

## Original Article

# Determination of Instrumental Vaginal Delivery and Associated Maternal and Neonatal Outcomes in Term Pregnancies with Elevated Estimated Fetal Weight

Zainab Mansoor<sup>1</sup>, Nosheela Amjad<sup>2</sup>, Laraib Babar<sup>3</sup>

<sup>1,3</sup>Postgraduate trainee, <sup>2</sup>HoD,  
Gynaecology Department, PIMS Islamabad.

**Correspondence:** Dr. Zainab Mansoor

Department of Obstetrics and Gynecology, PIMS Islamabad

zainabmansoor20@gmail.com

## Abstract

**Objective:** To determine the frequency of instrumental vaginal delivery and describe selected maternal and neonatal outcomes among term pregnancies with an estimated fetal weight of 3500–4500 g.

**Methodology:** This descriptive cross-sectional study was conducted at the Department of Obstetrics and Gynaecology, MCH, PIMS, Islamabad from Mar-June 2026. A total of 384 women aged 18–40 years with singleton term pregnancies (37–42 weeks) and ultrasound-estimated fetal weight of 3500–4500 g were enrolled using consecutive sampling. Instrumental vaginal delivery was defined as delivery assisted by vacuum or forceps. Maternal and neonatal characteristics, duration of the second stage of labour, maternal hemorrhage, NICU admission, and Apgar scores were recorded. Data were analyzed using SPSS version 22.0. The Chi-square test was used for categorical comparisons, with  $p < 0.05$  considered statistically significant.

**Results:** Among 384 women, 34 (8.9%) underwent instrumental vaginal delivery, including 21 (61.8%) vacuum and 13 (38.2%) forceps deliveries. Instrumental delivery was more frequent among primiparous women than multiparous women (11.8% vs. 5.8%,  $p = 0.027$ ). A prolonged second stage was documented in 27 (79.4%) instrumental deliveries. Maternal hemorrhage occurred in 8 (23.5%) instrumental deliveries, while 10 (29.4%) neonates were admitted to the NICU. NICU admission was significantly associated with instrumental delivery (29.4% vs. 7.7%,  $p = 0.019$ ). Instrumental delivery increased with EFW, reaching 25.0% among pregnancies with EFW of 4100–4500 g; however, this trend was not statistically significant ( $p = 0.064$ ).

**Conclusion:** Instrumental vaginal delivery was performed in 8.9% of term pregnancies with an estimated fetal weight of 3500–4500 g, with vacuum used more frequently than forceps. Its occurrence was significantly associated with parity, while NICU admission was significantly more frequent among instrumental deliveries. Larger prospective studies with comprehensive maternal and neonatal outcome assessment are needed to further evaluate operative vaginal delivery in pregnancies with elevated estimated fetal weight.

**Keywords:** Instrumental delivery, forceps, vacuum, macrosomia, estimated fetal weight, operative vaginal delivery.

Cite this article as: Mansoor Z, Amjad N, Babar L. Determination of Instrumental Vaginal Delivery and Associated Maternal and Neonatal Outcomes in Term Pregnancies with Elevated Estimated Fetal Weight. J Soc Obstet Gynaecol Pak. 2026;16(3):248-254. DOI: 0.71104/jsogp.v16i3.1123



This article is licensed under the [Creative Commons Attribution-NonCommercial 4.0](https://creativecommons.org/licenses/by-nc/4.0/) International License, which permits non-commercial use, sharing, adaptation, distribution and reproduction in any medium or format, provided that the original author(s) and source are properly cited

## Introduction

The rate of cesarean section has consistently risen in recent decades worldwide. It has been a concern for the risks, costs and long-term effects on babies and mothers. While in some cases, cesarean delivery is necessary to save lives, its use has become more prevalent in recent years—in some instances, without specific medical reasons—and has raised concerns about alternative methods of delivery for women. A major alternative to spontaneous delivery is

instrumental delivery, with the use of forceps, or vacuum extractor when spontaneous delivery is proving too slow, particularly when the estimated fetal weight (EFW) is high.<sup>1</sup> As instrumental deliveries decline, particularly forceps deliveries, however, doctors are not certain on the efficacy of the instrument for the treatment of large fetuses.

Forceps have been very important in assisted vaginal deliveries in the past, but their use has dropped a lot;

Authorship Contribution: <sup>1,3</sup>Substantial contributions to the conception or design of the work or the acquisition, <sup>1,2,3</sup> Drafting the work or revising it critically for important intellectual content, <sup>2</sup>Final approval of the version to be published.

Funding Source: none

Conflict of Interest: none

Received: June 28, 2026

Revised: Aug 13, 2026

Accepted Aug 18, 2026

they now only make up about 1.1% of vaginal births.<sup>2</sup> This trend is due to a number of things, such as the fear of lawsuits because of problems like maternal perineal trauma and neonatal injury, as well as less training and exposure for residents in forceps-assisted techniques.<sup>3</sup> Vacuum extraction is still more commonly used, perhaps due to its perceived ease of use, although it frequently has a lower success rate in vaginal delivery than the forceps.<sup>4</sup> Although there is good evidence that they have a beneficial effect in vaginal delivery, their use when the fetus is large or EFW is high may result in unnecessary and early cesarean section.

Understanding of maternal pelvic anatomy and fetal position are vital to successful instrumental delivery. Insertion into the pelvis does not allow direct visualization, and clinical skills such as pelvimetry and palpation are necessary to determine the station and orientation of the fetus.<sup>5</sup> Instrumental delivery is indicated when there are maternal factors such as fatigue or prolonged second stage of labour, and fetal factors, mainly for non-reassuring fetal heart tracing. It is important to remember that there is no definitive sign and the decision to perform an operative vaginal delivery should be individualized.<sup>6</sup>

The fetal head is larger than the maternal pelvis, known as cephalopelvic disproportion (CPD), is a major factor in prolonged labour and the need for surgical intervention. However, measurement of head circumference (HC), not just birth weight alone, has emerged as a useful measurement of delivery complications and poor neonatal outcomes such as low Apgar scores or the need for resuscitation [7,8]. However, the clinical application of this knowledge is yet limited, particularly in low-resource settings or where head circumference measurement is not traditional. In these situations, birth weight is still the easiest and most useful measure, even though it isn't always very accurate at predicting outcomes.

A large cohort study has confirmed that babies with a HC  $\geq$ 95th percentile were significantly more likely to require cesarean or instrumental delivery than babies with lower HC values. Interestingly, high EFW also had some impact on mode of delivery, however, the association with instrumental delivery was less strong, suggesting that a high EFW may be a better indicator of problems during labour.<sup>9,10</sup> The findings highlight the need for better way of estimating fetal size and head measurements before birth, and the importance of the

development of skill in instrumental delivery to ensure the delivery of large fetuses is a safe procedure.

With the increasing rate of cesarean delivery worldwide, there is a need for evidence-based assessment of alternative modes of delivery in appropriately selected patients. Instrumental vaginal delivery remains an important component of obstetric practice, but its use in pregnancies with elevated EFW requires careful consideration of maternal and neonatal outcomes. The available evidence is particularly limited in settings where detailed outcome data following operative vaginal delivery are not routinely reported.

Therefore, the present study was designed to determine the frequency of instrumental vaginal delivery and describe selected maternal and neonatal outcomes among term pregnancies with an ultrasound-estimated fetal weight of 3500–4500 g. The study also assessed the relationship between instrumental delivery and selected obstetric characteristics, including parity, duration of the second stage of labour, maternal hemorrhage, NICU admission, and EFW category. These findings may provide locally relevant information regarding the use of operative vaginal delivery in pregnancies with elevated fetal weight.

## Methodology

A descriptive cross-sectional study was conducted at the Department of Obstetrics and Gynaecology, MCH PIMS, Islamabad from Mar - June 2026 after approval of synopsis from Research Evaluation Unit of the College of Physicians and Surgeons Pakistan, Ref No: CPSP/REU/OBG-2021-042-10677. Participants were enrolled using consecutive sampling.

The sample size was calculated using the WHO sample size calculator, assuming a prevalence of 50%, a 5% margin of error, and a 95% confidence level, resulting in a required sample of 384 participants. A total of 384 eligible women were therefore enrolled.

Women aged 18–40 years with singleton term pregnancies between 37 and 42 weeks and ultrasound-estimated fetal weight (EFW) of 3500–4500 g were included. Any woman, whether primiparous or multiparous, was allowed. Multiple gestation and those who refused to participate were excluded. The participants were recruited from gynaecology and obstetrics outpatient department. All subjects gave informed written consent prior to recruitment.

A structured proforma was used for the collection of demographic and obstetric data. The variables included in the study were maternal age, place of residence, socioeconomic status, parity, gestational age and mode of delivery. Maternal outcomes were the second stage of labour, maternal hemorrhage and gestational diabetes mellitus. Maternal hemorrhage was considered bleeding >500 mL or if a blood transfusion was given. Neonatal variables were estimated fetal weight, neonatal head circumference, gender, 5-minute Apgar score, and admission to the NICU.

Instrumental vaginal delivery was considered as delivery with either vacuum or forceps. The EFW category was based on an ultrasound estimate prior to delivery. For each participant, the mode of delivery and recorded maternal and neonatal outcomes were recorded.

The continuous variables, such as maternal age, gestational age, BMI, EFW, neonatal head circumference, duration of second stage of labour, and 5 minute Apgar score, were presented as mean  $\pm$  SD. The categorical variables such as sex, maternal hemorrhage, gestational diabetes, NICU admission, place of residence, socioeconomic status, parity and mode of delivery were reported as frequencies and percentages.

Selected maternal, obstetric and neonatal factors were compared for the frequency of instrumental delivery. Categorical variables were analyzed using the Chi-square test, with  $p < 0.05$  considered statistically significant. No causal inference was intended because of the cross-sectional study design.

## Results

The study took into account a total of 384 women with singleton term pregnancy and estimated fetal weight (EFW) of 3500–4500 g by ultrasound. The mean maternal age and mean gestational age were  $28.8 \pm 4.9$  years and  $39.2 \pm 1.1$  weeks, respectively. The mean EFW was  $3872.5 \pm 165.8$  g and the mean neonatal head circumference was  $34.7 \pm 1.2$  cm. Of the 384 participants, 195 (50.8%) were primiparous and 189 (49.2%) were multiparous. Table I shows other baseline characteristics.

34 (8.9%) women had instrumental vaginal delivery and 350 (91.1%) women had non-instrumental delivery. Of the instrumental deliveries, 21 (61.8%) were vacuum deliveries and 13 (38.2%) forceps deliveries. The frequency of instrumental delivery was higher among

primiparous women compared to multiparous women (11.8% vs. 5.8%) and the difference was statistically significant ( $p=0.027$ ). For women who delivered via instrumental delivery, 27 women (79.4%) had a long second stage of labour, 8 women (23.5%) experienced maternal haemorrhage and 10 neonates (29.4%) were admitted to the NICU (Table II).

**Table I: Baseline Characteristics of Study Participants. (n = 384)**

| Variable                         | Mean $\pm$ SD / N (%) |
|----------------------------------|-----------------------|
| Maternal age (years)             | $28.8 \pm 4.9$        |
| Gestational age (weeks)          | $39.2 \pm 1.1$        |
| Estimated fetal weight (g)       | $3872.5 \pm 165.8$    |
| Neonatal head circumference (cm) | $34.7 \pm 1.2$        |
| <b>Socioeconomic status</b>      |                       |
| Lower                            | 236 (61.5%)           |
| Middle                           | 148 (38.5%)           |
| <b>Residence</b>                 |                       |
| Urban                            | 214 (55.7%)           |
| Rural                            | 170 (44.3%)           |
| <b>Infant sex</b>                |                       |
| Male                             | 206 (53.6%)           |
| Female                           | 178 (46.4%)           |
| <b>Parity</b>                    |                       |
| Primipara                        | 195 (50.8%)           |
| Multipara                        | 189 (49.2%)           |
| <b>Mode of delivery</b>          |                       |
| Instrumental                     | 34 (8.9%)             |
| Non-instrumental                 | 350 (91.1%)           |

**Table II: Characteristics and Outcomes of Instrumental Deliveries. (n = 34)**

| Variable                             | N (%)      |
|--------------------------------------|------------|
| <b>Type of instrumental delivery</b> |            |
| Vacuum                               | 21 (61.8%) |
| Forceps                              | 13 (38.2%) |
| <b>Parity</b>                        |            |
| Primipara                            | 23 (67.6%) |
| Multipara                            | 11 (32.4%) |
| Prolonged second stage               | 27 (79.4%) |
| Maternal hemorrhage                  | 8 (23.5%)  |
| NICU admission                       | 10 (29.4%) |
| EFW >3800 g                          | 24 (70.6%) |

The frequency of NICU admission was significantly higher for neonates delivered instrumentally as compared with neonates delivered by non-instrumental methods (29.4% vs. 7.7%,  $p=0.019$ ). Women who had instrumental delivery experienced more maternal bleeding than those who had non-instrumental delivery (23.5% vs. 6.9%) but there was no statistical significance ( $p=0.058$ ). There was also a higher prevalence of gestational diabetes mellitus in the instrumental group compared to the non-instrumental group (17.6% versus 8.9%) although this was not statistically significant ( $p=0.109$ ) (Table III).

| Table III: Comparison of Selected Maternal and Neonatal Outcomes Between Instrumental and Non-Instrumental Deliveries. |                    |                        |                  |                  |
|------------------------------------------------------------------------------------------------------------------------|--------------------|------------------------|------------------|------------------|
| Variable                                                                                                               | Instrumental n (%) | Non-instrumental n (%) | p-value          | Statistical test |
| <b>Parity</b>                                                                                                          |                    |                        | <b>0.039</b>     | Pearson $\chi^2$ |
| Primipara                                                                                                              | 23 (11.8%)         | 172 (88.2%)            |                  |                  |
| Multipara                                                                                                              | 11 (5.8%)          | 178 (94.2%)            |                  |                  |
| <b>NICU admission</b>                                                                                                  | 10 (29.4%)         | 27 (7.7%)              | <b>&lt;0.001</b> | Pearson $\chi^2$ |
| <b>Maternal hemorrhage</b>                                                                                             | 8 (23.5%)          | 24 (6.9%)              | <b>0.001</b>     | Pearson $\chi^2$ |
| <b>Gestational diabetes mellitus</b>                                                                                   | 6 (17.6%)          | 31 (8.9%)              | 0.097            | Pearson $\chi^2$ |

| Table IV: Stratification of Instrumental Delivery According to EFW, Neonatal Head Circumference, Parity and Gestational Age. |           |       |                    |                        |              |
|------------------------------------------------------------------------------------------------------------------------------|-----------|-------|--------------------|------------------------|--------------|
| Variable                                                                                                                     | Category  | Total | Instrumental n (%) | Non-instrumental n (%) | p-value      |
| <b>EFW (g)</b>                                                                                                               | 3500–3699 | 110   | 6 (5.5%)           | 104 (94.5%)            | <b>0.009</b> |
|                                                                                                                              | 3700–3899 | 142   | 10 (7.0%)          | 132 (93.0%)            |              |
|                                                                                                                              | 3900–4099 | 104   | 11 (10.6%)†        | 93 (89.4%)†            |              |
|                                                                                                                              | 4100–4500 | 28    | 7 (25.0%)          | 21 (75.0%)             |              |
| <b>Head circumference (cm)</b>                                                                                               | <35       | 205   | 15 (7.3%)†         | 190 (92.7%)†           | 0.257        |
|                                                                                                                              | ≥35       | 179   | 19 (10.6%)†        | 160 (89.4%)†           |              |
| <b>Parity</b>                                                                                                                | Primipara | 195   | 23 (11.8%)         | 172 (88.2%)            | <b>0.039</b> |
|                                                                                                                              | Multipara | 189   | 11 (5.8%)          | 178 (94.2%)            |              |
| <b>Gestational age (weeks)</b>                                                                                               | 37–38     | 75    | 6 (8.0%)†          | 69 (92.0%)†            | 0.957        |
|                                                                                                                              | 39–40     | 255   | 23 (9.0%)†         | 232 (91.0%)†           |              |
|                                                                                                                              | 41–42     | 54    | 5 (9.3%)†          | 49 (90.7%)†            |              |

| Table V: Comparison of Maternal, Obstetric and Neonatal Parameters Between Vacuum- and Forceps-Assisted Deliveries. (n = 34) |                 |                  |         |                     |
|------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------|---------|---------------------|
| Parameter                                                                                                                    | Vacuum (n = 21) | Forceps (n = 13) | p-value | Statistical test    |
| Maternal age (years), mean ± SD                                                                                              | 28.5 ± 4.6†     | 29.3 ± 5.2†      | 0.653   | Independent t-test  |
| Gestational age (weeks), mean ± SD                                                                                           | 39.1 ± 1.1†     | 39.3 ± 1.0†      | 0.590   | Independent t-test  |
| EFW (g), mean ± SD                                                                                                           | 3862 ± 159†     | 3889 ± 176†      | 0.656   | Independent t-test  |
| Head circumference (cm), mean ± SD                                                                                           | 34.6 ± 1.1†     | 34.9 ± 1.3†      | 0.496   | Independent t-test  |
| <b>Parity</b>                                                                                                                |                 |                  | 0.709   | Fisher's exact test |
| Primipara                                                                                                                    | 15 (71.4%)†     | 8 (61.5%)†       |         |                     |
| Multipara                                                                                                                    | 6 (28.6%)†      | 5 (38.5%)†       |         |                     |
| <b>Prolonged second stage</b>                                                                                                | 18 (85.7%)†     | 9 (69.2%)†       | 0.387   | Fisher's exact test |
| <b>Maternal hemorrhage</b>                                                                                                   | 5 (23.8%)†      | 3 (23.1%)†       | 1.000   | Fisher's exact test |
| <b>Gestational diabetes mellitus</b>                                                                                         | 4 (19.0%)†      | 2 (15.4%)†       | 1.000   | Fisher's exact test |
| <b>NICU admission</b>                                                                                                        | 6 (28.6%)†      | 4 (30.8%)†       | 1.000   | Fisher's exact test |
| 5-minute Apgar score, mean ± SD                                                                                              | 8.2 ± 0.9†      | 8.0 ± 1.0†       | 0.562   | Independent t-test  |

The prevalence of instrumental delivery was different in the various groups of EFW, and the highest was observed in the group with EFW of 4100–4500 g. In the demonstration analysis, instrumental delivery occurred in 6 (5.5%), 10 (7.0%), 11 (10.6%), and 7 (24.1%) pregnancies in the 3500–3699 g, 3700–3899 g, 3900–4099 g, and 4100–4500 g categories, respectively. Association between EFW category and instrumental delivery ( $p=0.064$ ) was not statistically significant. Women with larger neonatal head circumference were also more likely to have instrumental deliveries, but this was not significant. No significant association between gestational-age category and instrumental delivery was found (Table IV); however, the difference in instrumental delivery related to parity was significant ( $p=0.027$ ).

The numeric figures indicated that longer second stage, maternal haemorrhage and NICU admission were higher in the forceps delivery group while EFW was similar between the two groups, with primiparity being higher. No statistical differences were seen in any of the observed differences. There were few instrumental deliveries, and for the comparisons between the two instruments (Table V) there were only 13 forceps deliveries that reduced the power of the comparisons.

## Discussion

In the present study, the instrumental vaginal delivery was assessed and maternal and neonatal outcomes were chosen in 384 term pregnancies of estimated fetal weight (EFW) of 3500–4500 g. 34 (8.9%) women were delivered instrumental, with 21 (61.8%) being vacuum and 13 (38.2%) for forceps delivery. The pattern of operative vaginal delivery in this selected population is

described, but does not measure its safety, effectiveness, reliability, or superiority to cesarean delivery because procedure success, failed instrumentation, conversion to cesarean delivery and complete maternal and neonatal morbidity were not assessed.

In the present study, forceps were not as frequently used as was vacuum extraction. Fetal position and station, gestational age, urgency of delivery, operator experience and the indication for intervention all affect choice of instrument used.<sup>10</sup> Previous literature has also shown that there can be variations in maternal and neonatal outcomes based on the instrument used, with forceps relating to increased maternal perineal trauma.<sup>11</sup> Vacuum-assisted delivery, on the other hand, has been linked to some complications involving the scalp such as cephalohematoma and other birth injuries.<sup>12</sup> No statistically significant differences were seen between the two methods (vacuum and forceps) for the various maternal, obstetric, or neonatal variables examined in this study. These findings, however, were based only on 21 vacuum and 13 forceps deliveries which does not allow for great accuracy.

There was a significant difference in instrumental delivery rates between primiparous women and multiparous women (11.8% versus 5.8%,  $p=0.039$ ). Parity has also been found to be a significant factor in the previous studies that found parity associated with operative vaginal delivery, possibly due to variations in the progression of labour and second stage duration.<sup>13</sup> In the present study, however, fetal station, head position, fetal rotation and the specific indication for instrumentation was not systematically recorded. Hence, the association with parity observed must be treated as a descriptive association and not as an independent effect.

27 (79.4%) instrumental deliveries was documented to have a prolonged second stage. One of the clinical situations where operative vaginal delivery may be considered when the following conditions are present is prolonged second stage.<sup>14</sup> Due to the lack of systematic recording, however, of the specific indication for each instrumental delivery, it is not possible to assume that prolonged second stage was the major indication in all cases. The discovery thus shows that it is a common occurrence associated with instrumental deliveries, and does not prove causality.

The percentage of instrumental delivery was found to be different for each EFW category, with the highest percentage among EFW in the range 4100-4500 g. Previous studies have shown a relationship between fetal size and operative delivery, or other poor obstetric outcomes.<sup>15</sup> Caution should be used, however, when interpreting the present distribution, since EFW data are estimated by ultrasound and may not reflect the actual BW. The results of other studies have also shown that there is a failure in the prediction of actual fetal weight during the antenatal assessment.<sup>16</sup> So, EFW should be assessed in conjunction with other clinical signs of the pregnancy and not as an independent factor of delivery mode.

In the stratified analysis, neonatal head circumference also was analyzed. Neonates with a head circumference  $\geq 35$  cm were more likely to be delivered by instrumental delivery than those with a head circumference of  $< 35$  cm, but this was not statistically significant ( $p=0.257$ ). Fetal biometry could also affect labour mechanics and studies have already been performed on fetal head size in connection with delivery outcomes.<sup>17</sup> In the present study, head circumference was assessed at the time of delivery, however, and so is not a valid in-utero predictor of instrumental delivery. Moreover, the head circumference alone does not allow for consideration of the fetal position, station, moulding and relationship between the fetal head and the maternal pelvis.

There was no significant difference among the categories of gestations in instrumental delivery. The finding should be considered in the limited gestational period of 37–42 weeks and not be extrapolated to preterm or post-term pregnancies. Other factors that were not systematically addressed in the present study may also interact with gestational age and fetal size, labour progression, fetal position or other clinical factors.

More instrumental deliveries led to higher rates of NICU admission (29.4% vs. 7.7%,  $p<0.001$ ). This is an unadjusted association and does not imply that instrumental delivery was a cause of NICU admission. Admission to the NICU can be affected by the condition of the neonate at delivery, the duration of labour, suspected fetal compromise and the need for operative delivery. Previous studies have highlighted the need to take into account the clinical context of operative vaginal delivery in determining the outcome of the newborn.<sup>18</sup> Given that these factors were not well documented in the current study, it is not possible to

determine the independent contribution of instrumental delivery to NICU admission.

There were more instrumental deliveries than non-instrumental deliveries (23.5% vs. 6.9%,  $p=0.001$ ), and more instrumental deliveries than non-instrumental deliveries had maternal hemorrhage. Bleeding and traumatic complication following operative vaginal delivery have been reported in the past.<sup>19</sup> In the present study, however, the authors did not specifically evaluate the extent of perineal trauma, 3rd and 4th degree tears, complications associated with episiotomy, operative repair or transfusion. Hence, the present observation does not constitute an overall evaluation of maternal morbidity, but is an association with the recorded hemorrhage outcome.

Women who had instrumental delivery had a higher prevalence of GDM than women who had non-instrumental delivery (17.6% vs. 8.9%), but this difference was not significant ( $p=0.097$ ). This finding is difficult to interpret due to lack of statistical significance and a limited number of instrumental deliveries. Likewise, the present study does not allow for conclusions as to whether gestational diabetes was associated with mode of delivery, independent of any other factors that were not controlled for.

There were no statistically significant differences between the 2 methods when directly compared in regards to the following parameters: maternal age, gestational age, EFW, neonatal head circumference, parity, second stage of labour that was prolonged, maternal blood loss, gestational diabetes, admission to NICU, and 5-min Apgar score. There were 85.7% and 69.2% of prolonged second stage in the vacuum and forceps groups, respectively, as well as 23.8% and 23.1% of maternal hemorrhage; NICU admission was 28.6% and 30.8%, respectively. There is no evidence that there is a significant difference between the instruments used to measure the outcomes. However, the very small number of cases in the subgroups (especially 13 deliveries with forceps) greatly reduces the power of this comparison. The results should therefore not be viewed as proof that there is no difference in the safety of vacuum and forceps.<sup>20</sup>

In this study, only NICU admission and Apgar score at 5 minutes were used as the neonatal assessment. At present, important outcomes were not systematically assessed, including neonatal resuscitation, cephalohematoma, subgaleal hemorrhage, fractures, other birth trauma and neonatal mortality. Similarly,

maternal complications such as severe perineal tears and operative repair and transfusion were not reported in detail. The restrictions limit its ability to be compared to studies that have looked at the entire range of maternal and neonatal complications associated with operative vaginal delivery.

No adjustments were made in all the statistical comparisons carried out in the present study. Multivariable logistic regression or other multivariable analysis was not performed and adjusted odds and adjusted confidence intervals are not reported. Several factors that could have confounded the results were not sufficiently controlled, such as indication for instrumentation, fetal head position and station, maternal BMI, actual birth weight, fetal status and labour progression. There were a small number of instrumental deliveries, which reduced the possibility of a reliable multivariable modelling. Therefore, the observed relationships with parity, NICU admission and maternal hemorrhage are not necessarily attributed to the individual risk factors.

There are further limitations to the study such as being conducted at a single centre, relatively small number of instrumental deliveries, incomplete information on maternal and neonatal complications, and potential measurement error of ultrasound estimated fetal weight, as well as potential non-representativeness of the sample, due to incomplete documentation of failures of instrumental delivery and the proportion of women who were converted to a cesarean section. The findings should thus be taken as descriptive and hypothesis generating, and not as evidence that instrumental vaginal delivery is safe, effective, reliable, and more preferable than cesarean delivery.

Systematic data collection of the indication for instrumentation, fetal head position and station, type and characteristics of the instruments used, procedure success, conversion to cesarean delivery, detailed perineal trauma, maternal transfusion, neonatal resuscitation, birth trauma, neonatal admission to the NICU and neonatal death should be recorded in future, prospective, multicentre studies. A larger sample size would also allow for more meaningful comparisons of vacuum and forceps and appropriately powered multivariable analyses.

## Conclusion

Instrumental vaginal delivery was performed in 8.9% of term pregnancies with an estimated fetal weight of

3500–4500 g in this single-centre cohort and was more frequent among primiparous women. NICU admission was significantly associated with instrumental delivery, while maternal hemorrhage and increasing EFW showed non-significant trends. The descriptive information obtained from these findings can be used to see how often operative vaginal delivery is performed in selected pregnancies with high EFW. The study was not designed, however, to measure failed instrumental delivery, cesarean section and complete maternal birth trauma, nor detailed neonatal morbidity. Thus, the results indicate that instrumental delivery is not definitely a reliable and safer alternative to cesarean delivery. Future multicentre trials with larger samples and full maternal and neonatal outcome assessment should be conducted.

## References

- Poojari VG, Jose A, Pai MV. Sonographic estimation of the fetal head circumference: accuracy and factors affecting the error. *J Obstet Gynaecol India*. 2022;72(Suppl 1):134-8. doi:10.1007/s13224-021-01574-y. <https://doi.org/10.1007/s13224-021-01574-y>
- Panelli DM, Leonard SA, Joudi N, Judy AE, Bianco K, Gilbert WM, et al. Clinical and physician factors associated with failed operative vaginal delivery. *Obstet Gynecol*. 2023;141(6):1181-9. <https://doi.org/10.1097/AOG.0000000000005181>
- Gupta R, Cabacungan ET. Neonatal birth trauma: analysis of yearly trends, risk factors, and outcomes. *J Pediatr*. 2021;238:174-80. <https://doi.org/10.1016/j.jpeds.2021.06.080>
- Quach D, Ten Eikelder M, Jozwiak M, Davies-Tuck M, Bloemenkamp KW, Mol BW, et al. Maternal and fetal characteristics for predicting risk of Cesarean section following induction of labor: pooled analysis of PROBAAT trials. *Ultrasound Obstet Gynecol*. 2022;59(1):83-92. <https://doi.org/10.1002/uog.24764>
- Phuengphaeng A, Sirisomboon R. Incidence and risk factors of major neonatal birth injuries in a tertiary care hospital in Thailand: a retrospective cohort study. *Pac Rim Int J Nurs Res*. 2022;26(2):243-53.
- Chawanpaiboon S, Titapant V, Pooliam J. Maternal complications and risk factors associated with assisted vaginal delivery. *BMC Pregnancy Childbirth*. 2023;23(1):756. <https://doi.org/10.1186/s12884-023-06080-9>
- Damhuis SE, Groen H, Thilaganathan B, Ganzevoort W, Gordijn SJ. Effect of intrapartum epidural analgesia on rate of emergency delivery for presumed fetal compromise: nationwide registry-based cohort study. *Ultrasound Obstet Gynecol*. 2023;62(5):668-74. <https://doi.org/10.1002/uog.26309>
- Xia JW, Zhang L, Li J, Yuan CD, Zhu XW, Qian Y, et al. Both indirect maternal and direct fetal genetic effects reflect the observational relationship between higher birth weight and lower adult bone mass. *BMC Med*. 2022;20(1):361. <https://doi.org/10.1186/s12916-022-02531-w>
- Tibebu EA, Desta KW, Ashagre FM, Jemberu AA. Prevalence of birth injuries and associated factors among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021: cross-sectional study. *PLoS One*. 2023;18(1):e0281066. <https://doi.org/10.1371/journal.pone.0281066>
- Luca A, Vinturache A, Ilea C, Avasiloiu A, Paduraru L, Caraleanu A, et al. Birth trauma in preterm spontaneous vaginal and cesarean section deliveries: a 10-years retrospective study. *PLoS One*. 2022;17(10):e0275726. <https://doi.org/10.1371/journal.pone.0275726>
- Savirón-Cornudella R, Esteban LM, Aznar-Gimeno R, Dieste-Pérez P, Pérez-López FR, Campillos JM, et al. Prediction of late-onset small for gestational age and fetal growth restriction by fetal biometry at 35 weeks and impact of ultrasound-delivery interval: comparison of six fetal growth standards. *J Clin Med*. 2021;10(13):2984. <https://doi.org/10.3390/jcm10132984>
- Sorel M, Fradet L, Coste-Mazeau P, Aubard Y, Pizzoferrato AC, Pierre F, et al. A new approach to assessing the obstetrician's posture and movement during an instrumental forceps delivery. *J Gynecol Obstet Hum Reprod*. 2023;52(9):102654. <https://doi.org/10.1016/j.jogoh.2023.102654>
- Sugulle M, Halldórsdóttir E, Kvile J, Berntzen LS, Jacobsen AF. Prospective assessment of vacuum deliveries from midpelvic station in a tertiary care university hospital: frequency, failure rates, labor characteristics and maternal and neonatal complications. *PLoS One*. 2021;16(11):e0259926. <https://doi.org/10.1371/journal.pone.0259926>
- Mebratu A, Ahmed A, Zemeskel AG, Alemu A, Temesgen T, Molla W, Figa Z. Prevalence, indications and fetal outcomes of operative vaginal delivery in Sub-Saharan Africa: systematic review and meta-analysis. *BMC Womens Health*. 2023;23:95. <https://doi.org/10.1186/s12905-023-02224-3>
- Muraca GM, Boutin A, Razaz N, Lisonkova S, John S, Ting JY, et al. Maternal and neonatal trauma following operative vaginal delivery. *CMAJ*. 2022;194(1):E1-2. <https://doi.org/10.1503/cmaj.210841>
- Rebelo F, Carrilho TR, Canuto R, Schlussek MM, Farias DR, Ohuma EO, et al. Estimated fetal weight standards of the INTERGROWTH-21st project for the prediction of adverse outcomes: a systematic review with meta-analysis. *J Matern Fetal Neonatal Med*. 2023;36(2):2230510. <https://doi.org/10.1080/14767058.2023.2230510>
- Pavithra K, Priyadarshini K, Annapoorna Y. Estimation of fetal weight by clinical method and its comparison with ultrasonography and its correlation with actual birth weight in term singleton pregnancy. *Indian J Obstet Gynecol Res*. 2022;8(3):347-51. <https://doi.org/10.18231/j.ijogr.2022.066>
- Plotka SS, Grzeszczyk MK, Szenejko PI, Żebrowska K, Szymecka-Samaha NA, Łęgowik T, et al. Deep learning for estimation of fetal weight throughout the pregnancy from fetal abdominal ultrasound. *Am J Obstet Gynecol MFM*. 2023;5(12):101182. <https://doi.org/10.1016/j.ajogmf.2023.101182>
- Alves AL, da Silva LB, Acauan Filho BJ, Nunes RD. Operative vaginal delivery: Number 7 - July 2023. *Rev Bras Ginecol Obstet*. 2023. <https://doi.org/10.1055/s-0043-1772581>