*¹⁵ reported a significant increase in

caesarean delivery across increasing BMI categories among nulliparous women. The difference between their findings and the present study may be related to the specific selection of women with an unengaged foetal head at term, differences in BMI categorization, sample size, or other clinical factors. The present study was restricted to primigravida women with an unengaged foetal head, which may have influenced the observed relationship between BMI and mode of delivery.

Maternal BMI was not significantly associated with postpartum haemorrhage in the present study. This finding is consistent with the WOMAN-2 study¹⁶, which reported no significant association between maternal BMI and postpartum haemorrhage. Another observational study¹⁷ has reported a higher risk of postpartum haemorrhage among women with higher BMI. These differences may be related to differences in study populations, BMI categories, and mode of delivery. Maternal BMI was not significantly associated with foetal distress in the present study. This finding is consistent with previous evidence showing no significant association between maternal BMI and foetal distress.¹⁸ The findings suggest that maternal BMI was not a significant determinant of postpartum haemorrhage or foetal distress in this specific group of primigravida women with unengaged foetal head.

Low Apgar scores were more frequent among women with BMI >25 Kg/m². However, the differences were not statistically significant. This finding is consistent with previous work¹⁹ showing a higher frequency of low Apgar scores among women with higher BMI. A large population-based study²⁰ of 9 million mother-infant pairs also reported that maternal overweight and obesity were associated with higher odds of a low 5-minute Apgar score. Maternal age was not significantly associated with caesarean section, foetal distress, or low Apgar score in the present study. This differs from a 2023 study²¹ of primigravida women, which reported higher rates of foetal distress and other adverse outcomes among older primigravida women. These differences may be related to variations in study populations and clinical characteristics.

Neither maternal BMI nor age showed a significant association with the studied obstetric and neonatal outcomes in this study. In the multivariable analysis, after adjustment for maternal age and gestational age, maternal BMI was not significantly associated with caesarean section, postpartum haemorrhage, foetal distress, or low Apgar score. These findings are similar to results of Chi-square analysis. Although low Apgar score was more common in women with BMI >25 Kg/m², the difference was not statistically significant. Maternal BMI was not a significant predictor of studied outcomes in this group of primigravida women with unengaged foetal head.

LIMITATIONS & RECOMMENDATIONS

This single-centre study had a relatively small sample size of 139 participants which can limit the generalizability of the findings. Larger multicentre studies are recommended. The broad BMI categorization (≤ 25 and > 25 Kg/m²) can also limit the detection of differences between specific BMI groups. Multivariable analyses are recommended to determine whether BMI independently predicts CS, PPH, foetal distress and low Apgar score. Potential confounding factors such as gestational weight gain and foetal birth weight were not assessed.

CONCLUSION

Among primigravida women with an unengaged foetal head at term, caesarean section, foetal distress and postpartum haemorrhage were relatively common obstetric outcomes. However, maternal BMI was not significantly associated with caesarean section, postpartum haemorrhage, foetal distress or low Apgar score. These findings suggest that, within primigravida women with an unengaged foetal head at term, maternal BMI alone may not be a significant determinant of adverse obstetric or neonatal outcomes.

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