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SYSTEMATIC REVIEW

Vacuum extraction or caesarean section in the second stage of labour: A systematic review

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Abstract

Background: Prolonged second stage of labour is an important cause of maternal and perinatal morbidity and mortality. Vacuum extraction (VE) and second-stage caesarean section (SSCS) are the most commonly performed obstetric interventions, but the procedure chosen varies widely globally.

Objectives: To compare maternal and perinatal morbidity, mortality and other adverse outcomes after VE versus SSCS.

Search Strategy: A systematic search was conducted in PubMed, Cochrane and EMBASE. Studies were critically appraised using the Newcastle–Ottawa scale.

Selection Criteria: All artictles including women in second stage of labour, giving birth by vacuum extraction or cesarean section and registering at least one perinatal or maternal outcome were selected.

Data Collection and Analysis: The chi-square test, Fisher exact's test and binary logistic regression were used and various adverse outcome scores were calculated to evaluate maternal and perinatal outcomes.

Main Results: Fifteen articles were included, providing the outcomes for a total of 20 051 births by SSCS and 32 823 births by VE. All five maternal deaths resulted from complications of anaesthesia during SSCS. In total, 133 perinatal deaths occurred in all studies combined: 92/20 051 (0.45%) in the SSCS group and 41/32 823 (0.12%) in the VE group. In studies with more than one perinatal death, both conducted in low-resource settings, more perinatal deaths occurred during the decision-to-birth interval in the SSCS group than in the VE group (5.5% vs 1.4%, OR 4.00, 95% CI 1.17–13.70; 11% vs 8.4%, OR 1.39, 95% CI 0.85–2.26). All other adverse maternal and perinatal outcomes showed no statistically significant differences.

Conclusions: Vacuum extraction should be the recommended mode of birth, both in high-income countries and in low- and middle-income countries, to prevent unnecessary SSCS and to reduce perinatal and maternal deaths when safe anaesthesia and surgery is not immediately available.

KEYWORDS
caesarean section, maternal, morbidity, mortality, neonatal, operative vaginal delivery, perinatal, vacuum extraction

1 | INTRODUCTION

Maternal and perinatal mortality remain important global health challenges. The global maternal mortality ratio was 211/100 000 live births in 2017,[1] and the global perinatal mortality rate was 18.6/1000 births in 2015.[2] Most maternal and perinatal deaths occur in low- and middle-income countries (LMICs).[1–5] When complications occur during the second stage of labour, including a prolonged second stage, maternal exhaustion or fetal distress, physicians have two options to expedite birth: caesarean section or assisted vaginal birth. According to the guidelines of the International Federation of Gynaecology and Obstetrics (FIGO),[6] the National Institute for Health and Care Excellence (NICE),[7] and the American College of Obstetricians and Gynecologists (ACOG),[8] assisted vaginal birth is the first choice for shortening the second stage of labour, when the fetal head has descended in the maternal pelvis to at least the level of the ischial spines (station 0). Vacuum extraction (VE) is one of the key signal functions in both basic and comprehensive emergency obstetric care worldwide. It is acknowledged as safe and relatively easy to perform and is less often complicated by anal sphincter injuries compared with forceps extraction.[9] Therefore, in many countries VE is preferred over forceps-assisted birth.[10–12]

Despite the guidelines, VE is rarely used in many countries around the globe and instead, second-stage caesarean section is performed. The global rate of assisted vaginal birth in hospitals is 2.6% and continues to decrease.[13–16] In sub-Saharan Africa, the proportion of institutional births by VE or forceps extraction is even below 1% of all births.[17] Although several explanations for this low proportion have been suggested, fear of neonatal complications is identified as the most important reason.[17] Other reasons for low rates of assisted vaginal birth include a lack of equipment, a lack of trained personnel and a fear of mother-to-child transmission of HIV or other infectious diseases.[17]

Second-stage caesarean section (SSCS) is associated with adverse outcomes such as postpartum haemorrhage (PPH), infection and sepsis, a need for hysterectomy or admission to an intensive care unit.[18–20] Risks of caesarean section extend into every subsequent pregnancy and include uterine rupture, placenta accreta spectrum, PPH and preterm birth.[21–23] Notwithstanding these risks, the caesarean section rate is rising rapidly worldwide and has even doubled in two decades.[23,24] This drives the need for an assessment of maternal and perinatal outcomes of SSCS and VE in both high-income and LMIC settings.

We aimed to compare all available adverse maternal outcomes (mortality, PPH, urogenital tract injury, infection, uterine rupture, wound complication, re-operation and duration of hospital stay) and perinatal outcomes (mortality, low Apgar score, admission to a neonatal intensive care unit (NICU), hypoxic ischaemic encephalopathy (HIE), infection and birth trauma) of VE and SSCS, to provide an evidence-based recommended mode of birth when a shortening of the second stage is indicated.

2 | METHODS

2.1 | Protocol and registration

The study protocol was registered in the PROSPERO database: CRD42020156204. This review was conducted in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement.[25]

2.2 | Search strategy

A comprehensive systematic search was conducted in PubMed, Cochrane and EMBASE for all studies comparing VE with SSCS. The search was conducted on 10 April 2022. The search strategy was developed with the support of the librarian at the University Medical Center Utrecht. When applicable, predefined search (title/abstract) and Medical Subject Headings (MeSH)/Emtree terms were used. No limits were applied to the searches. The full search strategy is provided in Appendix S1. After the removal of duplicates, all publications were screened on title and abstract by two independent reviewers (ST and AB) using Rayyan (https://rayyan.qcri.org). Disagreements were resolved by a third reviewer (MJR). Full-text publications were selected based on predetermined inclusion and exclusion criteria (Appendix S1). The reference lists of key publications were checked to search for relevant additional publications.

2.3 | Critical appraisal

The critical appraisal was based on the Newcastle–Ottawa scale (NOS) for assessing the quality of non-randomised studies in meta-analyses,[26] and was used to appraise the validity and applicability of the selected studies. Studies were appraised in three categories: the selection of data, the comparability of the two cohort groups and the outcomes (Appendix S2). The assessment was conducted by two independent reviewers (ST and AB).

2.4 | Data extraction

Data on study design, sample size, population characteristics and outcomes were extracted from the studies, when available, by two reviewers (ST and AB). Authors were e-mailed for crude data if no isolated results for VE and/or SSCS were available. The following maternal outcomes were extracted: mortality; PPH; urogenital injury; infection; uterine rupture; wound complications; re-operation; and hospitalisation for >5 days. The extracted neonatal outcomes were: mortality; low Apgar score (<7 at 5 min); NICU admission; infection; birth trauma; and HIE. As the selected studies had divergent outcomes, the end points of the literature review were categorised for three outcomes. Urogenital tract injury included obstetric fistula, cervical injury, third- and fourth-degree perineal tears and operational complications on the urogenital tract, such as urethral damage. Neonatal encephalopathy included asphyxia, abnormal consciousness, difficulty maintaining respiration or difficulty feeding of presumed central origin and abnormal tone or reflexes. Birth trauma included lesions caused by instrument, intracerebral or subgaleal haematoma, nerve injury, clavicular fracture and skull fracture.

2.5 | Combined outcome

We opted to classify complications according to severity, and so three combined outcomes were calculated: the adverse outcome index (AOI), the weighed adverse outcome score (WAOS) and the severity index (SI).[27] The AOI corresponds to the ratio of births complicated by any adverse outcome, i.e. the total number of complicated births divided by the total number of births.[27] To calculate the WAOS and SI, every adverse outcome was scored according to predefined severity scores (see Appendix S3). The total score allocated for all complications was divided by all births to calculate the WAOS, whereas the total score was divided by the number of births complicated by any adverse outcome to calculate the SI. These outcomes are used to evaluate maternal and neonatal adverse outcomes, while weighing each type of outcome in terms of severity, thereby providing a more complete picture of the quality of care and impact of mode of birth (Appendix S3 provides an extended explanation).[27]

2.6 | Statistics

For comparison of results between the two groups, chi-square testing (or Fisher's exact test if $n<5$) and binary logistic regression were used. To compare the medians of the AOI, WAOS and SI the two-tailed Student's *t*-test and Mann–Whitney *U*-tests were performed, where applicable. Statistical significance was set at $p<0.05$. All statistical analyses were performed with SPSS 28 (IBM, Armonk, NY, USA). A meta-analysis of all included studies was not possible because of the heterogeneity of the clinical outcome definitions and the available data.

3 | RESULTS

3.1 | Search and critical appraisal

The search conducted yielded a total of 531 studies (Figure 1). After the removal of duplicates, 477 publications were screened on title and abstract, resulting in the selection of 37 articles for full-text screening. After full-text screening, 18 articles were suitable for analysis. One study was excluded because the same data set had already been used in another article. Two studies were excluded because of missing crude data. Fifteen articles were included in the final analysis, which provided outcomes of 32 823 vacuum-assisted births and 20 051 births by SSCS (Table 1).[28–42] During the critical appraisal, one study from Israel met the maximum score (Table 2).[41] Most studies (n = 12/15) did not describe the duration of follow-up for both women and neonates. Eight studies adjusted for confounding factors, and five studies specified for which confounding factors they adjusted, when comparing outcomes of SSCS with outcomes of VE. Gurney et al.[32] adjusted for body mass index (BMI), birthweight, parity, mode of analgesia, operator experience, indication for trial, fetal position and fetal station in the birth canal. Halscott et al.[33] controlled for maternal race, diabetes (pregestational and gestational), BMI, insurance status and hospital type. Muraca et al.[38] adjusted for maternal age, parity, birthweight, province of residence and fiscal year. Tempest et al.[42] adjusted for potential fetal compromise (fetal distress ascertained by cardiotocographic abnormality or fetal scalp pH, antepartum haemorrhage and cord presentation) and demographics: age, BMI, parity, length of first and second stages of labour, reason for assisted birth, operator seniority and birthweight.

Nolens et al.[39] adjusted for strongest confounding factor per outcome and included: previous CS, birthweight, indication of delay, indication of fetal distress, impending uterine rupture, nulliparous and admission in second stage in their logistic regression. Bailit et al.,[28] Giacchino et al.,[31] and Hendler et al.[34] did not specify for which confounding factors they adjusted. All studies but one scored the maximum score with regards to the selection of data, implying that it was known whether a woman gave birth by VE or SSCS, and that neither of the maternal or neonatal outcomes mentioned above in 'data extraction' were already present at the onset of VE or SSCS.

3.2 | Study characteristics

The study characteristics are presented in Table 1 and Table S1. Definitions of outcomes for each article are presented in Table S2. The included articles were published between 2010 and 2021, although there was no date limit to the search. Two studies were prospective cohort studies, the other included studies had a retrospective cohort study design. Most studies (13/15) were conducted in high-income countries (four in the USA, three each in the UK and Israel, one each in Canada, Germany and Sweden) and two were conducted in LMICs (Nigeria and Uganda).

3.3 | Maternal mortality

Three of the included studies reported on maternal mortality.[33,36,39] The only study population in which maternal deaths occurred was that of the study conducted in Uganda.[39] This study described five maternal deaths, which all happened in the SSCS group (SSSC 5/245, 1.2%,

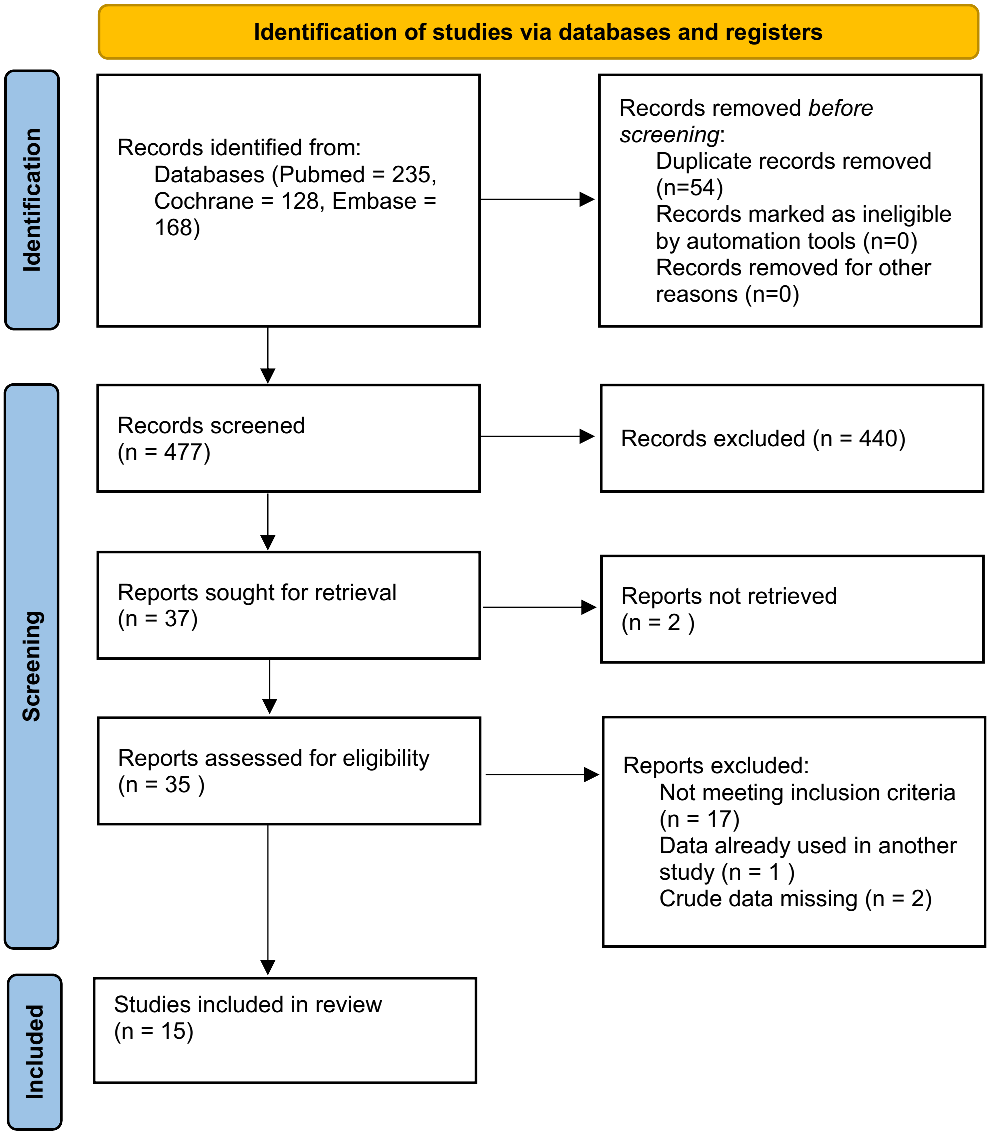

FIGURE 1 PRISMA flowchart for the search and inclusion of studies.

vs VE, 0/358, 0%; $p = 0.07$). Causes of maternal death were complete spinal block ($n = 5$) with cardiac arrest ($n = 4$) and complete spinal block with hypoxic brain damage ($n = 1$). Contributing factors were severe PPH, sepsis and aspiration pneumonia.[39]

3.4 | Perinatal mortality

Eight studies had perinatal mortality as an outcome, in which five perinatal deaths also occurred (see Table 3 and Table S5). In the Federal Teaching Hospital of Abakaliki in Nigeria, defined as a resource-poor setting by the authors, 13.2% (46/348) of neonates died peripartum in the SSCS group and 4.7% (10/211) of neonates died in the VE group (OR 3.14, 95% CI 1.55–6.36).[30] The decision-to-birth interval (DBI) was registered as less than 30 min in 6% of the SSCS group compared to 93.4% of the VE group (OR 0.01, 95% CI 0.00–0.01). A total of 27 (7.8%) intrauterine fetal deaths took place during the DBI in the SSCS group, compared with three (1.4%) in the VE group (OR 2.34, 95% CI 1.00–5.46). In the study conducted in Mulago Hospital, Kampala, Uganda, there was no difference in the total number of perinatal deaths between SSCS and VE groups (11%, 45/410, vs 8.4%, 29/347, OR 1.39, 95% CI 0.85–2.26; $p = 0.227$). In this study a higher incidence of intrauterine fetal deaths during DBI in the SSCS group compared with the VE group (8.4%, 29/425, vs 0.9%, 3/358, OR 5.07, 95% CI 1.48–17.38) was described.[39] The DBI exceeded 60 min in 81.9% (298/364) of the SSCS group compared with 29.3% (66/225) of the VE group (OR 0.23, 95% CI 0.16–0.34).[39]

Three other studies registered one perinatal death, one study conducted in the USA registered one death after SSCS,[33] the second study conducted in Israel registered one death after VE,[36] and the third study that registered one death was also conducted in Israel and registered an intrapartum death during VE.[37] No further explanation of the cause of perinatal death was given in these studies.

TABLE 1 Study characteristics of included studies.

Author (year)	Study design	Time frame	*N*	*n* per mode of birth	Inclusion criteria	Country	Primary outcomes	Secondary outcomes	Type of cup
Bailit (2006)	PCS	2008–2011	2531	VE: 1382 SSCS: 131 F: 1018	Term, singleton, vertex, fetal station 2+ or below	USA	Composite neonatal outcome, composite maternal outcome	Neonatal outcomes including skin laceration and brain bleeding	N/S
Contag (2010)	RCS	2002–2005	549	VE: 192 SSCS: 149 F: 208	Nulliparous, singleton, fetal head at station 1+ or below	USA	Apgar scores, umbilical artery pH, umbilical artery base excess, highest level of neonatal care, neonatal injury		N/S
Eze (2020)	RCS	2012–2016	559	VE: 211 SSCS: 348	Term, singleton, cephalic, fetal station 2+ or below	Nigeria	Fetal death within the DDI, severe perinatal admission into NICU and perinatal death		Kiwi
Gurney (2020)	RCS	2014–2018	223	VE: 116 SSCS: 107	Singleton, cephalic	UK	Successful vaginal delivery	Composite risk score	N/S
Giacchino (2020)	RCS	2010–2018	1184	VE: 334 SSCS: 840	Singleton, >24 weeks of gestation	UK	Maternal: PPH, OASIS Neonatal: admission to NICU, HIE, 5 min Apgar score < 7, jaundice, birth trauma, shoulder dystocia		N/S
Halscott (2015)	RCS	2002–2008	2518	VE: 1598 SSCS: 222 F: 698	Term, singleton, cephalic, fetal station 2+	USA	Maternal adverse outcome composite, neonatal adverse outcome composite	Each individual outcome and maternal thromboembolism, wound complication, episiotomy, third- and fourth-degree lacerations, cervical or sulcal lacerations and length of stay	N/S
Hendler (2017)	RCS	2011–2013	547	VE: 200 SSCS: 197 F: 150	Nulliparous, gestational age > 35 weeks, age > 20 years	Israel	Neonatal and maternal composite outcome		Metal cups
Kessous (2013)	RCS	1993–2010	319	VE: 184 SSCS: 135	Trial of VBAC, prolonged second stage, singleton	Israel	Apgar scores at 1 and 5 min < 7, birthweight, fetal gender and mortality		N/S
Krizman (2019)	RCS	1996–2002	1837	VE: 608 SSCS: 486 F: 743	Trial of VBAC, term, singleton	USA	Maternal composite morbidity and neonatal composite morbidity		N/S

(continues)

TABLE 1 (Continued)

Author (year)	Study design	Time frame	N	n per mode of birth	Inclusion criteria	Country	Primary outcomes	Secondary outcomes	Type of cup
Levin (2021)	RCS	2011–2019	611	VE: 565 SSCS: 46	Birthweight <2500 g	Israel	Composite adverse neonatal outcome	Neonatal: Apgar <7 at 5 min, low umbilical blood pH (<7.1), NICU admission, mechanical ventilation Maternal: OASIS, PPH	N/S
Muraca (2018)	RCS	2003–2013	28 923	VE: 4887 SSCS: 15 034 F: 4741	Term, singleton, prolonged second stage	Canada	Composite severe perinatal morbidity and mortality and composite severe maternal morbidity and mortality	All birth trauma, obstetric trauma and severe perineal lacerations	N/S
Nolens (2018)	PCS	2014–2015	783	VE: 358 SSCS: 425	Term, singleton, vertex	Uganda	Maternal death, composite of severe maternal, perinatal death, composite perinatal outcome	PPH, infection, genital tract injury and duration of hospital admission, admission to NICU, duration of admission in NICU, diagnosis	Kiwi, Bird and silicone cups
Polkowski (2018)	RCS	2004–2014	1971	VE: 393 SSCS: 1429 F: 149	Singleton, gestational age > 34 weeks	Germany	Maternal: blood loss during labour and postpartum anaemia Neonatal: 5 min Apgar score, arterial cord blood pH < 7.20, need for oxygen mask, intubation, reanimation and admission to NICU	Lacerations, episiotomy, maternal complications such as wound healing deficits, postpartum fever, sepsis and need for hysterectomy or postpartum laparotomy Neonatal: cephalhaematomas after birth, caput succedaneum, imprints and lesions caused by instruments	Metal cup 5 or 6 or Kiwi device
Shmueli (2017)	RCS	2007–2014	3449	VE: 3093 SSCS: 356	Term, prolonged second stage	Sweden	General composite neonatal outcome	Traumatic composite neonatal outcome	N/S
Tempest (2013)	RCS	2006–2010	1291	VE: 107 SSCS: 146 F: 1038	Prolonged second stage through malposition of the head	UK	Failure of vaginal birth	Massive obstetric haemorrhage, sphincter injury, third-degree partial, third-degree complete, fourth-degree, maternal hospital stay (in days), NICU admission	N/S

Abbreviations: NICU, neonatal intensive care unit; OASIS, obstetric anal sphincter injurt; PCS, prospective cohort study; PPH, postpartum haemorrhage; RCS, retrospective cohort study.

TABLE 2 Critical appraisal according to The Newcastle–Ottawa scale (NOS).

Author	Selection	Comparability	Outcome	Total score
Bailit (2016)	****	*	*	6
Contag (2010)	****		***	7
Eze (2020)	****	**	*	7
Giacchino (2020)	****	**	*	7
Gurney (2020)	****	**	**	8
Halscott (2015)	****	*	*	6
Hendler (2017)	****	*	*	6
Kessous (2013)	****		*	5
Krizman (2019)	****	*	*	6
Levin (2021)	****		**	6
Muraca (2018)	**		**	4
Nolens (2018)	****	**	**	8
Polkowski (2018)	****		***	7
Shmueli (2017)	****	**	***	9
Tempest (2013)	****	**	**	8

Note: The critical appraisal was based on NOS for assessing the quality of nonrandomised studies in meta-analyses.

3.5 | Maternal morbidity

The results of all maternal and neonatal outcomes are shown in Tables 3 and S3. The included studies showed conflicting results regarding postpartum infection, haemorrhage and wound complications. Uterine rupture (during the waiting time for SSCS or VE) occurred more often during the waiting time for SSCS in one study in Uganda (19, 3.9%, vs 5, 0.8%, OR 4.90, 95% CI 1.82–13.23).[35,36,39] Both studies that included the duration of hospitalisation as an outcome showed a longer stay in hospital after SSCS.[34,39] Urogenital tract injury occurred more often after VE in eight out of ten studies, and mainly consisted of third- or fourth-degree perineal lacerations.

3.6 | Perinatal morbidity

The included studies showed conflicting results regarding Apgar score, NICU admission, occurrence of encephalopathy, perinatal infection and birth trauma (Tables 3 and S3). Either there were no differences between the groups or the studies resulted in diverging conclusions.

3.7 | Adverse outcome index

The scores of the AOI, WAOS and SI are shown in Table 4. No statistically significant differences were found between the two groups. There were no differences in the median values of the AOI, WAOS and SI. The calculated scores per study and extended figures are presented in Figure S1 and Table S4.

4 | DISCUSSION

4.1 | Main findings and interpretation

This systematic review included 15 studies providing the outcomes for a total of 20 051 births by SSCS and 32 823 births by VE. In total, five maternal deaths were registered, all in the SSCS group, and a total of 133 perinatal deaths occurred: 92/20 051 (0.45%) in the SSCS group and 41/32 823 (0.12%) in the VE group. In the studies that registered DBI, there were longer waiting times for SSCS than for VE.

The five maternal deaths were all a direct result of complications of anaesthesia during caesarean section in a low-resource setting. These results are aligned with a recent systematic review on caesarean section complications in LMICs. The review showed a 100 times higher risk of maternal mortality when women underwent a CS in LMICs, compared with high-income countries (HICs), and a 12 times increased risk regarding maternal mortality when caesarean section was performed during the second stage. Therefore, the authors called out for training and promoting assisted vaginal birth to decrease the rate of SSCS.[43]

The two studies that registered more than one perinatal death were conducted in low-resource settings (Nigeria and Uganda). In both studies the longer DBI for SSCS compared with VE was suggested as an important factor contributing to the higher incidence of perinatal deaths during and after SSCS. Previous research found a longer DBI, mostly defined as >30 min, as an important factor contributing to perinatal deaths.[44–46]

Urogenital tract injury occurred more frequently after VE, whereas the hospital stay was longer after SSCS. No differences were found between incidences of other maternal and perinatal complications. This might be the result of the relatively small study groups, the difference in definitions of the complications per study, the lack of adjustment for confounding factors and the inevitable differences in study groups because of the cohort study designs.

Obstetric fistula, a major complication of obstructed labour, was only registered in one study.[39] More attention for this outcome would be appropriate, because of the severity of the complication and because of the global epidemic of caesarean sections, which might lead to an increase in iatrogenic fistulas.[47–49] Both the shortening of the second stage of labour and decreasing the numbers of caesarean sections might be a way to decrease this complication. Future studies should therefore include obstetric fistula as a long-term outcome.

The results concerning neonatal trauma are important, because it is assumed to be one of the most pressing reasons why some healthcare professionals are reluctant to perform VE.[17,50] This study did not show any evidence that SSCS

TABLE 3 Results of included studies.

	Maternal						Perinatal					
	Mortality	PPH	Urogenital injury	Infection	Uterus rupture	Wound complications	Mortality	5-min Apgar < 7	NICU admission	HIE	Infection	Birth trauma
Bailit (2016)												
VE (1382)		**19 (1.4)**	**263 (19.1)**	**3 (0.2)**			0	**5 (0.4)**		**11 (0.8)**		44 (3.2)
SSCS (131)		**5 (3.8)**	**0**	**7 (5.3)**			0	**3 (2.3)**		**3 (2.3)**		1 (0.8)
p-Value		**0.03**	**0.00**	**0.00**				**0.03**		**0.1**		0.17
Contag (2010)												
VE (192)								4 (1.2)	14 (4.2)	0		0
SSCS (149)								8 (4.2)	9 (4.7)	1 (0.5)		0
p-Value								0.14	0.38	0.44		
Eze (2020)												
VE (211)							10 (4.7)	24 (11.3)	30 (14.4)	18 (8.5)	6 (2.9)	3 (1.4)
SSCS (348)							46 (13.2)	35 (10.0)	46 (14.0)	24 (6.9)	9 (2.7)	1 (0.3)
p-Value							0.01	0.62	0.74	0.48	0.62	0.15
Giacchino (2020)												
VE (344)		**49 (14.2)**	**16 (4.7)**					8 (2.3)	8 (2.3)	3 (0.9)		**13 (3.8)**
SSCS (840)		**231 (27.5)**	**0**					22 (2.6)	23 (2.7)	3 (0.4)		**14 (1.7)**
p-Value		**0.00**	**0.00**					0.77	0.69	0.36		**0.03**
Gurney (2020)												
VE (116)		5 (4.3)	**12 (10.3)**				1 (0.9)	**3 (2.6)**	11 (9.6)			
SSCS (107)		6 (5.6)	**0**				0	**10 (9.3)**	3 (2.8)			
p-Value		0.06	**0.00**				1.0	**0.04**	0.05			
Halscott (2015)												
VE (2296)	0	51 (4.3)	**236 (19.6)**	**3 (0.2)**		**6 (0.4)**	0	1 (0.1)	**99 (6.2)**		**29 (1.8)**	98 (6.1)
SSCS (222)	0	10 (4.5)	**2 (0.9)**	**6 (2.7)**		**5 (2.3)**	1 (0.5)	0	**28 (12.6)**		**5 (2.3)**	4 (1.8)
p-Value		0.63	**0.00**	**0.00**		**0.03**	0.08	1.0	**0.00**		**0.00**	0.08
Hendler (2017)												
VE (200)		13 (8.6)	4 (2.0)	**0**				2 (1.0)	4 (2.0)			23 (11.5)
SSCS (197)		5 (2.5)	0	**6 (3.0)**				3 (1.5)	5 (2.5)			13 (6.6)
p-Value		0.06	0.12	**0.01**				0.68	0.75			0.09
Kessous (2013)												
VE (184)		7 (3.8)	8 (4.3)		1 (0.5)		0	3 (1.6)				
SSCS (135)		1 (0.7)	8 (5.9)		2 (1.5)		0	1 (0.7)				

TABLE 3 (Continued)

	Maternal						Perinatal					
	Mortality	PPH	Urogenital injury	Infection	Uterus rupture	Wound complications	Mortality	5-min Apgar < 7	NICU admission	HIE	Infection	Birth trauma
p-Value		0.14	0.52		0.58			0.64				
Krizman (2019)												
VE (608)	0		**94 (15.5)**	**7 (1.2)**	**5 (0.8)**	**2 (0.3)**	0	3 (0.5)	68 (11.2)	1 (0.2)		17 (2.8)
SSCS (486)	0		**13 (2.7)**	**41 (8.4)**	**19 (3.9)**	**9 (1.9)**	0	1 (0.2)	58 (11.9)	2 (0.4)		11 (2.3)
p-Value			**0.00**	**0.00**	**0.00**	**0.01**		0.63	0.69	0.59		0.58
Levin (2021)												
VE (565)							1 (0.2)	**24 (4.2)**	101 (18)			0
SSCS (46)							0	**11 (23.9)**	11 (23.9)			1 (2)
p-Value							1.0	**0.00**	0.30			0.07
Muraca (2018)												
VE (24 851)			**3820 (15.4)**									**2182 (8.8)**
SSCS (15 034)			**1052 (7.0)**									**373 (2.5)**
p-Value			**0.00**									**0.00**
Nolens (2018)												
VE (358)	0	3 (1.0)	7 (1.9)	**10 (3.5)**	2 (0.6)	**8 (2.8)**	29 (8.4)	18 (5.7)	80 (25.2)	41 (12.9)	14 (4.4)	9 (2.8)
SSCS (425)	5 (1.2)	10 (2.9)	4 (0.9)	**58 (15.9)**	8 (1.9)	**51 (13.9)**	45 (11.0)	19 (5.2)	69 (18.9)	40 (11.0)	14 (3.8)	4 (1.1)
p-Value	0.07	0.16	1.0	**0.00**	0.20	**0.00**	0.23	0.78	0.05	0.44	0.71	0.10
Polkowski (2018)												
VE (393)		**24 (6.1)**	**33 (8.4)**	0		1 (0.3)			**29 (7.3)**			**9 (2.3)**
SSCS (1429)		**21 (1.5)**	**0**	2 (0.1)		8 (0.6)			**185 (13.0)**			**0**
p-Value		**0.00**	**0.00**	1.0		0.70			**0.00**			**0.00**
Shmueli (2017)												
VE (3093)							0	**15 (0.5)**	**405 (13.1)**	5 (0.2)	291 (9.4)	**791 (25.6)**
SSCS (356)							0	**8 (2.2)**	**65 (18.3)**	0	44 (12.4)	**43 (12.1)**
p-Value								**0.00**	**0.01**	1.0	0.08	**0.00**
Tempest (2013)												
VE (107)		2 (1.9)							13 (12.1)			
SSCS (146)		3 (2.1)							16 (11.0)			
p-Value		1.0							0.91			

Bold indicates statistical significance was set at $p < 0.05$.

Abbreviations: HIE, hypoxic ischaemic encephalopathy; *n*, number; NICU, neonatal intensive care unit; *p*, probability; PPH, postpartum haemorrhage; SSCS, second-stage caesarean section; VE, vacuum extraction.

TABLE 4 Combined maternal and perinatal outcomes.

	VE	SSCS	*p*-Value
Adverse outcome index (AOI)			
Median (IQR)	24.2 (9.3–42.2)	17.8 (6.8–50.0)	0.31
Weighed adverse outcome scale (WAOS)			
Median (IQR)	6.7 (3.1–44.1)	8.2 (1.8–61.4)	0.63
Severity index (SI)			
Median (IQR)	25 (3.45–104.7)	32.5 (19.3–163.6)	0.25

Note: AOI is the number of complicated births/the total number of births. WAOS is the total score allocated by all adverse outcomes/the total number of births. SI is the total score allocated by all adverse outcomes/the total number of complicated births.

Abbreviations: SSCS, second-stage caesarean section; VE, vacuum extraction.

protects neonates from birth trauma or other adverse outcomes. On the contrary, this review provides evidence that SSCS and especially the DBI for SSCS could lead to perinatal death. The perception of healthcare professionals that VE has a substantial risk of birth trauma is not founded in the literature. More insights into this perception might provide information as to why a specific mode of birth is preferred. Studies included in the review showed conflicting results according to neonatal trauma and it is expedient to identify the causes of these differences. Known factors contributing to the risk of birth trauma when performing VE include the type of cup used, the pelvic station at which the VE was performed, the experience of the healthcare professional, and the number of tractions and cup detachments.[51,52] Such specifics were missing in most of the included studies. Only four studies noted the type of cup used and there was no information available about the VE procedure. Previous studies showed that a lack of equipment and well-trained staff are a problem in low-resource settings.[50] Encouragement by a colleague to perform a VE was found to be a reason to do so,[50] whereas attempting assisted vaginal birth without adequate training or equipment can lead to severe maternal and perinatal trauma and should be dissuaded.[53] Because no information about the physicians and VE procedure was included in the studies, this might also have distorted the outcomes. Including such information in future studies could lead to stronger evidence on the safety of VE and could help to recommend a certain type of cup or training.

4.2 | Strengths and limitations

This is the first systematic review comparing VE and SSCS, and the first review in which a combination of maternal and neonatal outcomes was compared using the AOI, WAOS and SI. It provides valuable information to contribute to the continuing debate regarding the rising numbers of CS worldwide. The heterogeneity across studies in design, definitions and methods was too large to perform a meta-analysis. Although we have – to the best of our knowledge – collected all of the evidence available, the included studies were cohort studies, where groups differ, by definition, at the moment of the decision to expedite birth. Even when studies did adjust for confounding factors at baseline, factors that influence outcomes, such as the indication to shorten the second stage or the interpretation of the cardiotocography (CTG) tracing at the time of clinical decision making, might have influenced the birth attendant's choice. There were no randomised controlled trials that compared outcomes of SSCS with those of VE. A limitation regarding the included studies is that in none of the studies women were followed into the next pregnancy, and therefore these studies could not report the effects of a scarred uterus on a subsequent birth or the long-term effects of neonatal or maternal trauma. Most of the included studies had too small a number of included births for certain complications to occur, let alone reach any statistical significance. Another limitation was that there were no data available on shared decision making, partner involvement in decision making, or costs for the mother or for the health system. Such factors should be taken into account in future studies.

4.3 | Outcome measures and future studies

In order to compare all maternal and neonatal outcomes together, combined outcome scores were calculated. No statistically significant differences were found in median scores between the two groups, which indicates that there was no increased overall risk for mother or baby with either procedure based on these limited numbers. Although the short-term outcomes in HICs seem comparable for these two modes of delivery, the long-term outcomes are not well researched and are expected to be less favourable after SSCS.[21–23] Therefore, a randomised controlled trial will be hard to realise because of ethical objections. A step-wedge cluster randomised trial could be a study design to generate robust data while implementing VE in a setting where VE is not yet used. Further analysis with more studies and longer follow-up periods, including social and emotional outcomes, are needed. However, in the meantime, it seems advisable to implement and advocate for the use of VE across all settings, also in light of healthcare costs and qualitative findings favouring VE over SSCS in the perception of many women.[54–56] There certainly is no doubt that in settings where safe anaesthesia and surgery is not immediately available, VE should be the method of choice.

5 | CONCLUSION

This systematic review showed that in the secondary stage of labour VE has the potential to decrease perinatal deaths during DBI in the two studies from low-resource settings, and that VE has no other adverse outcomes compared with SSCS, except for more frequent perineal tears. VE might be able to decrease maternal deaths and other severe adverse outcomes, including obstetric fistula and uterine rupture, in low-resource settings. No evidence was found for the superiority of SSCS over VE in a high-resource setting regarding adverse maternal and neonatal outcomes in the short-term follow up. As might have been expected, we found a higher number of urogenital tract injuries in the VE group compared with the SSCS group in both high- and low-resource settings. Nevertheless, more studies with different study designs are needed with larger sample sizes to provide more robust measures of effect. In the meantime, VE should be the recommended mode of birth in both LMICs and HICs, to prevent perinatal and maternal deaths in settings where safe anaesthesia and surgery is not immediately available, and to prevent unnecessary CSs and associated long-term consequences in HICs.

AUTHOR CONTRIBUTIONS

The searches, the screening and selection of articles, and the critical appraisal were all executed by ST and AB. MJR functioned as the third reviewer. All statistical analyses were performed by ST and AB. BN, TA, MJR and KB all contributed to the article with their specialist knowledge about vacuum extractions, both in academic and clinical settings. They provided context and helped interpret and discuss the results.

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CONFLICT OF INTEREST STATEMENT

One of the authors (BN) published one of the included articles. Nevertheless, none of the authors have any conflicts of interest to declare. There are no financial interests to report, and all authors have seen and agreed to the contents of this article. Completed disclosure of interests form available to view online as supporting information.

ETHICS APPROVAL

This review only used data of previous published studies.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. World Health Organization [Internet]. Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. [cited 15 June 2022]. Available from: https://www.unfpa.org/featured-publication/trends-maternal-mortality-2000-2017
2. Wang H, Bhutta ZA, Coates MM, Coggeshall M, Dandona L, Diallo K, et al. Global, regional, national, and selected subnational levels of stillbirths, neonatal, infant, and under-5 mortality, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388(10053):1725–74.
3. World Health Organization [Internet]. Trends in maternal mortality: 1990-2015: estimates from WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. World Health Organization. 2015 [Cited 15 June 2022]. Available from: https://www.unfpa.org/publications/trends-maternal-mortality-1990-2015
4. Kassebaum NJ, Barber RM, Bhutta ZA, Dandona L, Gething PW, Hay SI, et al. Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden Of Disease Study 2015. Lancet. 2016;388(10053):1775–812.
5. Villar J, Carroli G, Zavaleta N, Donner A, Wojdyla D, Faundes A, et al. Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study. BMJ. 2007;335(7628):1025.
6. Wright A, Nassar AH, Visser G, Ramasauskaite D, Theron G, FIGO Safe Motherhood and Newborn Health Committee. FIGO good clinical practice paper: management of the second stage of labor. Int J Gynecol Obstet. 2021;152(2):172–81.
7. Nunes VD, Gholitabar M, Sims JM, Bewley S. Intrapartum care of healthy women and their babies: summary of updated NICE guidance. BMJ. 2014;349:g6886.
8. Caughey AB, Cahill AG, Guise JM, Rouse DJ, American College of Obstetricians and Gynecologists. Safe prevention of the primary cesarean delivery. Am J Obstet Gynecol. 2014;210(3):179–93.
9. O'Mahony F, Hofmeyr GJ, Menon V. Choice of instruments for assisted vaginal delivery. Cochrane Database Syst Rev. 2010;(11):CD005455.
10. Chalmers JA, Chalmers I. The obstetric vacuum extractor is the instrument of first choice for operative vaginal delivery. BJOG. 1989;96(5):505–6.
11. O'Mahony F, Hofmeyr GJ, Menon V. Choice of instruments for assisted vaginal delivery [Internet]. Cochrane database of systematic reviews. [updated 24 September 2021; cited 15 June 2022]. Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD005455.pub3/full
12. Johanson R, Menon V. Vacuum extraction versus forceps for assisted vaginal delivery [Internet]. Cochrane Database of Systematic Reviews. [updated at 10 November 2010, cites 15 June 2022]. Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD000224.pub2/full
13. Martin JA. Births: final data for 2010 [Internet]. National vital statistics reports. 2012; vol. 61(1). [cited 15 June 2022]. Available from: http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_05.pdf
14. Anozie OB, Osaheni LL, Onu FA, Onoh RC, Ogah EO, Eze JN, et al. Declining rate of operative vaginal deliveries in Nigeria. Open J Obstet Gynecol. 2018;8(3):175–84.
15. Hirshberg A, Srinivas SK. Role of operative vaginal deliveries in prevention of cesarean deliveries. Clin Obstet Gynecol. 2015;58(2):256–62.
16. Bailey PE. The disappearing art of instrumental delivery: time to reverse the trend. Int J Gynecol Obstet. 2005;91(1):89–96.

17. Bailey PE, van Roosmalen J, Mola G, Evans C, de Bernis L, Dao B. Assisted vaginal delivery in low and middle income countries: an overview. BJOG. 2017;124(9):1335–44.
18. Magann EF, Evans S, Hutchinson M, Collins R, Lanneau G, Morrison JC. Postpartum hemorrhage after cesarean delivery: an analysis of risk factors. South Med J. 2005;98(7):681–6.
19. Fawcus S, Moodley J. Postpartum haemorhage associated with caesarean section and caesarean hysterectomy. Best Pract Res Clin Obstet Gynaecol. 2013;27(2):233–49.
20. Zuarez-Easton S, Zafran N, Garmi G, Salim R. Postcesarean wound infection: prevalence, impact, prevention, and management challenges. Int J Womens Health. 2017;9:81–8.
21. Zwart JJ, Richters JM, Öry F, De Vries JI, Bloemenkamp KW, Van Roosmalen J. Uterine rupture in The Netherlands: a nationwide population-based cohort study. BJOG. 2009;116(8):1069–80.
22. Yang Q, Wen SW, Oppenheimer L, Chen XK, Black D, Gao J, et al. Association of caesarean delivery for first birth with placenta praevia and placental abruption in second pregnancy. BJOG. 2007;114(5):609–13.
23. Wood SL, Tang S, Crawford S. Cesarean delivery in the second stage of labor and the risk of subsequent premature birth. Am J Obstet Gynecol. 2017;217(1):63.e1–63.e10.
24. Boerma T, Ronsmans C, Melesse DY, Barros AJ, Barros FC, Juan L, et al. Global epidemiology of use of and disparities in caesarean sections. Lancet. 2018;392(10155):1341–8.
25. Prisma statement [Internet]. [cited 15 June 2022]. Available from: http://www.prisma-statement.org/
26. Ottawa: Ottawa Hospital Research Institute. [Internet]. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. [cited 15 June 2022]. Available from: http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp
27. Mann S, Pratt S, Gluck P, Nielsen P, Risser D, Greenberg P, et al. Assessing quality in obstetrical care: development of standardized measures. Jt Comm J Qual Patient Saf. 2006;32(9):497–505.
28. Bailit JL, Grobman WA, Rice MM, Wapner RJ, Reddy UM, Varner MW, et al. Evaluation of delivery options for second-stage events. Am J Obstet Gynecol. 2016 May 1;214(5):638–e1.
29. Contag SA, Clifton RG, Bloom SL, Spong CY, Varner MW, Rouse DJ, et al. Neonatal outcomes and operative vaginal delivery versus cesarean delivery. Am J Perinatol. 2010;27(6):493–9.
30. Eze P, Lawani LO, Chikezie RU, Ukaegbe CI, Iyoke CA. Perinatal outcomes of babies delivered by second-stage caesarean section versus vacuum extraction in a resource-poor setting, Nigeria–a retrospective analysis. BMC Pregnancy Childbirth. 2020;20:298.
31. Giacchino T, Karkia R, Zhang W, Beta J, Ahmed H, Akolekar R. Kielland's rotational forceps delivery: a comparison of maternal and neonatal outcomes with rotational ventouse or second stage caesarean section deliveries. Eur J Obstet Gynecol Reprod Biol. 2020;254:175–80.
32. Gurney L, Al Wattar BH, Sher A, Echevarria C, Simpson H. Comparison of perinatal outcomes for all modes of second stage delivery in obstetric theatres: a retrospective observational study. BJOG. 2021;128(7):1248–55.
33. Halscott TL, Reddy UM, Landy HJ, Ramsey PS, Iqbal SN, Huang CC, et al. Maternal and neonatal outcomes by attempted mode of operative delivery from a low station in the second stage of labor. Obstet Gynecol. 2015;126(6):1265–72.
34. Hendler I, Kirshenbaum M, Barg M, Kees S, Mazaki-Tovi S, Moran O, et al. Choosing between bad, worse and worst: what is the preferred mode of delivery for failure of the second stage of labor? J Matern Fetal Neonatal Med. 2017;30(15):1861–4.
35. Kessous R, Tirosh D, Weintraub AY, Benshalom-Tirosh N, Sergienko R, Sheiner E. Second stage disorders in patients following a previous cesarean section: vacuum versus repeated cesarean section. Arch Gynecol Obstet. 2013;287(6):1075–9.
36. Krizman E, Grzebielski P, Antony KM, Sampene E, Shanahan M, Iruretagoyena JI, et al. Operative vaginal delivery is a safe option in women undergoing a trial of labor after cesarean. Am J Perinatol Rep. 2019;9(2):e190–4.
37. Levin G, Rottenstreich A, Cahan T, Mankuta D, Yagel S, Yinon Y, et al. Second stage expedite delivery of low birth weight neonates: emergent cesarean delivery versus vacuum assisted delivery. J Gynecol Obstet Hum Reprod. 2021;50(8):102136.
38. Muraca GM, Sabr Y, Lisonkova S, Skoll A, Brant R, Cundiff GW, et al. Morbidity and mortality associated with forceps and vacuum delivery at outlet, low, and midpelvic station. J Obstet Gynaecol Can. 2019;41(3):327–37.
39. Nolens B, Namiiro F, Lule J, van den Akker T, van Roosmalen J, Byamugisha J. Prospective cohort study comparing outcomes between vacuum extraction and second-stage cesarean delivery at a Ugandan tertiary referral hospital. Int J Gynecol Obstet. 2018;142(1):28–36.
40. Polkowski M, Kuehnle E, Schippert C, Kundu S, Hillemanns P, Staboulidou I. Neonatal and maternal short-term outcome parameters in instrument-assisted vaginal delivery compared to second stage cesarean section in labour: a retrospective 11-year analysis. Gynecol Obstet Invest. 2018;83(1):90–8.
41. Shmueli A, Salman L, Ashwal E, Hiersch L, Gabbay-Benziv R, Yogev Y, et al. Perinatal outcomes of vacuum assisted versus cesarean deliveries for prolonged second stage of delivery at term. J Matern Fetal Neonatal Med. 2017;30(8):886–9.
42. Tempest N, Hart A, Walkinshaw S, Hapangama DK. A re-evaluation of the role of rotational forceps: retrospective comparison of maternal and perinatal outcomes following different methods of birth for malposition in the second stage of labour. BJOG. 2013;120(10):1277–84.
43. Sobhy S, Arroyo-Manzano D, Murugesu N, Karthikeyan G, Kumar V, Kaur I, et al. Maternal and perinatal mortality and complications associated with caesarean section in low-income and middle-income countries: a systematic review and meta-analysis. Lancet. 2019;393(10184):1973–82.
44. Maaløe N, Housseine N, Bygbjerg IC, Meguid T, Khamis RS, Mohamed AG, et al. Stillbirths and quality of care during labour at the low resource referral hospital of Zanzibar: a case-control study. BMC Pregnancy Childbirth. 2016;16(1):351.
45. Mishra N, Gupta R, Singh N. Decision delivery interval in emergency and urgent caesarean sections: need to reconsider the recommendations? J Obstet Gynaecol India. 2018;68(1):20–6.
46. Hirani BA, Mchome BL, Mazuguni NS, Mahande MJ. The decision delivery interval in emergency caesarean section and its associated maternal and fetal outcomes at a referral hospital in northern Tanzania: a cross-sectional study. BMC Pregnancy Childbirth. 2017;17(1):411.
47. Raassen TJ, Ngongo CJ, Mahendeka MM. Iatrogenic genitourinary fistula: an 18-year retrospective review of 805 injuries. Int Urogynecol J. 2014;25(12):1699–706.
48. Tasnim N, Bangash K, Amin O, Luqman S, Hina H. Rising trends in iatrogenic urogenital fistula: a new challenge. Int J Gynecol Obstet. 2020;148:33–6.
49. Abrams M, Pope R. Obstetric and gynecologic genitourinary fistulas. Clin Obstet Gynecol. 2021;64(2):321–30.
50. Capelle M, Nolens B, Lule J, Byamugisha J, van Roosmalen J, van den Akker T. Health workers' perspectives on vacuum extraction in Mulago Hospital, Uganda. [cited 2023 Jan 31]. Available from: https://assets.researchsquare.com/files/rs-33627/v2/9619ab05-ccbc-4d8c-b2c1-d0029170a47c.pdf?c=165366
51. Simonson C, Barlow P, Dehennin N, Sphel M, Toppet V, Murillo D, et al. Neonatal complications of vacuum-assisted delivery. Obstet Gynecol. 2007;109(3):626–33.
52. Vacca A. Vacuum-assisted delivery. Best Pract Res Clin Obstet Gynaecol. 2002;16(1):17–30.
53. Wright A, Nassar AH, Visser G, Ramasauskaite D, Theron G, FIGO Safe Motherhood and Newborn Health Committee. FIGO good clinical practice paper: management of the second stage of labor. Int J Gynecol Obstet. 2021;152(2):172–81.
54. Nolens B, van den Akker T, Lule J, Twinomuhangi S, van Roosmalen J, Byamugisha J. Birthing experience and quality of life after vacuum delivery and second-stage caesarean section: a prospective cohort study in Uganda. Trop Med Int Health. 2018;23(8):914–22.

55. Declercq E, Cunningham D, Johnson C, Sakala C. Mothers' reports of postpartum pain associated with vaginal and caesarean deliveries: results of a national survey. Birth. 2008;35:16–24.
56. Carlander AKK, Andolf E, Edman G, Wiklund I. Health-related quality of life five years after birth of the first child. Sex Reprod Healthc. 2015;6:101–7.

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Additional supporting information can be found online in the Supporting Information section at the end of this article.

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