Original Research Article

Success rate of external cephalic version in relation to the woman's body mass index and other factors—a population-based cohort study

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Abstract
Introduction: The aim of this study was to evaluate the impact of women’s body mass index (BMI) on the probability of a successful external cephalic version (ECV).
Material and methods: A retrospective population-based observational study including all women that underwent an ECV in the southeast region of Sweden from January 2014 to December 2019. Data were collected from electronic medical records, Obstetrix, Cerner. The women were divided into BMI categories according to the World Health Organization classification. Women with a BMI below 25 kg/m² formed the reference group. Crude and adjusted odds ratios for unsuccessful ECV in each BMI group were calculated using binary logistic regression. Furthermore, the association between maternal characteristics and clinical and ultrasound variables at the time of the ECV and unsuccessful ECV was evaluated.
Results: A total of 2331 women were included. The overall success rate of ECV was 53.4%. Women with a BMI below 25 kg/m² had a success rate of 51.3% whereas obese women had a success rate of 58.6%. The risk of an unsuccessful ECV among obese women (BMI ≥30 kg/m²) had an OR of 0.74 (95% CI 0.59–0.94) compared with women with a BMI below 25 kg/m². After adjusting for suitable confounding factors, the association was no longer significant. Higher maternal age, multiparity, higher gestational age, posterior placenta position, polyhydramnios and higher estimated weight of the fetus at the ECV significantly decreased the risk of an unsuccessful ECV.
Conclusions: Maternal obesity does not seem to negatively influence the success rate of ECV. This is a finding that may encourage both caregivers and obese pregnant women to consider an ECV and so avoid a planned cesarean section for breech presentation in this group.

Keywords
body mass index, breech presentation, external cephalic version, obesity, population-based

Abbreviations: BMI, body mass index; ECV, external cephalic version.

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1 | INTRODUCTION

Three to four percent of all infants at the time of labor present in the breech position.1 Breech presentation occurs more frequently in nulliparous women and in preterm deliveries.2 Hannah et al showed decades ago that children in a breech presentation that are delivered vaginally are at higher risk for suffering from early perinatal and neonatal mortality and adverse neonatal outcomes compared with children in a breech presentation that are delivered by a planned cesarean section.3 The presentation of the Hannah study virtually eradicated vaginal breech births in many countries. In parallel, the overall cesarean section rate has increased dramatically, the breech position contributing to a considerable number of them.4

External cephalic version (ECV) is the only used method that can turn the fetus to a cephalic presentation. It is a procedure with a low complication rate, with the most common complication being transient abnormalities of the fetal heart rate,5 and some women experience discomfort or pain during the ECV.6 The success rate of ECV varies between 45% and 65% in different studies.7,8

The number of pregnant women that are classified as overweight or obese has increased dramatically. From the end of the 1990s to 2019, the proportion of pregnant overweight or obese women in Sweden increased from 25% to 42%. This pattern is also seen globally, where the number of people suffering from overweight or obesity reaches approximately one-third of the population.9

The ECV procedure has been evaluated in relation to maternal body mass index (BMI) but results are inconsistent and many questions persist. Burgos et al, and recently Jouzova et al, found no difference in the success rate of ECV according to the BMI of the woman; neither did McLaren et al, whose study population comprised women with a previous cesarean section.10–12 In contrast, Ben-Meir et al showed that a BMI over 25 kg/m² was a factor associated with an unsuccessful ECV.13 Chaudary et al, Isakov et al, and Correia Costa et al, found that obese women had a lower probability of a successful ECV.8,14,15 There are not only conflicting results concerning the impact of maternal BMI on the success rate of ECV in the previous literature, but there are also inconsistent data on relevant adjustments related to BMI as the exposure. The majority of the performed studies are based on single-center cohorts, increasing the risk of selection bias. To the best of our knowledge, no previous population-based study has examined the association between maternal BMI and the success of ECVs.

The primary aim of this study was to examine how the BMI of the woman affects the possibility for a successful ECV. Overweight and obese women were compared with underweight and normal weight women to determine the probability of a successful ECV. Second, conceivable associations between maternal characteristics, clinical and ultrasound variables at the time of the ECV, and the result of the ECV were evaluated.

2 | MATERIAL AND METHODS

This retrospective population-based observational cohort study included women who underwent an ECV in the southeast region of Sweden between January 2014 and December 2019. All seven hospitals in the southeast region of Sweden contributed with their ECVs. If a woman underwent more than one ECV attempt, only the first procedure was included in the analysis. Maternal characteristics and information on the ECV were obtained from electronic medical records (Obstetrix, Cerner®). The variables extracted were successful ECV yes/no, maternal height and weight in early pregnancy, age, parity, gestational age by the time of the ECV, medication at the time of the ECV, placenta position and position of the fetal head in relation to the woman before the procedure, the time required for the procedure, and finally the hospital where the ECV was performed.

Clinical and ultrasound variables at the time of the ECV were manually extracted from the ultrasound chart in the electronic medical records. The ultrasound scan was performed by a sonographer on the same day as the ECV or, in a few cases, the day before.

The amount of amniotic fluid was measured and presented either as the single deepest pocket or the amniotic fluid index. To determine the single deepest pocket, the greatest depth of amniotic fluid was measured in centimeters. Oligohydramnios was considered if the single deepest pocket was less than 2 cm and polyhydramnios if the single deepest pocket was more than 8 cm. The amniotic fluid index was calculated by dividing the uterus into four quadrants and then adding the four greatest depths of amniotic fluid in centimeters from these quadrants. An amniotic fluid index below 5 cm was considered as oligohydramnios, and an amniotic fluid index above 25 cm was considered as polyhydramnios. In the analysis, the amount of amniotic fluid was then reported as oligohydramnios, normal amount of amniotic fluid or polyhydramnios. Fetal weight was also estimated at the ultrasound at the time of the ECV and was stated in grams.

The gestational age at the ECV was calculated backwards from the estimated date of birth. BMI was calculated from the measured weight and the mainly self-reported height of the woman at the maternity care center in the first trimester. BMI was calculated by dividing the weight in kilograms by the height in meters squared. The World Health Organization classification of BMI was used to divide the study population into different groups. BMI under 18.5 kg/m² was classified as underweight, BMI 18.5–24.9 kg/m² was normal weight, and BMI 25–29.9 kg/m² was classified as overweight. BMI above 30 kg/m² was classified as obesity, which was further divided into classes I–III. Obesity class I corresponds to a BMI between 30 and 34.9 kg/m², obesity class II to a BMI between 35–39.9 kg/m² and obesity class III to a BMI above 40 kg/m². Furthermore, the time
required to perform the ECV procedure was calculated from the start time to the end time in minutes.

All women in the southeast region of Sweden with a fetus in the breech presentation were booked for an ECV from gestational week 36 of their pregnancy. The ECV was performed according to common guidelines in the region. At admission to the maternity ward, the well-being of the fetus was assessed by cardiotocography lasting 30 minutes. If the cardiotocography was classified as normal the woman received an infusion or injection of terbutaline intravenously. After approximately 1 minute the obstetrician began the version. The operator provided pressure through the abdominal wall of the woman to convert the fetus into cephalic presentation. The fetus was monitored with cardiotocography and the version was discontinued if there were difficulties performing the procedure, if the fetal heart rate was deviating from normal, or if the mother experienced severe pain. After the procedure, successful or not, a 30-minute cardiotocography trace was run. Contraindications to ECV were multiple pregnancy, water discharge, pathological cardiotocography, or vaginal bleeding in the past 7 days.

2.1 | Statistical analyses

All statistical analyses were performed using SPSS Statistical package, version 25 (IBM Inc.). Categorical variables were analyzed using a chi-squared test. Fisher’s exact test was used to analyze the amount of amniotic fluid and medication at the time of the ECV. Statistical significance was defined as a p-value less than 0.05. The odds ratio was calculated with a 95% CI by binary logistic regression. Underweight and normal weight women were combined to create a reference group because of low numbers of underweight women. Two models for adjustment were used. Model 1 included age, parity, and gestational age. In model 2, the placenta position and the position of the fetal head at the time of the ECV were added to model 1.

2.2 | Ethical approval

Ethical approval for this study was given by the Regional Ethics Review Board, Stockholm, Sweden (Dnr: 2020–01763) on May 27, 2020.

3 | RESULTS

A total of 2734 ECVs were performed in the southeast region of Sweden from January 2014 to December 2019. Of these attempts, 403 (14.7%) were excluded because of being a second or sometimes third try at the procedure. The final number of ECVs included in this study was 2331. A flow chart of the study population is presented in Figure 1. The exact number of women declining ECV per year was impossible to extract from the medical record system, although lead obstetricians at the included units report that fewer than five women per year decline the procedure after being given relevant information. There was a missing BMI for 88 (3.8%) of the women. A total number of 1411/2331 (61%) women underwent an ultrasound scan at the time of the ECV.

The percentage of women classified as underweight was 1.7%, 51.9% were normal weight, 26.8% were overweight, 10.4% of the women were categorized as obesity class I, 4.2% were categorized as obesity class II, and 1.2% were categorized as obesity class III. In the entire study population, the success rate of ECV was 53.4%.

The characteristics of the study population are shown in Table 1. Women with a successful ECV were slightly older and more often multiparous than women with unsuccessful ECV. From gestational week 38 onwards the number of successful ECVs exceeded the number of unsuccessful ones. Women with an anterior placenta underwent a successful version in 47.2% of cases, whereas women with a posterior placenta had a success rate of 57.7%. The position of the fetal head in relation to the woman’s body before the ECV also influenced the result; when the head was positioned in the right arcus the ECV had a success rate of 48.1% whereas if the head was positioned in the left side a successful version was accomplished in 82.9% of the cases. The success rate of ECV also differed significantly among the hospitals in the region (p = 0.01).

Underweight and normal weight women had a success rate of 51.3% whereas women with obesity class I had a success rate of 60.1%. When combined into one group, women with a BMI of 30 kg/m² or more had a success rate of 58.7% and a decreased risk of unsuccessful ECV (OR 0.754, 95% CI 0.59–0.94) (Table 2). When adjusting for age, parity, gestational week, position of the head before the ECV, and placenta position, there was no longer a difference in success rate between obese women (BMI ≥30 kg/m²) and women with BMI below 25 kg/m². Women in obesity class I had a lower risk of a failed ECV attempt compared with the underweight and normal weight women (OR 0.70, 95% CI 0.53–0.93). There was no difference in the success rate of ECV in obesity classes II and III compared with women with BMI between 25–30 kg/m².
### TABLE 1 Baseline characteristics of the study population

|                                | Total, n (%) | Successful ECV, n (%) | Unsuccessful ECV, n (%) | \(p\) value |
|--------------------------------|--------------|-----------------------|-------------------------|-------------|
| **Total**                      | 2331         | 1245 (53.4)           | 1086 (46.6)             | <0.001      |
| **Age categories (years)**     |              |                       |                         |             |
| \(\leq 24\)                   | 260 (11.3)   | 113 (9.2)             | 147 (13.7)              |             |
| 25–29                          | 753 (32.7)   | 333 (27.1)            | 420 (39.0)              |             |
| 30–34                          | 787 (34.1)   | 454 (36.9)            | 333 (30.9)              |             |
| 35–39                          | 389 (16.9)   | 244 (19.9)            | 145 (13.5)              |             |
| \(\geq 40\)                   | 116 (5.0)    | 85 (6.9)              | 31 (2.9)                |             |
| **Parity**                     |              |                       |                         | <0.001      |
| Nulliparity                    | 1084 (47.7)  | 383 (31.4)            | 701 (66.6)              |             |
| Multiparity                    | 1187 (52.3)  | 835 (68.6)            | 352 (33.4)              |             |
| **Gestational age (weeks)**    |              |                       |                         | <0.001      |
| \(\leq 35\)                   | 18 (0.8)     | 6 (0.5)               | 12 (1.1)                |             |
| 36                             | 535 (23.2)   | 249 (20.2)            | 286 (26.5)              |             |
| 37                             | 1155 (50.0)  | 578 (47.0)            | 577 (53.3)              |             |
| 38                             | 307 (13.3)   | 201 (16.3)            | 106 (9.8)               |             |
| 39                             | 163 (7.1)    | 114 (9.3)             | 49 (4.5)                |             |
| 40                             | 69 (3.0)     | 45 (3.7)              | 24 (2.2)                |             |
| \(\geq 41\)                   | 62 (2.7)     | 37 (3.0)              | 25 (2.3)                |             |
| **Placenta position**          |              |                       |                         | <0.001      |
| Fundus                         | 312 (16.0)   | 154 (15.3)            | 158 (16.8)              |             |
| Posterior                      | 789 (40.5)   | 455 (45.1)            | 334 (35.5)              |             |
| Anterior                       | 848 (43.5)   | 400 (39.6)            | 448 (47.7)              |             |
| **Position of the head before the ECV** |          |                       |                         | <0.001      |
| Right arcus                    | 1384 (61.4)  | 666 (54.9)            | 718 (69.0)              |             |
| Right side                     | 133 (5.9)    | 110 (9.1)             | 23 (2.2)                |             |
| Left arcus                     | 643 (28.5)   | 359 (29.6)            | 284 (27.3)              |             |
| Left side                      | 94 (4.2)     | 78 (6.4)              | 16 (1.5)                |             |
| **Medication at ECV (Terbutaline)** |          |                       |                         | 0.051       |
| 0.5 mg/9 mL NaCl               | 900 (43.0)   | 494 (44.7)            | 406 (41.1)              |             |
| 0.5 ml iv                      | 686 (32.8)   | 366 (33.2)            | 320 (32.4)              |             |
| 0.25 mg iv                     | 479 (22.9)   | 235 (21.3)            | 244 (24.7)              |             |
| 0.5 mg/100 mL glucose          | 20 (1.0)     | 7 (0.6)               | 13 (1.3)                |             |
| 2.5 mg/500 mL 5% glucose 60 mL/h| 3 (0.1)     | 2 (0.2)               | 1 (0.1)                 |             |
| 5 mg/500 mL 5% glucose 60 mL/h | 3 (0.1)     | 0                     | 3 (0.3)                 |             |
| **Time required to perform the ECV (minutes)** | | | | <0.001 |
| 1–10                           | 1395 (77.0)  | 876 (88.6)            | 519 (62.7)              |             |
| 11–20                          | 416 (23.0)   | 113 (11.4)            | 303 (37.3)              |             |
| **Hospitals**                  |              |                       |                         | 0.010       |
| 1 and 2                        | 1007 (43.2)  | 555 (55.1)            | 452 (44.9)              |             |
| 3                              | 421 (18.1)   | 239 (56.8)            | 182 (43.2)              |             |
| 4                              | 247 (10.6)   | 129 (52.2)            | 118 (47.8)              |             |
| 5                              | 151 (6.5)    | 70 (46.4)             | 81 (53.6)               |             |
| 6                              | 191 (8.2)    | 109 (57.1)            | 82 (42.9)               |             |
| 7                              | 314 (13.5)   | 143 (45.5)            | 171 (54.5)              |             |

Abbreviation: ECV, external cephalic version; iv, intravenous.

Values of \(p\) were calculated using the chi-squared test. \(p < 0.05\) was considered significant.

*Row percentages.*
below 25 kg/m², but the numbers were low and should be interpreted with caution.

As shown in Table 3, the risk of an unsuccessful ECV decreased with a higher age. The ECV was more successful if the mother had a posterior placenta. The success rate was lowest if the head of the fetus was positioned in the right arcus, compared with a head position in the left arcus, right side or left side. The time required to perform the ECV was higher for unsuccessful ECVs than for successful procedures.

A total number of 1411/2331 (61%) women received an ultrasound scan at the time of the ECV. The amount of amniotic fluid and the estimated weight of the fetus influenced the result of the version (Table 4). The larger the size of the infant at the time of the ECV the less the risk of an unsuccessful ECV. Oligohydramnios significantly reduced the possibility of a successful ECV and accordingly when polyhydramnios was present, the probability of a successful ECV increased.

### 4 | DISCUSSION

This population-based cohort study was performed in a context where nearly 100% of the women with diagnosed breech position in gestational week 36 later underwent an ECV. Women with obesity (BMI ≥30 kg/m²) had a higher probability of a successful ECV compared with underweight and normal weight women. This association was no longer statistically significant when taking maternal age, parity, placenta location, and position of the head before the ECV into account. The same pattern was seen in women in obesity class I.

Contrary to the present findings, previous studies have shown that the probability of a successful version is either lower for overweight or obese women, or that the BMI of the women does not contribute to the result of the version. Burgos et al found no difference in success rate based on the BMI of the woman in a Spanish cohort including 500 ECVs from a single center. In that study, the BMI of the woman was measured the same day as the version was performed, unlike the present study where the BMI of the woman was determined at the maternity care center in the first trimester. McLaren et al studied a subgroup of women with previous cesarean section and found no correlation between maternal BMI and the outcome of the version. They obtained data from the US Natality Database (generated from birth certificates) from 2014 to 2017. According to the flowchart they identified 1.6 million women with a scar and ended up analyzing 2329 ECVs, which might indicate that an absolute majority of women with breech presentation had a repeat cesarean delivery. Recently, a single-center study from the Czech Republic including 981 ECVs did not show a significant impact of BMI on the success rate of the ECV. Chaudhary et al performed a large cross-sectional study, also based on birth certificates, from the population of all live births in the USA from 2010 to 2014, evaluating just over 51 000 ECVs. They found that obese women had a lower probability of a successful version compared with normal weight women, and that the success rate of the version decreased as the maternal BMI increased. Even after adjusting for diabetes, infant birthweight at the time of delivery, gestational age, and newborn gender, the association persisted. Data on parity were not available in that study and could not be adjusted for. Similar results were presented from two small single-center studies performed in Israel and Portugal, including 250 and 324 ECVs, respectively. Conflicting results, concerning the impact of BMI on success rate of ECV, could to some extent be due to different study designs, selection of ECVs performed, small sample sizes, and single-center specific procedures.

Besides maternal BMI, other factors of importance in relation to the success rate of ECV have been evaluated. Hellström et al analyzed which factors had the largest impact on the success rate of ECV and found that parity, fetal presentation, and the amount of amniotic fluid greatly influenced the result of the procedure. Nulliparity has also been shown to be associated with a lower success rate of ECV in nulliparous women was 34.1%, so even with a factor strongly associated with an unsuccessful version more than one-third of nulliparous women would benefit from the procedure and so avoid planned cesarean section.

Polyhydramnios has been presented as one of the most important factors for a successful ECV, which is in accordance with findings...
of the present study. The estimated weight of the fetus at the time of ECV was presented in the study that Burgos et al performed as a factor that does not influence the success of ECV. Rijnders et al stated the opposite and showed that a higher estimated weight of the fetus had a positive effect on the result of the version. In the present study a dose–response pattern was found between increasing fetal weight at the time of the ECV and increasing odds of a successful ECV. Burgos et al found no association between gestational age and success rate of the ECV. This does not correspond to our results, where a gestational duration of 38 weeks or more was significantly

| Total, n (%) | Successful ECV, n (%) | Unsuccessful ECV, n (%) | OR (95% CI) |
|-------------|----------------------|------------------------|-------------|
| Age categories (years) | | | |
| ≤24 | 260 (11.3) | 113 (9.2) | 147 (13.7) | Reference |
| 25–29 | 753 (32.7) | 333 (27.1) | 420 (39.0) | 0.97 (0.73–1.29) |
| 30–34 | 787 (34.1) | 454 (36.9) | 333 (30.9) | 0.56 (0.43–0.75) |
| 35–39 | 389 (16.9) | 244 (19.9) | 145 (13.5) | 0.46 (0.33–0.63) |
| ≥40 | 116 (5.0) | 85 (6.9) | 31 (2.9) | 0.28 (0.17–0.45) |
| Parity | | | |
| Nulliparity | 1084 (47.7) | 383 (31.4) | 701 (66.6) | Reference |
| Multiparity | 1187 (52.3) | 835 (68.6) | 352 (33.4) | 0.23 (0.19–0.28) |
| Gestational age (weeks) | | | |
| ≤35 | 18 (0.8) | 6 (0.5) | 12 (1.1) | Reference |
| 36 | 535 (23.2) | 249 (20.2) | 286 (26.5) | 0.57 (0.21–1.55) |
| 37 | 1155 (50.0) | 578 (47.0) | 577 (53.3) | 0.50 (0.19–1.34) |
| 38 | 307 (13.3) | 201 (16.3) | 106 (9.8) | 0.26 (0.10–0.72) |
| 39 | 163 (7.1) | 114 (9.3) | 49 (4.5) | 0.22 (0.08–0.61) |
| 40 | 69 (3.0) | 45 (3.7) | 24 (2.2) | 0.27 (0.09–0.80) |
| ≥41 | 62 (2.7) | 37 (3.0) | 25 (2.3) | 0.34 (0.11–1.02) |
| Placenta position | | | |
| Fundus | 312 (16.0) | 154 (15.3) | 158 (16.8) | Reference |
| Anterior | 789 (40.5) | 455 (45.1) | 334 (35.5) | 1.09 (0.84–1.42) |
| Posterior | 848 (43.5) | 400 (39.6) | 448 (47.7) | 0.72 (0.55–0.93) |
| Position of the fetal head before the ECV | | | |
| Right arcus | 1384 (61.4) | 666 (54.9) | 718 (69.0) | Reference |
| Right side | 133 (5.9) | 110 (9.1) | 23 (2.2) | 0.19 (0.12–0.31) |
| Left arcus | 643 (28.5) | 359 (29.6) | 284 (27.3) | 0.73 (0.61–0.89) |
| Left side | 94 (4.2) | 78 (6.4) | 16 (1.5) | 0.19 (0.11–0.33) |
| Time required to perform the ECV (minutes) | | | |
| 1–10 | 1395 (77.0) | 876 (88.6) | 519 (62.7) | Reference |
| 11–20 | 416 (23.0) | 113 (11.4) | 303 (37.3) | 4.62 (3.63–5.86) |
| Hospitals | | | |
| 1 and 2 | 1007 (43.2) | 555 (55.1) | 452 (44.9) | Reference |
| 3 | 421 (18.1) | 239 (56.8) | 182 (43.2) | 0.94 (0.74–1.18) |
| 4 | 247 (10.6) | 129 (52.2) | 118 (47.8) | 1.12 (0.85–1.48) |
| 5 | 151 (6.5) | 70 (46.4) | 81 (53.6) | 1.42 (1.01–2.00) |
| 6 | 191 (8.2) | 109 (57.1) | 82 (42.9) | 0.92 (0.68–1.26) |
| 7 | 314 (13.5) | 143 (45.5) | 171 (54.5) | 1.47 (1.14–1.90) |

Abbreviations: ECV, external cephalic version; OR, odds ratio.
TABLE 4 Factors associated with an unsuccessful ECV among women with an ultrasound scan performed at the time of the ECV (n = 1411)

| Amount of amniotic fluid       | Total, n (%) | Successful ECV, n (%) | Unsuccessful ECV, n (%) | OR (95% CI) |
|--------------------------------|--------------|-----------------------|-------------------------|-------------|
| Normal amount                  | 1366 (96.8)  | 730 (96.6)            | 636 (97.0)              | Reference   |
| Oligohydramnios                | 19 (1.3)     | 4 (0.5)               | 15 (2.3)                | 4.32 (1.42–13.05) |
| Polyhydramnios                 | 26 (1.8)     | 21 (2.8)              | 5 (0.8)                 | 0.27 (0.10–0.73) |

| Estimated weight of the fetus at the ECV (stated in grams) | Total, n (%) | Successful ECV, n (%) | Unsuccessful ECV, n (%) | OR (95% CI) |
|-------------------------------------------------------------|--------------|-----------------------|-------------------------|-------------|
| ≤2499                                                        | 275 (20.7)   | 103 (14.4)            | 172 (28.1)              | Reference   |
| 2500–2999                                                    | 644 (48.4)   | 343 (47.8)            | 301 (49.1)              | 0.53 (0.39–0.70) |
| 3000–3499                                                    | 307 (23.1)   | 195 (27.2)            | 112 (18.3)              | 0.34 (0.25–0.48) |
| ≥3500                                                        | 104 (7.8)    | 76 (10.6)             | 28 (4.6)                | 0.22 (0.13–0.36) |

Abbreviations: ECV, external cephalic version; OR, odds ratio.

associated with a more successful version. One might speculate that a longer gestation and a larger fetus facilitates palpation of the different parts of the fetus during the version and thereby the success rate of the procedure.17

The position of the fetal head in relation to the woman before the ECV certainly influenced the success rate. If the head was positioned under the right arcus the success rate was strikingly lower compared with if the head was positioned in the left arcus. This finding has, to our knowledge, not been presented before. A putative explanation could be that the position of the fetal head decides the obstetrician’s choice of side to perform the ECV (left or right side of the woman), which might affect the success rate.

The use of terbutaline varies in different studies. Melo et al used 0.25 mg salbutamol intravenously only in the cases where the ECV failed on the first attempt.19 In previous studies, tocolysis has improved the success rate of ECV.20,21 The women in our study were given terbutaline before each ECV attempt and neither the dosage (0.25 versus 0.50 mg) nor the method of administration (diluted or not) differed between successful and unsuccessful ECVs. No studies were found that examined whether the effect of terbutaline differed depending on the BMI of the woman. However, a meta-analysis concluded that a relaxed uterus was related to a successful ECV.22

In Sweden, very few women with a breech fetus who are offered an ECV do not go through with the procedure. That is a huge difference from other countries such as the USA and Australia, where only 10.5% of women underwent an ECV, 22.3% of women had contraindications and were not offered the procedure, and 67.2% of women with a breech fetus were suitable for an ECV but chose not to attempt the procedure.23

A major strength is the population-based design, including all ECVs in the southeast of Sweden between 2014 and 2019. The low risk of selection bias strengthens our results and might explain our contrasting findings—that obesity may be beneficial in terms of a successful version, or at least not a negative factor. Another strength is that we excluded repeated attempts at ECV. The generalizability to similar populations is probably high. The ability to combine high coverage, a large sample size, and detailed information on each ECV is certainly a strength. The large number of participants made it possible to divide the women into all three sub-classifications of obesity. Furthermore, BMI was available for 96.3% of the women included in the study, again reducing the risk for selection bias. Despite the large sample size, few women were in obesity classes II and III; therefore, results concerning these two groups should be interpreted with caution. The study also has several limitations to be acknowledged. Data were extracted from electronic medical records and notes and observations were performed by a great number of different operators. However, all data were prospectively collected and documented in relation to the outcome of the ECV. Another shortcoming is the lack of information regarding the experience of the operator at the ECV. Years of experience could be a factor that has an impact on the probability of a successful ECV. Other information that would have been valuable to compare between the BMI groups is how the women experienced the ECV. Pain scores might differ according to women’s BMI. However, lack of this information does not affect the current results. Underweight and normal weight women were combined into one category because of the low number of study participants with underweight included in the study. The probability of a successful ECV might differ between underweight women and normal weight women.

5 | CONCLUSION

Maternal obesity does not seem to negatively influence the success rate of ECV. This is a finding that could encourage care givers, operators, and obese pregnant women to consider an ECV and so in a majority of cases (almost 60%) avoid a planned cesarean section for breech presentation. Although, it has previously been presented that the success rate of ECV is lower in overweight or obese women, our study suggests that, after having taken several important confounding factors into account, the success rate of an ECV does not statistically differ between the BMI categories.
CONFLICTS OF INTEREST

None.

AUTHOR CONTRIBUTION

ES, MN, and MB designed the study. ES, DA, MN, SN, and MB extracted data from the medical records. ES and MB conducted the statistical analyses. ES, MN, DA, SN, and MB contributed to the analysis and interpretation of data for the work. ES and MB wrote the manuscript. DA critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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