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## Reintroduction of vacuum extraction in a tertiary referral hospital in Uganda

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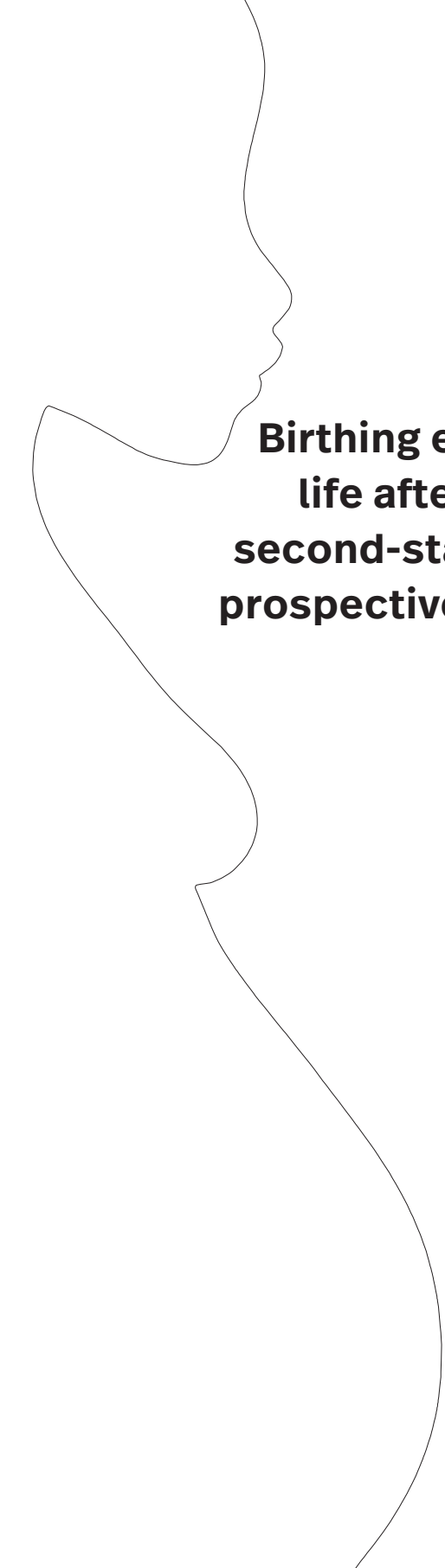
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**Birthing experience and quality of  
life after vacuum extraction and  
second-stage caesarean section: a  
prospective cohort study in Uganda**

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## Abstract

### Objective

To assess perceptions of women undergoing vacuum extraction or second-stage caesarean section in a tertiary referral hospital in sub-Saharan Africa.

### Methods

Prospective cohort study, with six months follow-up, of women who gave birth to a term singleton in cephalic presentation by vacuum extraction (n=289) or second-stage caesarean section (n=357) between 25th of November 2014 and 8th of July 2015, in Mulago hospital, Uganda. Excluded were women who had failed vacuum extraction, severe birth complications and those whose neonates had died. Outcome measures were birthing experience satisfaction, physical component summary (PCS) and mental component summary (MCS) of the SF-12 quality-of-life questionnaire, pain scores and dyspareunia.

### Results

One day after vacuum extraction, 63.7% (181/284) of women were feeling well versus 48.1% (167/347) after caesarean section (OR 1.89; 95%CI 1.37–2.61) and mean pain scores were 2.70 versus 3.87 ( $P<0.001$ ). In both groups, more than 90% of women were satisfied with their birthing experience. At six weeks, in vacuum extraction versus caesarean section, mean pain scores were 0.40 versus 0.89 ( $P<0.001$ ); mean PCS was 48.67 versus 44.03 ( $P<0.001$ ); mean MCS was 52.80 versus 51.23 ( $P=0.203$ ); 40% (70/175) versus 28.3% (70/247) of women had resumed sexual intercourse (OR 1.69; 95%CI 1.12–2.54) and 21.4% (15/70) versus 28.6% (20/70) had dyspareunia (OR 0.68; 95%CI 0.32–1.47). No differences were found at six months after birth.

### Conclusions

One day and six weeks after birth, outcomes were better in women who had vacuum extraction. At six months, outcomes were similar. To promote quick recovery, vacuum extraction should be the first intervention considered in the second stage of labour.

## Introduction

Increased use of vacuum extraction or other modes of assisted vaginal birth could potentially prevent many maternal deaths caused by complications of prolonged labour or unsafe caesarean section and a large proportion of stillbirths and neonatal deaths in sub-Saharan Africa.<sup>1-8</sup>

Indications for vacuum extraction are prolonged second stage of labour, fetal distress, maternal exhaustion or the need to avoid expulsive efforts in maternal conditions such as severe anaemia or heart failure.<sup>9-12</sup> Use of vacuum and forceps-assisted vaginal birth varies from more than 10% in northern Europe to less than 1% in many places in sub-Saharan Africa.<sup>2,13</sup> In many sub-Saharan African countries, surgery carries higher risks due to unsafe anaesthesia and unavailability of blood for transfusion.<sup>6,14,15</sup> A uterine scar may lead to uterine rupture and abnormal or invasive placentation in a subsequent pregnancy.<sup>16</sup> Women with a uterine scar may not be aware of these risks and try to give birth at home.<sup>6</sup> Recent publications suggest that caesarean section in the second stage of labour increases the risk of spontaneous preterm birth in the next pregnancy.<sup>17,18</sup> Therefore, particularly in these settings, preventing caesarean section is important: this view is supported by WHO and other international reproductive health and maternity care leaders.<sup>19-21</sup> Thus, vacuum extraction, the simplest method of assisted vaginal birth, was re-introduced in the main teaching hospital in Uganda in 2012.<sup>9</sup> After re-introduction, clinical maternal and perinatal outcome improved significantly with considerably fewer intrapartum stillbirths and uterine ruptures.<sup>3</sup>

In addition to clinical outcomes, birthing experience, pain, ability to work and pain-free sexual intercourse are also very important birth outcomes, particularly from a woman's perspective (and influencing her decision on where to give birth the next time). These outcomes, in women who had assisted vaginal births, have only been studied in high-income settings.<sup>22-29</sup>

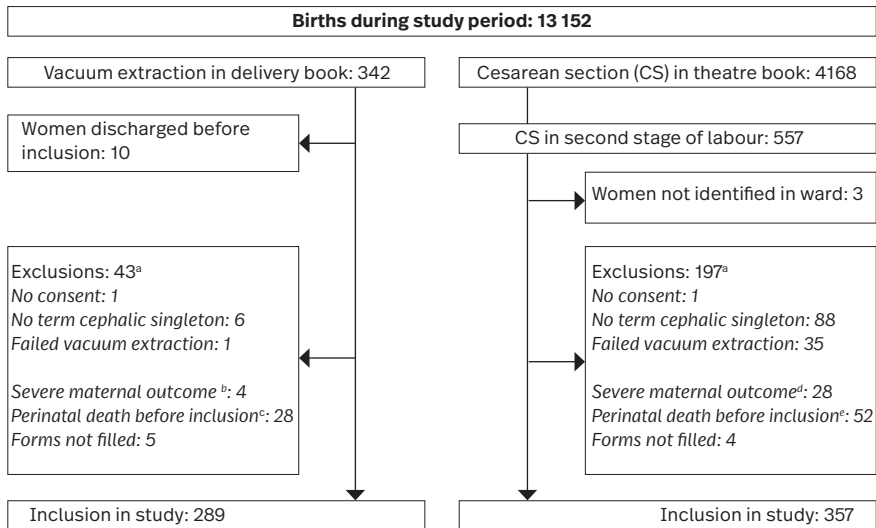
The aim of this study was to assess how vacuum extraction was experienced by women after its re-introduction in a tertiary referral hospital in sub-Saharan Africa, using women-centred outcomes such as birthing experience satisfaction; pain one day after birth; and quality of life, pain and dyspareunia six weeks and six months after birth. Outcome is compared with outcome after second-stage caesarean section, which is another intervention in case of delay or failure to progress in the second stage of labour.

This study was part of a larger study that also investigated clinical maternal and perinatal outcome after vacuum extraction and second-stage caesarean section.<sup>6</sup> Vacuum extraction (including failed vacuum extraction and subsequent caesarean section) had better maternal outcomes than caesarean section and equivalent perinatal outcomes. The odds ratio for severe maternal complications after vacuum extraction versus second-stage caesarean section was 0.24 (95%CI 0.07–0.84). The odds ratio for perinatal death was 0.83 (95%CI 0.49–1.41).

## Methods

### Participants

This was an observational, prospective cohort study, comparing women-centred outcomes after vacuum extraction and second-stage caesarean section. The study was conducted in the main labour ward of Mulago national referral hospital, Kampala, Uganda. The inclusion period was from 25th of November 2014 to 8th of July 2015, and women were interviewed one day, six weeks and six months after birth. Included were women who gave birth to a term singleton in cephalic presentation by vacuum extraction or second-stage caesarean section and who consented to being included. Excluded were women who had a failed vacuum extraction followed by caesarean section due to the inability to ascribe outcomes to either procedure, and women who had severe complications (defined as maternal death, uterine rupture, re-laparotomy, obstetric fistula and eclampsia) or perinatal death that had occurred before the moment of inclusion at one day after birth (Figure 1). Women whose neonates had died before six-week or six-month follow-up were excluded from analysis of outcome at that time-point. Clinical outcome of women and neonates excluded here is described elsewhere.<sup>6</sup> Vacuum extraction was compared to second-stage caesarean section as the alternative treatment option. Forceps was hardly used in this hospital (fewer than five times during the study period).



**Figure 1** | Inclusion process

CS, caesarean section; IUFD, intrauterine fetal death

<sup>a</sup> More than one exclusion criterion could apply

<sup>b</sup> Ruptured uterus and re-laparotomy (2), eclampsia (2)

<sup>c</sup> IUFD on admission (10), IUFD in waiting time or during vacuum extraction (3), neonatal death on day one (15)

<sup>d</sup> Maternal death (5), ruptured uterus (13: 5 on admission, 8 in waiting time for CS), re-laparotomy (5), eclampsia (4), obstetric fistula (4)

<sup>e</sup> IUFD on admission (15), IUFD in waiting time or during CS (18), neonatal death on day one (19)

## Setting

Mulago hospital is the national referral and main teaching hospital of Uganda. It is a government hospital with 2700 beds and more than 31 000 births annually, with the capital Kampala and surroundings as catchment area. Maternity services are free of charge. Vacuum extraction was by Kiwi vacuum extractor (Clinical Innovations, South Murray, Utah, US) or Bird and silicone cups with hand and foot pumps. Regional analgesia during labour or assisted vaginal birth was not used.

Episiotomy for vacuum extraction was not routinely performed. If performed, local lidocaine infiltration was used, if available. Caesarean section was by lower abdominal transverse incision (Pfannenstiel, Joel-Cohen or modification) or subumbilical midline incision. Caesarean section was most often performed under spinal anaesthesia. Post-vacuum analgesia was by paracetamol and NSAIDs. Post-caesarean section analgesia was by pethidine, tramadol, paracetamol and NSAID's, when available. Women were normally discharged at the first day after vacuum extraction or the third day after caesarean section.

## Inclusion process

On the first day after birth, women who had given birth by vacuum extraction were identified from the hospital's birth register by a member of the research team. Women who had had a caesarean section were identified from the operating theatre register. To identify those women who had been in the second stage of labour during caesarean section, their medical records were examined. Women who fulfilled the inclusion criteria were asked to participate in the study on the first day after birth. After obtaining written informed consent, the woman was interviewed by a trained research assistant in either English or Luganda, which are the most commonly spoken languages in Kampala. Baseline characteristics were extracted from the medical records.

## Birthing experience interview

The birthing experience assessment consisted of a short interview, based on four questions, each with four fixed response options. Questions addressed how women had experienced giving birth (Appendix S1). A numeric pain rating scale (NPRS, scale 0–10) was filled.<sup>30</sup>

## Follow-up

Postnatal consultations took place six weeks and six months after birth. During these visits, women were interviewed using structured questionnaires (Appendix S2). The questionnaires consisted of the SF-12v1 questions, pain scores (NPRS 0–10) and a question concerning dyspareunia.<sup>30–32</sup> Women who missed postnatal consultations were

interviewed over the phone, using the same questionnaire, from which SF-12 questions were excluded. Therefore, groups with analysis of SF12-questions are smaller.

### **SF-12 questionnaire**

The Short Form 12 (SF-12) questionnaire contains 12 items and is based on the original SF-36 Health Survey.<sup>30,31</sup> It is a norm-based generic measure to assess health-related quality of life, widely used and psychometrically robust.<sup>31</sup> SF-12 measures general physical and mental health status and is not specific for age, disease or health condition. It assesses eight physical and mental health dimensions: physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality, social functioning, role limitations due to emotional health problems and mental health. From these eight dimensions, a physical component summary (PCS) and mental component summary (MCS) are calculated. The tool is designed such that mean PCS and MCS (in the US population) are 50 with a standard deviation (SD) of 10. High scores indicate better subjective health functioning (PCS) and emotional wellbeing (MCS). The SF-12 questionnaire is used worldwide and has been translated in more than 100 languages.<sup>31,33</sup>

### **Outcome measures**

Outcome measures were birthing experience satisfaction (based on the answers from the interview at the first day after birth), quality of life (mean PCS and MCS scores from the SF-12 questionnaire and answers per question at six weeks and six months after birth); pain during the procedure and at one day, six weeks and six months after birth (using mean and stratified pain scores; 0: no pain; 1–4: mild pain; 5–7: moderate pain; 8–10: severe pain); percentage of women who reported they had resumed sexual intercourse at six weeks and six months, and percentage of women with dyspareunia at these timepoints.

### **Analysis**

Baseline characteristics are reported in counts and percentages with P-values comparing vacuum extraction to second-stage caesarean section. Outcome parameters are reported as means with standard deviations (SD) and P-values or counts with percentages and odds ratios (OR) with 95% confidence intervals (CI). P-values were calculated with two-sided Chi-square (or two-sided Fisher's exact test where total events were <10). Differences in means between groups were calculated using independent t-tests. Data were entered in Microsoft Excel, and SPSS version 24 was used for data analysis.

### **Sample size**

A convenience sample was used, as this study was part of a larger study including clinical outcome after vacuum extraction and second-stage caesarean section.<sup>6</sup> The sample size for that study was based on expected differences in perinatal deaths per mode of birth.

## Handling of missing data

Percentages were calculated by dividing the number of women with a certain characteristic or outcome parameter by the number of women with a valid response for that characteristic or outcome parameter at each timepoint. Therefore, the denominator in the fractions may differ slightly per characteristic or outcome parameter. In the tables, the total number of participating women and the number of women with a valid response per characteristic or outcome parameter are shown. The number of women with missing data can be calculated by subtracting the number with valid responses from the total number.

Analysis was performed for included women at one day, six weeks and six months after birth. Groups were not exactly the same at six weeks and six months. Some women came for either the six-week or the six-month consultation, but not for both.

## Ethical clearance

Ethical permission to conduct this study was obtained from the Mulago hospital Research and Ethics Committee (refnr: MREC 489) and the Uganda National Council for Science and Technology (refnr: HS1752).

## Results

During the study period, 289 women were enrolled after vacuum extraction and 357 women after second-stage caesarean section (Figure 1). More women who had given birth by vacuum extraction were nulliparous or had their neonates admitted to the neonatology unit, but these findings did not reach statistical significance (Table 1).

After six weeks, losses to follow-up were 29.8% (86/289) for vacuum extraction and 23.2% (83/357) for caesarean section. Thirteen women who had given birth by vacuum extraction, and ten women who had had caesarean section were excluded because the neonate had died in the time elapsed between one day and six weeks postpartum. One woman who had had vacuum extraction was excluded because the neonate was found to have a serious congenital syndrome and died after five months. After six months, losses to follow-up were 31.5% (91/289) for vacuum extraction and 28.3% (101/357) for caesarean section. In both groups, one woman was excluded because the neonate had died.



**Table 1** | Baseline characteristics

	Vacuum extraction (289)	Second-stage caesarean section (357)	P-value
	n/N <sup>a</sup> (%)	n/N <sup>a</sup> (%)	
<b>Pre-labour characteristics</b>			
Nulliparous	156/283 (55.1)	173/357 (48.5)	0.094
Maternal age <20 years	65/284 (22.9)	74/356 (20.8)	0.522
Mean age	23.5 (284) (SD 5.21)	24.0 (356) (SD 5.21)	0.191
Education ≤ 6 years	64/284 (22.5)	89/352 (25.3)	0.420
Formally employed	111/284 (39.1)	154/352 (43.8)	0.235
HIV-positive	28/240 (11.7)	28/309 (9.1)	0.317
<b>Labour and postpartum characteristics</b>			
More than three hours in second stage	78/287 (27.2)	118/357 (33.1)	0.107
5-min Apgar score below seven	18/286 (6.3)	21/354 (5.9)	0.849
Neonate in neonatology unit at time of interview	59/289 (20.4)	53/357 (14.8)	0.063
<b>Perineal status</b>			
Perineal status known	262/289 (90.7)	NA NA	NA
- intact	89/262 (34.0)	NA NA	NA
- episiotomy	94/262 (35.9)	NA NA	NA
- 1st or 2nd degree tear	78/262 (29.8)	NA NA	NA
- 3rd degree tear	2/262 (0.8)	NA NA	NA
<b>Type of incision</b>			
Incision known	NA NA	345/357 (96.7)	NA
- Pfannenstiel	NA NA	308/345 (89.3)	NA
- Midline	NA NA	37/345 (10.7)	NA
<b>Anaesthesia</b>			
Anaesthesia known	NA NA	349/357 (97.8)	NA
- Spinal	NA NA	340/349 (97.4)	NA
- General	NA NA	9/349 (2.6)	NA
<b>Exclusive breastfeeding at six weeks</b>			
Kind of feeding known	186/189 (98.4)	256/264 (97.0)	0.325
Exclusive breastfeeding	166/186 (89.2)	231/256 (90.2)	0.735

SD, standard deviation; NA, not applicable

<sup>a</sup> In n/N, n is the number of women with this characteristic and N is the number of women with known data for this variable.

## Birthing experience

One day after birth, women were feeling significantly better if they had given birth by vacuum extraction than by caesarean section (Table 2). After either intervention, more than 90% of women were satisfied with their birthing experience, although more than 50% had been very concerned about their baby. Compared to caesarean section, more women reportedly had been 'very scared' during vacuum extraction (Table 2).

**Table 2** | Birthing experience

	Vacuum extraction (289)	Second-stage caesarean section (357)	OR	(95%CI)
Are you/were you:	n/N <sup>a</sup> (%)	n/N <sup>a</sup> (%)		
Feeling well <sup>b</sup>	181/284 (63.7)	167/347 (48.1)	1.89	(1.37-2.61)
Satisfied about birth <sup>c</sup>	257/282 (91.1)	332/355 (93.5)	0.71	(0.40-1.28)
Very scared during birth <sup>d</sup>	46/287 (16.0)	25/357 (7.0)	2.54	(1.52-4.24)
Very concerned about baby <sup>e</sup>	169/287 (58.9)	185/357 (51.8)	1.33	(0.97-1.82)

OR, odds ratio; CI, confidence interval

<sup>a</sup> In n/N, n is the number of women with this characteristic and N is the number of women with valid responses for this variable. <sup>b</sup> "very good" or "normal"; <sup>c</sup> "very much" or "yes"; <sup>d</sup> "very scared" or "afraid of dying"; <sup>e</sup> "very concerned" or "afraid the baby would die" (Answers from questionnaire, Appendix S1)

## Pain

Women experienced more pain during vacuum extraction than during caesarean section, but they reported less pain in the first 24 hours after birth (Table 3). One day after vacuum extraction 91.6% (263/287) of women had no pain or mild pain (NPRS 0–4), versus 62.6% (223/356) after caesarean section (OR 6.54; 95%CI 4.09–10.46). Women experienced more pain at one day after subumbilical midline incision than lower transverse incision: mean pain score 4.41 versus 3.78 (P=0.038). Perineal status (intact, episiotomy, tear) had no influence on pain scores during the procedure, or one day after birth in women who gave birth vaginally.

At six weeks after birth, women who had given birth by vacuum extraction had lower mean pain scores than women who had given birth by caesarean section (Table 3). At six-week follow-up, no pain (NPRS 0) was reported by 76.2% (144/189) of women after vacuum extraction, compared to 55.5% (146/264) after caesarean section (OR 2.56; 95%CI 1.70–3.88). Of women who had given birth by vacuum extraction, 3.4% (4/119) had had 'severe' or 'very severe' pain in the four weeks prior to the follow-up visit, versus 17.1% (21/123) after caesarean section (OR 0.17; 95%CI 0.06–0.51) and for 50% (56/112) versus 73.6% (89/121) pain had interfered with daily activities ('normal work, including both work outside the home and house-work')(OR 0.36; 95%CI 0.21–0.62) (Appendix S3).

**Table 3** | Pain scores

	Mean	SD	Mean	SD	P-value
<b>One day after birth</b>	<b>Vacuum extraction (289)<sup>a</sup></b>		<b>Second-stage caesarean section (357)<sup>a</sup></b>		
Pain during intervention	5.35 (287) <sup>b</sup>	3.79	0.35 (357) <sup>b</sup>	0.93	<0.001
Pain first 24 hours	2.70 (287) <sup>b</sup>	1.34	3.87 (356) <sup>b</sup>	1.75	<0.001
<b>Six weeks after birth</b>	<b>Vacuum extraction (189)<sup>a</sup></b>		<b>Second-stage caesarean section (264)<sup>a</sup></b>		
Pain abdominal/vaginal	0.40 (189) <sup>b</sup>	0.84	0.89 (262) <sup>b</sup>	1.21	<0.001
<b>Six months after birth</b>	<b>Vacuum extraction (186)<sup>a</sup></b>		<b>Second-stage caesarean section (245)<sup>a</sup></b>		
Pain abdominal/vaginal	0.28 (185) <sup>b</sup>	1.06	0.27 (244) <sup>b</sup>	0.72	0.952

SD, Standard deviation;

<sup>a</sup> Number of women that was interviewed per time point; <sup>b</sup> Number of valid responses

Six months after birth, there was no significant difference in pain scores between both groups. Mean pain scores were 0.28 and 0.27 after vacuum extraction and caesarean section, respectively (Table 3). After vacuum extraction, 89.2% (165/185) of women reported no pain at all versus 85.2% (208/244) after caesarean section. In 8.8% (10/113) of women after vacuum extraction, pain had interfered 'moderately' to 'extremely' with daily activities in the four weeks prior to the consultation, versus 10.6% (11/104) in women after caesarean section (difference not statistically significant).

### Quality of life

During the six-week follow-up visit, the SF-12 questionnaire was completed by 112 women after vacuum extraction and 121 women after caesarean section. At the six-month follow-up visit, the questionnaire was completed by 113 and 104 women, respectively.

Six weeks after birth the physical component summary (PCS), measured with the SF-12 questionnaire, was better after vacuum extraction than after caesarean section (Table 4). The mental component summary (MCS) was comparably good. After six months, PCS and MCS had improved and were comparable between both groups.

At six weeks, all 12 questions of the SF-12 questionnaire had better scores after vacuum extraction, seven of them statistically significant (Appendix S3). Six weeks after vacuum extraction, fewer women reported that they 'accomplished less work than they would like' as a result of their physical health, compared to after caesarean section (31/112 (27.8%) versus 57/121 (47.1%), OR 0.43; 95%CI 0.25–0.74). Similarly, fewer women reported that they 'accomplished less work than they would like' as a result of emotional problems after vacuum extraction compared to after caesarean section (16/112 (14.3%) versus 32/121 (26.4%), OR 0.46; 96% CI 0.24–0.90) (Appendix S3).

**Table 4** | Quality of life

	Mean	SD	Mean	SD	P-value
<b>Six weeks after birth</b>	<b>Vacuum extraction (112)</b>		<b>Second-stage caesarean section (121)</b>		
PCS	48.67	7.31	44.03	9.15	<0.001
MCS	52.80	8.94	51.23	9.78	0.203
<b>Six months after birth</b>	<b>Vacuum extraction (113)</b>		<b>Second-stage caesarean section (104)</b>		
PCS	52.42	6.52	52.43	6.33	0.993
MCS	54.41	7.28	52.99	8.02	0.173

SD, Standard deviation; PCS, physical component summary; MCS, mental component summary

**Table 5** | Dyspareunia

	n (%)	n (%)	OR	(95%CI)	P-value
<b>Sexual activity at six weeks after birth</b>	<b>Vacuum extraction (189)</b>		<b>Second-stage caesarean section (264)</b>		
Resumed	70/175 (40.0)	70/247 (28.3)	1.69	(1.12-2.54)	0.012
Painful when resumed	15/70 (21.4)	20/70 (28.6)	0.68	(0.32-1.47)	0.329
No comment, excluded from analysis	14/189 (7.4)	17/264 (6.4)			0.687
<b>Sexual activity at six months after birth</b>	<b>Vacuum extraction (186)</b>		<b>Second-stage caesarean section (245)</b>		
Resumed	177/185 (95.7)	229/242 (94.6)	1.26	(0.51-3.10)	0.620
Painful when resumed	16/177 (9.0)	12/229 (5.2)	1.80	(0.83-3.90)	0.134
No comment, excluded from analysis	1/186 (0.5)	3/245 (1.2)			0.637

OR, odds ratio; CI, confidence interval

## Dyspareunia

At six weeks follow-up, more women reported to have resumed sexual intercourse after vacuum extraction than after caesarean section (Table 5). At six months, almost all women had resumed sexual intercourse in both groups. Dyspareunia decreased over time and was comparably low for the groups at six weeks and six months after birth.

## Discussion

### Main findings

This study shows that women-centred outcomes, such as pain scores, quality of life and absence of dyspareunia, were better in the first six weeks postpartum in women who had given birth by vacuum extraction than in women who had given birth by second-stage caesarean section. Six months after birth outcomes were similar. More than ninety percent of women who had given birth by vacuum extraction were satisfied about their birthing experience.

### Other findings

Similar to women after second-stage caesarean section, more than half of the women after vacuum extraction reported to have been 'very concerned' about their baby during the intervention. Information about the procedure and its safety for mother and neonate to women undergoing vacuum extraction is needed to prevent anxiety and concern. Debriefing after birth might reduce fear in future pregnancies.<sup>22</sup>

Understandably, pain scores during vacuum extraction were higher than during caesarean section, as spinal or general anaesthesia were used during caesarean section. Pain scores during vacuum extraction in our study are comparable to pain scores during spontaneous vaginal birth reported in the literature.<sup>34</sup> Pain was, however, significantly worse after caesarean section at one day and six weeks after birth. The latter was also found in a study in the US, where, in the first two months after birth 68% of women experienced significant pain after assisted vaginal birth and 79% after caesarean section. Six months after birth, these percentages had decreased to 2% after assisted vaginal birth and 18% after caesarean section.<sup>23</sup>

Although mean PCS scores were better after vacuum extraction, we did not find differences in mean MCS scores of the SF-12 quality-of-life questionnaire per mode of birth. These findings were similar in a Norwegian study.<sup>24</sup> In a study from the UK, however, women who gave birth by forceps or unplanned caesarean section had a higher risk of reduced postnatal health and wellbeing (including increased risk of post traumatic stress syndrome following forceps birth), while outcomes after vacuum extraction were comparable to those after spontaneous birth.<sup>25</sup> A study from Sweden reported better quality of life five years after assisted vaginal birth compared to emergency caesarean section.<sup>26</sup>

At six weeks after birth, pain, body weakness and emotional problems interfered significantly less with daily activities after vacuum extraction than caesarean section (Appendix S3). This could be of particular importance in a setting where many women are self-employed and do not have a paid maternity leave, while their family is depending on their income.

Reports on dyspareunia after different modes of birth give a wide range of results. In a study from Germany, 13.9% of women had dyspareunia six months after assisted vaginal birth versus 3.4% after caesarean section.<sup>27</sup> In a study from Australia, 59.5% of women had dyspareunia at six months after vacuum extraction and 40.6% after emergency caesarean section. At 18 months, these percentages were 28.9% and 29.3% in that study.<sup>28</sup>

Another study from Australia reported that at 12 months after birth, sexual function had returned to early pregnancy levels, irrespective of mode of birth.<sup>29</sup>

### **Strengths and limitations**

Strengths of this study are its prospective design and follow-up to six months after birth, use of validated questionnaires and large number of participants. Nearly all eligible women were included, preventing selection bias (Figure 1). Follow-up at one day, six weeks and six months prevented recall bias. This study is the only study known to us about this subject in sub-Saharan Africa and the only study performed just after the reintroduction of vacuum extraction in a maternity care service.

Limitations of the study were its observational design, which may have introduced bias. However, not statistically different, nulliparity or admission of the neonate to the neonatology unit were somewhat more frequent in the vacuum extraction group and this may have introduced bias. But the absence of this bias would probably have resulted in even larger differences in favour of vacuum extraction. Excluding women with a neonate in the neonatology unit at the time of birthing experience interview did not have an effect on the results. Losses to follow-up may have caused bias but these were comparable between both groups and comparable to losses to follow-up in other studies.<sup>22,24,26-29</sup> Recruitment from a single hospital compromises generalisability, but the situation in many resource-constrained high-volume hospitals in sub-Saharan Africa is likely to be similar.

### **Interpretation and implications**

This study is the first study describing how vacuum extraction was experienced by women after its re-introduction in a hospital in sub-Saharan Africa. The major contribution is that it shows that aside from medical reasons to prevent caesarean section, there are several reasons in favour of vacuum extraction instead of caesarean section from the women's point of view. Main reasons are pain, quality of life and ability to perform daily activities in the first six weeks after birth.

## **Conclusion**

Women-centred outcomes, such as pain scores and quality of life, were better in the first six weeks postpartum in women who had given birth by vacuum extraction, compared to women who had given birth by second-stage caesarean section. Six months after birth outcomes were similar. Our findings suggest that women, even if they are not acquainted with the procedure, are satisfied with their birthing experience after vacuum extraction. These findings, in combination with medical reasons, support the use of vacuum extraction as first intervention to be considered in the second stage of labour to prevent complications and promote quick recovery.

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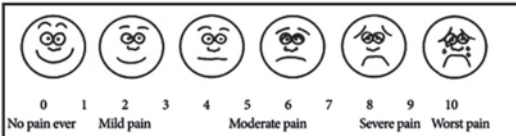


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## Supporting information

Additional Supporting Information can be found below and on the next pages:

### Appendix S1 | Questionnaire day one

1	How are you feeling? <i>Owulire otya?</i>	very good <i>bulungi nnyo</i>	normal <i>nga bulijjo</i>	not well <i>sibulungi</i>	bad <i>bubi</i>
2	Are you satisfied about your birth? <i>Oli mumativu mu ngeri gyózáddemu?</i>	not at all <i>tewali wadde</i>	no <i>nedda</i>	yes <i>yee</i>	very much <i>nnyo ddala</i>
3	Were you scared during the vacuum extraction/caesarean section? <i>Watyá nga basikayo omwana oba nga balongoosa?</i>	no <i>nedda</i>	a little scared <i>satyo nnyo</i>	very scared <i>natya nnyo</i>	afraid of dying <i>ntya okufa</i>
4	Were you concerned about the baby? <i>Wafaayo nnyo ku omwana?</i>	no <i>nedda</i>	a little concerned <i>nafaayo katono</i>	very concerned <i>nafaayo nnyo</i>	afraid the baby would die <i>natya nti omwana ayinza okufa</i>
5	Did you experience pain during the vacuum extraction/caesarean section? Indicate how much, circle the number:  <i>Wawulira obulumi nga basikayo oba bakulongoosa?</i>	 <p>0 1 2 3 4 5 6 7 8 9 10 No pain ever Mild pain Moderate pain Severe pain Worst pain</p>			
6	Did you experience pain after the vacuum extraction/caesarean section (first 24-hours)?  <i>Wawulira obulumi oluvannyuma lw'okusikayo omwana, oba nga bamaze okulongoosamu omwana?</i>	 <p>0 1 2 3 4 5 6 7 8 9 10 No pain ever Mild pain Moderate pain Severe pain Worst pain</p>			

**Appendix S2** | Questionnaire six weeks and six months

1	Do you still have abdominal/vaginal pain?	No	Yes				
2	Is having sexual intercourse painful?	No	Yes				
		Not resumed yet					
3	How much pain have you had during the past four weeks?	None	Very mild	Mild	Moderate	Severe	Very severe
SF1	In general, would you say your health is:	Excellent		Very Good	Good	Fair	Poor
The following items are about activities you might do during a typical day.							
SF2	Does your health now limit you in moderate activities, such as moving a table (pushing a vacuum cleaner, bowling or playing golf)?	Yes, limited a lot		Yes, limited a little		No, not limited at all	
SF3	Does your health now limit you in climbing several flights of stairs?	Yes, limited a lot		Yes, limited a little		No, not limited at all	
During the past four weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?							
SF4	Accomplished less than you would like	No	Yes				
SF5	Were limited in the kind of work or other activities	No	Yes				
During the past four weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?							
SF6	Accomplished less than you would like	No	Yes				
SF7	Didn't do work as carefully as usual	No	Yes				
SF8	During the past four weeks, how much did pain interfere with your normal work (including both work outside the house and housework)?	Not at all		A little bit	Moderately	Quite a bit	Extremely
These questions are about how you feel and how things have been with you during the past four weeks. For each question, please give the answer that comes closest to the way you have been feeling. How much time during the past four weeks:							
SF9	Have you felt calm and peaceful?	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
SF10	Did you have a lot of energy?	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
SF11	Have you felt downhearted and blue?	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
SF12	During the past four weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
If follow-up was on phone, only the first two questions were asked							

## Appendix S3 | SF-12 interview at six weeks after birth, outcome per question

	Vacuum extraction (112)	Second-stage caesarean section (121)	P-value
	n (%)	n (%)	OR* (95%CI)
<b>1. In general, would you say your health is:</b>			
Excellent (1)	21 (18.8)	11 (9.1)	
Very good (2)	44 (39.3)	36 (29.8)	
Good (3)	37 (33.0)	63 (52.1)	
Fair (4)	10 (8.9)	10 (8.3)	
Poor (5)	0 (0)	1 (0.8)	
Mean (SD)	2.32 (0.88)	2.62 (0.80)	0.007
<b>The following items are about activities you might do during a typical day.</b>			
<b>2. Does your health now limit you in moderate activities, such as moving a table (pushing a vacuum cleaner, bowling or playing golf)?</b>			
Yes, limited a lot (1)	6 (5.4)	17 (14.0)	
Yes, limited a little (2)	19 (17.0)	40 (33.1)	
No, not limited at all (3)	87 (77.7)	64 (52.9)	
Mean (SD)	2.72 (0.56)	2.39 (0.72)	<0.001
<b>3. Does your health now limit you in climbing several flights of stairs?</b>			
Yes, limited a lot (1)	6 (5.4)	8 (6.6)	
Yes, limited a little (2)	22 (19.6)	23 (19.0)	
No, not limited at all (3)	84 (75.0)	90 (74.4)	
Mean (SD)	2.70 (0.57)	2.68 (0.60)	0.806
<b>During the past four weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?</b>			
<b>4. Accomplished less than you would like</b>			
No (1)	81 (72.3)	64 (52.9)	
Yes (2)	31 (27.7)	57 (47.1)	0.43 (0.25-0.74)
Mean (SD)	1.28 (0.45)	1.47 (0.50)	0.002
<b>5. Were limited in the kind of work or other activities</b>			
No (1)	80 (71.4)	62 (51.2)	
Yes (2)	32 (28.6)	59 (48.8)	
Mean (SD)	1.29 (0.45)	1.49 (0.50)	0.002
<b>During the past four weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?</b>			
<b>6. Accomplished less than you would like</b>			
No (1)	96 (85.7)	89 (73.6)	
Yes (2)	16 (14.3)	32 (26.4)	0.46 (0.24-0.90)
Mean (SD)	1.14 (0.35)	1.26 (0.44)	0.022
<b>7. Didn't do work as carefully as usual</b>			
No (1)	100 (89.3)	90 (74.4)	
Yes (2)	12 (10.7)	31 (25.6)	0.35 (0.17-0.72)
Mean (SD)	1.11 (0.31)	1.26 (0.44)	0.003

Continued on next page

## Appendix S3 | continued

<b>8. During the past four weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?</b>			
Not at all (1)	56 (50.0)	32 (26.4)	
There was interference (a little bit to extremely)	56 (50.0)	89 (73.6)	0.36 (0.21-0.62)
- A little bit (2)	35 (31.3)	45 (37.2)	
- Moderately (3)	14 (12.5)	23 (19.0)	
- Quite a bit (4)	7 (6.3)	14 (11.6)	
- Extremely (5)	0 (0)	7 (5.8)	
Mean (SD)	1.75 (0.91)	2.33 (1.16)	<0.001
These questions are about how you feel and how things have been with you during the past four weeks. For each question, please give the answer that comes closest to the way you have been feeling. How much time during the past four weeks:			
<b>9. Have you felt calm and peaceful?</b>			
All the time (1)	56 (50.0)	51 (42.1)	
Most of the time (2)	25 (22.3)	31 (25.6)	
A good bit of the time (3)	4 (3.6)	9 (7.4)	
Some of the time (4)	14 (12.5)	16 (13.2)	
A little of the time (5)	7 (6.3)	8 (6.6)	
None of the time (6)	6 (5.4)	6 (5.0)	
Mean (SD)	2.19 (1.56)	2.31 (1.53)	0.533
<b>10. Did you have a lot of energy?</b>			
All the time (1)	52 (46.4)	42 (34.7)	
Most of the time (2)	21 (18.8)	26 (21.5)	
A good bit of the time (3)	9 (8.0)	15 (12.4)	
Some of the time (4)	17 (15.2)	21 (17.4)	
A little of the time (5)	10 (8.9)	9 (7.4)	
None of the time (6)	3 (2.7)	8 (6.6)	
Mean (SD)	2.29 (1.52)	2.61 (1.59)	0.123
<b>11. Have you felt downhearted and blue?</b>			
All the time (1)	4 (3.6)	7 (5.8)	
Most of the time (2)	5 (4.5)	6 (5.0)	
A good bit of the time (3)	3 (2.7)	6 (5.0)	
Some of the time (4)	12 (10.7)	10 (8.3)	
A little of the time (5)	19 (17.0)	30 (24.8)	
None of the time (6)	69 (61.6)	62 (51.2)	
Mean (SD)	5.18 (1.34)	4.95 (1.48)	0.219
<b>12. During the past four weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?</b>			
All the time (1)	23 (20.5)	29 (24.0)	
Most of the time (2)	9 (8.0)	5 (4.1)	
Some of the time (3)	8 (7.1)	11 (9.1)	
A little of the time (4)	17 (15.2)	29 (24.0)	
None of the time (5)	55 (49.1)	47 (38.8)	
Mean (SD)	3.64 (1.62)	3.50 (1.60)	0.487