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Improving apgar scores and reducing perineal injuries through midwife-led quality improvements: an observational study in Uganda

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Abstract

Background Globally, the quality of maternal and newborn care remains inadequate, as seen through indicators like perineal injuries and low Apgar scores. While midwifery practices have the potential to improve care quality and health outcomes, there is a lack of evidence on how midwife-led initiatives, particularly those aimed at improving the use of dynamic birth positions, intrapartum support, and perineal protection, affect these outcomes.

Objective To explore how the use of dynamic birth positions, intrapartum support, and perineal protection impact the incidence of perineal injuries and the 5-min Apgar score within the context of a midwife-led quality improvement intervention.

Methods A cohort of 630 women with uncomplicated full-term pregnancies was recruited from a hospital in Uganda. Observations and questionnaires assessed birth positions, intrapartum support, perineal protection, health outcomes and maternal characteristics. Primary outcomes included perineal injuries and the 5-min Apgar scores. The primary outcomes were analysed using descriptive data, with trends visualised through a run chart to assess changes during the midwife-led Quality Improvement intervention. Secondary outcomes included postpartum haemorrhage, admission to neonatal intensive care, newborn resuscitation, skin-to-skin care, and breastfeeding initiation.

Result A statistically significant association was found between women having intact perineum (i.e., no perineal injuries) and giving birth in a dynamic birth position [AOR; 0.6 (95% CI 0.4 – 0.90)], receiving intrapartum support [AOR; 0.9 (95% CI 0.9 – 1.0)], and using perineal protection measures [AOR; 0.3 (95% CI 0.2 – 0.5)]. Newborns with an Apgar score below seven at five minutes were significantly associated with intrapartum support [AOR; 0.8 (95% CI 0.7 – 1.0)] and perineal protection [AOR; 0.3 (95% CI 0.1 – 0.8)]. However, after adjustment, no significant association was found between Apgar score and birth positions [AOR; 0.5 (95% CI 0.2 – 1.5)]. Perineal injuries and low Apgar scores significantly decreased ($p < 0.001$) during the Midwife-led Quality Improvement intervention period.

Conclusion This study demonstrates that low 5-min Apgar scores and perineal injuries decreased during a midwife-led Quality Improvement intervention focusing on dynamic birth positions, intrapartum support, and perineal protection strategies.

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Keywords Midwifery, Quality of care, Maternal health, Neonatal health, Pregnancy outcome, Apgar score, Birth injuries, Uganda

Key messages

What is already known on this topic

Globally, the quality of maternal and newborn care is often insufficient, with high rates of perineal injuries and low Apgar scores serving as important indicators of this problem. While midwifery practices have the potential to enhance the quality of care and these outcomes, there is limited evidence on how midwife-led improvements, specifically concerning dynamic birth positions, intrapartum support, and perineal protection, impact perineal injuries and Apgar scores.

What this study adds

This study demonstrates that midwife-led quality improvements, including the use of dynamic birth positions, intrapartum support and perineal protection, can significantly reduce perineal injuries and improve neonatal Apgar scores.

How this study might affect research, practice or policy

The study provides evidence to support the adoption of midwife-led, context-specific quality improvement interventions in maternal and newborn healthcare. This approach could inform future research, enhance clinical practice, and shape policies to reduce birth-related injuries and improve neonatal health, particularly in low-resource settings.

Background

Ensuring high-quality maternal and newborn health services is essential for improving health outcomes globally. Unfortunately, all countries encounter challenges related to poor care quality, such as inappropriate or unnecessary interventions, inadequate or unsafe clinical facilities, and insufficiently trained healthcare providers [1]. These issues are particularly severe in low- and middle-income countries, where the lack of quality care before, during, and after childbirth leads to alarmingly high rates of maternal and neonatal morbidity and mortality [2, 3]. To address these pressing challenges, urgent strategies are needed to enhance the quality of care and improve health outcomes for mothers and newborns.

Properly trained and supported midwives can be crucial in improving the quality of maternal and newborn health services. Their expertise in providing continuous, person-centred care throughout pregnancy, labour, and postpartum period allows them to address critical aspects of maternal and newborn health [4]. Despite their importance, midwives are often underutilised due to organisational and resource constraints that restrict their practice [5, 6]. However, with proper resources, training and support, midwives have the potential to increase the use of best practices that prevent complications, reduce the need for medical interventions, and promote safer birth outcomes [4, 7].

An important indicator of maternal care quality is the perineal status after childbirth, i.e. if the woman sustained a perineal injury or maintained an intact perineum. A lower incidence of perineal injuries typically suggests skilled midwifery, effective communication, strong calming and reassurance techniques, and the appropriate use of best practices [8]. Globally, 53–79% of women experience perineal injuries during birth, which result from either an episiotomy or spontaneous tearing that requires suturing [9, 10]. These injuries are linked to immediate and long-term complications, including pain, reduced pelvic floor strength, and sexual dysfunction, making their prevention a critical priority in maternity care [11, 12]. In low-resource settings like Uganda, reducing perineal injuries poses additional challenges due to shortages of both midwives and essential supplies, such as suture materials, proper beds, and adequate lighting [13].

Another critical health outcome indicator that reflects the quality of newborn care and is closely linked to the work of midwives is the Apgar score. Midwives and other healthcare professionals commonly use this score to evaluate critical parameters such as heart rate, breathing, muscle tone, reflexes, and skin colour at 1, 5, and 10 min after birth [14]. The tool is especially important for identifying birth asphyxia, a major cause of neonatal mortality worldwide and responsible for 60% of neonatal deaths in Uganda [15, 16]. Beyond indicating asphyxia, A 5-min Apgar score under seven is also linked to immediate issues like respiratory distress and feeding difficulties, as well as long-term complications such as cerebral palsy and sensory impairments [17, 18], which underscores the need for improvement in newborn Apgar scores.

Quality midwifery care can lower perineal injury rates and improve Apgar scores, but finding ways to achieve this in clinical practice has been challenging [19, 20]. To address this gap, an intervention aimed at enhancing midwifery care and improving maternal and newborn outcomes, specifically reducing perineal

injuries and increasing Apgar scores, was carried out in a labour ward in Kampala, Uganda. A co-creation and needs assessment process identified three critical areas for improvement, aligned with WHO recommendations for intrapartum care [2, 19, 21]. These areas, which are now the focus of a midwife-led quality improvement (QI) initiative, include promoting the use of i) Dynamic Birth Positions (DBP), ii) intrapartum support, and iii) perineal protection measures.

DBP was selected as the first improvement area of the midwife-led QI initiative due to its positive impact on labour care quality, particularly in enhancing women's decision-making and promoting better health outcomes during and after childbirth [19, 22–26]. DBP involves using upright positions such as kneeling, all-fours, a birth stool, or lateral positions while allowing women to follow their instincts and adjust their position during labour [27]. Compared to static supine positions like dorsal (lying flat on the back), semi-recumbent (semi-sitting), and lithotomy (legs in stirrups) [27, 28], DBPs are linked to a more positive birth experience, less pain, shorter labour, and fewer fetal heart rate abnormalities, low Apgar scores, Neonatal Intensive Care (NICU) admissions, instrumental deliveries, and c-Sects[19, 22–26].. These benefits highlight the importance of promoting DBPs as part of respectful, evidence-based maternity care.

The second improvement area, intrapartum support, is critical for enhancing maternal satisfaction, providing respectful care, and improving overall birth outcomes in clinical practice [20, 29, 30]. Intrapartum support includes different aspects of care, such as emotional and physical support, information sharing, and advocacy [29]. Adequate intrapartum support has been linked to higher rates of spontaneous vaginal deliveries, shorter labour duration, reduced instrumental births, greater birth satisfaction, and improved neonatal outcomes, including higher Apgar scores [19, 21, 31, 32]. This means that strengthening intrapartum support in clinical settings is essential when improving the quality of maternal and newborn care.

The third improvement area, perineal protection, is crucial in preventing tears [19]. Perineal protection is closely linked to the DBP improvement area, as introducing new approaches for staff to support women in unfamiliar birthing positions without training in perineal protection could otherwise increase the risk of injuries [33]. Recommended perineal techniques include, for example, facilitating a two-step birth (where the head and body are not delivered during the same contraction) [33], using hands-on perineal protection to support the perineum and control the expulsion of the fetal head, and encouraging spontaneous pushing [34]. These strategies underscore the importance of integrating perineal protection into routine care to improve birth outcomes for both mothers and newborns.

In Uganda, as in many other global settings, the use of DBP, intrapartum support, and perineal protection is insufficient, leading to a high prevalence of perineal injuries and poor newborn health outcomes, as indicated by low Apgar scores [19, 20, 30, 35]. Therefore, there is a clear need to improve the quality of care related to these areas. Despite the importance and the potential of midwives to improve the quality of care, the impact of midwife-led quality improvements has not been thoroughly studied. Therefore, this study aims to explore how DBPs, intrapartum support, and perineal protection impact perineal injuries and the 5-min Apgar score within the context of a midwife-led quality improvement intervention.

Method

Study population

This prospective observational study included women aged 18 and older with uncomplicated full-term pregnancies (37 + 0 to 41 + 6 weeks) who arrived at the labour ward during the QI project between May and December 2022 and during follow-up periods in February and May 2023. Exclusion criteria included women with multiple gestations, preterm births (< 37 + 0 weeks gestation), post-term births (≥ 42 + 0), known pregnancy complications, caesarean sections, and known fetal abnormalities. Eleven women were excluded due to stillbirth ($n = 1$), arriving late in the second stage of labour ($n = 4$), and when the research assistant could not document multiple simultaneous births ($n = 6$). Nine women declined to participate in the study without giving a reason. Eight women consented to the study but were lost to follow-up after leaving the hospital quickly, leaving a total of 630 women.

Study setting

The study was conducted at a public national referral hospital in Kampala, the capital city of Uganda. The maternity department officially has a 25-bed capacity, but more beds have been squeezed in, bringing the total to 37. The department is staffed by 32 midwives, 11 of whom are assigned to the labour ward, together with four obstetricians and junior house officers. It manages approximately 9,000 births annually and has a c-section rate of about 44%. The labour room is small, with three beds separated by low walls and curtains, allowing one midwife to monitor all three beds if necessary. While cold water is available most days, there is no hot water. Due to the overcrowding and limited space, some women give birth in the admission room or corridors while waiting to enter the labour room. Most of the time, women remain

in the corridor outside the admission and labour rooms, entering the labour room only for check-ups or when they are about to give birth or shortly before.

Data collection

Trained research assistants ($n=2$) collected data from 1st May to December 2022, with subsequent follow-up assessments conducted for two weeks in February and May 2023, respectively. The data collection schedule was adjusted when the QI intervention expanded to include the night-time shift starting in October 2022; Data were collected from 9 AM to 2 PM, Monday to Friday, between May and September, and from 9 AM to 2 PM and 10 PM to 6 AM from October to December 2022 and February and May 2023. The research assistants received a one-day training and interacted with the lead author (JB) every weekday during the data collection period.

To uphold data accuracy, three authors (JB, HL, KE) oversaw the data collection over seven days in May, three days in July, and three days in September 2022. The supervision involved observing data collection and discussing cases with the research assistants to ensure clarity and consistency.

The data collection form used in the study originated from the Midwize Capacity Building Program, an online leadership program where healthcare professionals lead QI in maternal care[36]. The form was customised, tested and refined before the intervention began through collaborative sessions with the research team, research assistants, and Midwize Ambassadors. The data collection form was divided into two parts. Part one involved data collected through direct systematic observations during birth. The research assistant was present in the labour room, where they completed a study form during the birth. Part two of the form included structured interviews with women after birth (See Appendix 1).

In part one of the data collection form, women's use of the three improvement areas: birth positions, intrapartum support, perineal protection, and primary and secondary health outcomes were collected through direct observations during birth. Birth positions were classified as either DBP or non-DBP. Intrapartum support was measured using a set of 11 items specifically designed to capture various aspects of support provided to women during labour. These items were selected following the guidelines outlined in The Royal Colleges of Midwives' *'Evidence-Based Guidelines for Midwifery-Led Care in Labour'* [29]. Each item had a 'yes' or 'no' answer to quantify the level of support received. Perineal protection was measured using three methods based on WHO recommendations and previous evidence [19, 33, 34]. Table 1 provides a detailed description of the systematic

Table 1 Data collection measures for the Improvement areas: dynamic birth position, intrapartum support and perineal protection

Improvement areas	Definition	
	Yes	**No**
Dynamic birth position	Birth chair, all-fours, lateral (lying on the side), kneeling	Supine positions; dorsal (lying on the back) Lithotomy position (lying on the back, knees bent and raised above the hips, spread apart in stirrups) Semi-recumbent (semi-sitting, trunk tilted forwards up to 30º to the horizontal)[28]
Intrapartum support	If a staff/companion/student performed/gave guidance on i) calm breathing, ii) gentle strokes, iii) massage, iv) other emotional or relaxation techniques, v) encouraged the woman to use different positions before entering the birth room If a staff/companion/student performed/gave guidance on vi) calm breathing, vii) gentle strokes, viii) massage, ix) other emotional or relaxation techniques, x) encouraged the woman to use different positions after she entered the birth room to give birth If the woman was involved in decision-making, xi) An individual decision was made by a woman or a guided/joint decision made by a woman and staff over birth positions	If the staff/companion/student did not perform/give guidance on i) calm breathing, ii) gentle strokes, iii) massage, iv) other emotional or relaxation techniques, v) encouraging the woman to use different positions before entering the birth room If the staff/companion/student did not perform/give guidance on vi) calm breathing, vii) gentle strokes, viii) massage, ix) other emotional or relaxation techniques, x) encouraged the woman to use different positions after she entered the birth room to give birth The woman was not involved in decision-making, xi) The decision on the birth position was made individually by a staff member
Perineal protection	If the staff: i) facilitated a two-step birth, i.e. head born in one contraction and shoulders in between or during the next contraction, ii) provided hands-on perineal protection, iii) followed the woman's instinctual urge to push (spontaneous pushing). All three measures needed to be used to qualify as a "Yes." (complete Perineal protection)	If the staff used i) a one-step birth, ii) hands-off perineal protection, iii) directed pushing, i.e. birth attendants encouraged the woman to take a deep breath at the beginning of a contraction, then hold it and bear down throughout the contraction). None, one or two measures used to qualify as a "No" (Incomplete perineal protection)

observation related to the three improvement areas. Primary outcomes for women included perineal injuries (defined as episiotomy or any degree of tear requiring sutures), and for newborns, an Apgar score below seven at 5 min after birth. Secondary outcomes encompassed postpartum haemorrhage with an estimated blood loss of 500 ml or more within 1 h after birth, newborn resuscitation requiring breathing assistance through ventilation with a bag mask and/or chest compressions, newborn transfer to NICU within the first hour after birth, skin-to-skin contact between mother and newborn within 1 min, maintaining this contact for the first hour after birth, and initiating breastfeeding within one hour.

Part two of the data collection form was administered to the same women who had just given birth through structured interviews within 24 h after birth. These interviews gathered information on socio-demographic and obstetric backgrounds and the support provided before the woman entered the labour room to give birth.

Intervention

Details about the intervention focusing on the three improvement areas have been previously reported in Blomgren, et al. [30]. Briefly, the intervention is based on the Midwize conceptual framework, which emphasises multisectoral collaboration and positions midwives as key change agents in improving the quality of care [37]. Seven Midwize Ambassadors underwent basic and follow-up training in QI methodology and the three improvement areas. The training sessions, which started on 15th May 2022, included the theoretical background and evidence for the three improvement areas as well as QI methods and tools to enhance the Midwize Ambassadors' leadership skills. The training prioritised on-site engagement, recognising that changes in clinical care practices are best conveyed through hands-on training. Additionally, the intervention highlighted the role of birth companions in intrapartum support and DBP. It incorporated education for women and their companions, including antenatal classes, brochures, videos, and one-on-one sessions to increase the understanding and use of the clinical improvements.qq

Guided by a QI support team of researchers and clinicians with QI expertise, the Midwize Ambassadours led the QI using a train-the-trainer approach where they trained and mentored other staff. The intervention's key drivers were planned using process mapping and evolved throughout the intervention period. The Model for Improvement was used to test and implement changes [38]. Weekly online meetings and bi-monthly in-person meetings were held for discussion and planning. More details of the co-creation and needs assessment of the intervention and the Midwize Ambassadours QI and improvement areas can be found in Blomgren, et al. [20].

Data analysis

Statistical analyses were performed using IBM SPSS Statistics, version 28. A total score was created for measuring intrapartum support by summing the 11 intrapartum support items (see Table 1). Each item was scored as 1 for 'yes' and 0 for 'no,' with higher scores indicating higher levels of intrapartum support. The scale's internal consistency was assessed using Cronbach's alpha, which yielded a value of 0.8, and no items showed a low correlation (<0.3) in the Item-Total Correlation analysis, indicating that all items contributed meaningfully to the overall score.

Descriptive statistics and bivariate analysis were conducted to illustrate population characteristics, frequency distributions, and associations between variables. A run chart was constructed to depict monthly changes in the proportion of Apgar scores <7 at 5 min and the women with intact perineum throughout the midwife-led QI intervention period (May-Noc 2022) and follow-up data periods (Feb and May 2023). We conducted a Pearson's chi-square test to compare the distribution of outcomes at the first time point (May 2022) with the combined data from all subsequent intervention and follow-up time points.

A binary logistic regression modelling was performed to study the association between health outcomes and the improvement areas. Crude and adjusted odds ratios were computed with a 95% confidence interval. We adjusted for parity and birth weight for all improvement areas as they are known risk factors for perineal injuries and low Apgar scores [39, 40]. We also adjusted for perineal protection for DBP and intrapartum support to investigate whether DBP and intrapartum support, independent of perineal protection measures, was associated with a reduction in perineal injuries.

We employed Pearson's Chi-square test for categorical variables to evaluate whether DBP and perineal protection measures varied based on participants' socio-demographic background. We used a one-way Analysis of Variance (ANOVA) to determine if support levels varied based on participants' socio-demographic background for the continuous variable, intrapartum support. When significant differences were found in the ANOVA results related to education and employment levels, post-hoc analyses were performed using Tukey's Honestly Significant Difference (HSD) test. This step was necessary to identify specific group differences that contributed to the overall significant effect.

Result

Socio-demographic background

A total of 630 women participated in this study. The majority were aged between 20 and 29 years (61.9%), married (88.4%), had completed secondary education (51.9%), and were unpaid family workers (38.1%) (See Table 2).

There were no statistically significant differences in age and marital status between those who received the three improvement areas and the overall study population. Also, there were no statistically significant differences in education and employment levels regarding the use of birth positions and perineal protection measures. However, there were statistically significant differences in intrapartum support related to a woman's education level ($p < 0.05$) and employment status ($p < 0.05$) (see Table 2). A more detailed analysis using Tukey's HSD post-hoc test revealed that women employed for wages received significantly more support during birth compared to unpaid family workers (Mean difference = -0.9, $p < 0.05$). However, no significant differences were found in the level of support received across varying education levels. See Appendix 2 for Tukey's HSD post-hoc test.

Health outcomes in relation to the midwife-led quality improvement

During the Midwife-led Quality Improvement intervention (May 2022–November 2022) and subsequent follow-up measurements (Feb and May 2023), significant improvements were observed in Apgar scores ($p < 0.001$) and the proportion of women with an intact perineum ($p < 0.001$). See Fig. 1 for the runchart data. Details on the mechanisms driving these changes are provided in the study Blomgren, et al. [30].

Obstetric variables

There were no statistically significant differences in parity between those who received the three improvement areas and those who did not. For birth weight, women with newborns with a weight < 2500 g received less intrapartum support ($p < 0.05$) and less perineal protection ($p < 0.05$) than those whose infants were ≥ 2500 g. There were no statistically significant differences between birth weight and using DBP and perineal protection. See Table 3 for details on women's obstetric background in relation to the three improvement areas.

Most women (72.9%) gave birth in a DBP; 53.1% were lateral, 16.3% were on a birth chair, and 1.9% were in other DBP. 27.1% used supine positions. No women gave birth in lithotomy or semi-recumbent positions.

Table 2 Demographic Analysis in relation to the three improvement areas

	Total *N* = 630 n(%)	**Dynamic birth position *n* = 459 n(%)**	**Intrapartum support *n* = 630 n(%)**	**Perineal protection *n* = 508 n(%)**
Age groups (p-value)		**0.97**	**0.3**	**0.3**
Age < 20	79 (12.5)	59 (12.9)	77 (12.2)	60 (11.3)
Age 20–29	390 (61.9)	283 (61.7)	385 (61.1)	317 (59,5)
Age 30–39	149 (23.7)	107 (23.3)	148 (23.5)	124 (23.3)
> 40	8 (1.3)	6 (1.3)	8 (1.3)	7 (1.3)
Missing	4 (0.6)	4 (0.6)	12 (1.9)	25 (4.7)
Education (p-value)		**0.5**	**0.01**	**0.2**
Primary education or no formal education	135 (21.4)	99 (21.7)	132(21.0)	112 (21.0)
Secondary Education	327 (51.9)	243 (52.9)	325(51.6)	261(48.9)
Technical/ vocational	92 (14.6)	60 (13.1)	91(14.4)	77(14.4)
College diploma	47 (7.5)	35 (7.6)	46(7.3)	40(7.5)
University Degree	25 (4.0)	19 (4.1)	24(3.8)	18(3.4)
Missing	4 (0.6)	4(0.6)	12(1.9)	26(4.9)
Employment (p-value)		**0.4**	**0.03**	**0.9**
Employed for wages	184 (29.2)	134 (29.0)	180(28.6)	146(27.3)
Self-Employed	164 (26.0)	117 (25.3)	163(25.9)	133(24.9)
Unemployed	17 (2.7)	9 (1.9)	16(2.5)	14(2.6)
Student	20 (3.2)	14 (3.0)	20(3.2)	16(3.0)
Unpaid family worker	240 (38.1)	183 (39.6)	238(37.8)	198(37.1)
Missing	5 (0.8)	5 (1.1)	13 (2.1)	27 (5.1)
Marital status (p-value)		**0.8**	**0.1**	**0.6**
Married	557 (88.4)	406 (87.7)	549(87.1)	456 (85.4)
Non-married	62 (9.8)	46 (9.9)	62(9.8)	46 (8.6)
Missing	11 (1.7)	11 (2.3)	19 (3.0)	32 (6.0)

Additionally, 80.0% received all three perineal protection measures, with 91.0% of midwives using hands-on perineal support, 91.7% spontaneous pushing and 90.5% a two-step birth. All women received support for some items on the 11-item support scale, averaging 6.4 support measures (SD 3.1). See Appendix 3 for the distribution of different birth positions and their associated primary outcomes and Appendix 4 for the distribution of perineal protection measures and their associated primary outcomes.

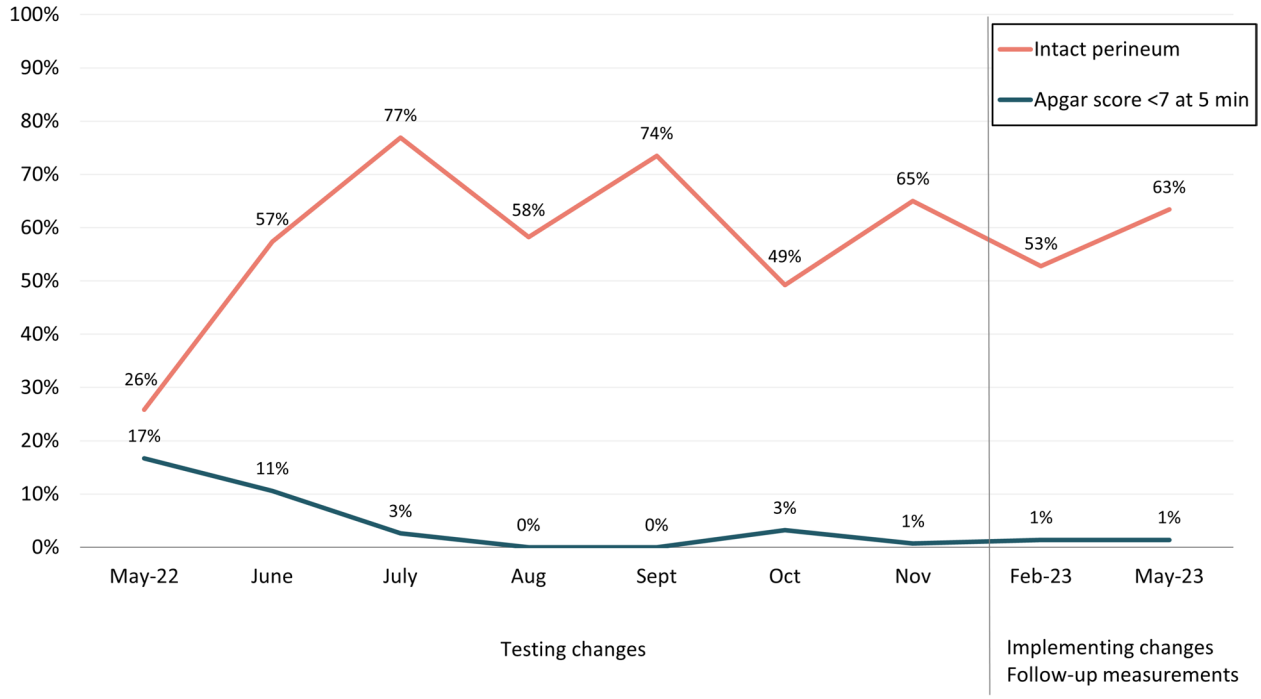

Fig. 1 Intact perineum and Apgar scores < 7 at 5 min during the Midwife-Led QI intervention and follow-up measurements

Table 3 Obstetric background in relation to the three improvement areas

	Total ***N*** **= 630** **n(%)**	**Dynamic Birth Position** ***n*** **= 459** **n(%)**	**Intrapartum Support** ***n*** **= 630** **n(%)**	**Perineal Protection** ***n*** **= 508** **n(%)**
Parity (p-value)		**0.2**	**0.5**	**0.09**
Primi-para	220(34.8)	154(34.5)	216(34.3)	169(33.9)
One previous birth	156(24.6)	115(25.7)	154(24.4)	126(25.3)
Two or three previous births	192(30.3)	149(33.3)	188(30.0)	167(33.5)
Four or more previous births	47(7.4)	29 (6.4)	46(7.3)	36(7.2)
Missing	18(2.9)	18(2.9)	26(4.0)	38(6.0)
Birth weight (p-value)		**0.4**	**0.02**	**0.02**
< 2500	28(4.4)	17(3.7)	27(4.2)	17(3.4)
2500–3500	452(71.7)	337(74.2)	446(70.8)	374(74.1)
> 3500	143(22.7)	100(22.0)	142(22.5)	114(22.6)
Missing	7(1.1)	7(1.1)	15(2.4)	7(1.1)

Primary outcomes

Perineal injuries

Overall, 41.4% of the women in the study experienced perineal injuries, while 58.6% had an intact perineum following childbirth. All three improvement areas were statistically significantly associated with improved rates of intact perineum. Women who used a DBP were more likely to have an intact perineum (62.3% vs. 48.5%) compared to those who gave birth in the supine position [AOR: 0.6, 95% CI: 0.4–0.90]. Women with intact perineum received more intrapartum support (mean score 6.6 vs. 5.8) compared to those with perineal injuries [AOR: 0.9, 95% CI: 0.9–1.0]. Women who received complete perineal protection (all three measures) were more likely to have intact perineum (63.4% vs 35.1%) than those who received zero, one, or two of the measures [AOR: 0.3, 95% CI: 0.2–0.5]. Among the perineal protection measures, hands-on perineal protection [AOR: 0.3

95% CI: 0.1–0.5] and a two-step birth approach [AOR: 0.4, 95% CI: 10.2–0.7] were statistically significantly associated to higher rates of intact perineum. Spontaneous pushing was not statistically significantly associated with intact perineum after adjusting for confounders [AOR: 0.5, 95% CI: 0.3–1.1]. (See Table 4).

Apgar score

Overall, 2.9% of newborns had an Apgar score below seven at 5 min. The intrapartum support level and perineal protection measures were statistically significantly associated with higher Apgar scores. Before adjustments for confounding factors, women who used a DBP were less likely to give birth to a newborn with an Apgar score under seven at 5 min (2.0% vs 5.3%) compared to those who gave birth in the supine position [Crude OR; 0.1 (CI 95% 0.1–0.90)]. However, this association was not statistically significant after adjustments. Women whose newborns had an Apgar score below seven at 5 min received less intrapartum support (mean score 3.9 vs. 6.3) compared to those whose babies had an Apgar score ≥ seven at 5 min [AOR; 0.8 (CI 95% 0.7–1.0)]. Newborns were less likely (2.0% vs 6.2%) to have an Apgar score below seven at 5 min when the woman received complete perineal protection compared to those who did not [AOR; 0.3 (CI 95% 0.1–0.8)]. Among the perineal protection measures, spontaneous pushing (as opposed to directed pushing) [AOR; 0.06 (CI 95% 0.02–0.2)] and using hands-on perineal protection [AOR; 0.2 (CI 95% 0.07–0.7)] were statistically significantly associated with higher Apgar scores. A two-step birth approach was not statistically significantly associated with Apgar scores (See Table 4).

Secondary outcomes

Among the newborns in the study population, 3.5% required resuscitation, 5.7% were transferred to the NICU, 94.1% breastfed within the first hour, 95.9% were placed in skin-to-skin within one minute, and only 3.8% remained skin-to-skin for an hour. Additionally, 3.0% of the women experienced postpartum haemorrhage (PPH) exceeding 500 ml.

Using complete perineal protection compared to non-complete perineal protection was statistically significantly associated with fewer transfers to the NICU (4.1% vs 12.4%) [AOR: 0.3, 95% CI: 0.1–0.7] and higher rates of breastfeeding within one hour (96.3% vs 90.3% [AOR: 3.0, 95% CI: 1.3–7.0]. Additionally, increased intrapartum support for women was associated with a lower likelihood of newborns needing resuscitation (mean score 6.3 vs. 3.9), though this was not statistically significant after adjusting for confounding factors. All three areas of improvement were associated with more newborns being placed skin-to-skin within one minute after adjusting for confounding variables (DBP [AOR: 3.1, 95% CI: 1.4–7.4], Intrapartum support [AOR: 1.4, 95% CI: 1.2–1.7], Perineal protection [AOR: 2.8, 95% CI: 1.0–7.4]). No other associations were found between the improvement areas and secondary outcomes (See Table 4).

Discussion

Main findings

This observational study, which included 630 women who gave birth spontaneously, demonstrates that midwife-led QI interventions focusing on dynamic birth positions, intrapartum support, and perineal protection measures can reduce the incidence of perineal injuries and low 5-min Apgar scores. These findings are essential, as perineal injuries can have a considerable impact on women's physical and mental health [11, 12, 41, 42], and low 5-min Apgar scores can cause both short-term morbidity and long-term neurological complications [17, 18].

While dynamic birth positions, intrapartum support, and perineal protection are recommended practices, they are often underutilised, particularly in low-resource settings like Uganda [35, 43]. These practices were also underused at the study site at the start of the midwife-led QI intervention [20]. However, after one year of midwife-led QI efforts, we observed a significant increase in the use of these practices [30], which, together with the results from this study, demonstrates how a practical and low-cost midwife-led QI method can improve health outcomes for women and newborns, particularly regarding perineal injuries and Apgar scores.

Interpretation

Some associations between DBP, intrapartum support, perineal protection, and health outcomes identified in this study are novel, while others confirm existing knowledge.

Previous research suggests that DBPs like lateral, kneeling, and all-fours generally protect against perineal injuries [23, 24, 44] or show no significant difference in injury rates [45]. However, one study links the birth chair position with a higher incidence of severe tears [44]. Building on these mixed findings, our study found that all the DBPs we examined—birth chair, lateral, kneeling, and all-fours—were protective against perineal injuries. In previous studies, the impact of birth positions on Apgar scores showed no difference between upright and supine positions [19]. Similarly, we did not observe a significant reduction in low 5-min Apgar scores, though there was a positive trend toward improved scores. These findings suggest that, at the very least, using DBPs can help prevent perineal injuries without adversely affecting Apgar scores.

Table 4 Primary and secondary outcomes for women and newborns

		Total *N* = 630 n(%)	Dynamic Birth Position *N* = 459 n(%)	Non-dynamic birth position *N* = 171 n(%)	Crude OR (95% CI)	Adjusted OR (95% CI)	Intrapartum support *N* = 619 (mean, SD)	Crude OR (95% CI)	Adjusted OR (95% CI)	Perineal protection *N* = 508 n(%)	Incomplete perineal protection *N* = 97 n(%)	Crude OR (95% CI)	Adjusted OR (95% CI)
Primary outcomes	Intact perineum	369(58.6)	286(62.3)	83(48.5)	0.6(0.4–0.8)**	0.6(0.4–1.0)*[b]	361(6.6, 3.0)	0.9(0.9–1.0)**	0.9(0.9–1.0)*[b]	322(63.4)	34(35.1)	0.3(0.2–0.5)***	0.3(0.2–0.5)***[a]
	Perineal injury	261(41.4)	173(37.7)	88 (51.8)			258(5.8, 3.3)			186(36.6)	63(64.9)		
	Missing, n (%)	0	0			42 (6.7)	11 (1.8)		50 (7.9)	25 (4.0)			22 (3.5)
	Apgar score < 7 at 5 min	18(2.9)	9(2.0)	9(5.3)	0.4(0.1–0.9)*	0.5(0.2–1.5)[a]	17(3.9, 3.2)	0.8(0.6–0.9)**	0.8(0.7–1.0)*[a]	10(2.0)	6(6.2)	0.3(0.1–0.9)*	0.3(0.1–0.8)*[a]
	Apgar score > 7 at 5 min	608(96.5)	447(98.0)	161(94.7)			601(6.3, 3.1)			498(98.0)	91(93.8)		
	Missing n (%)	4(0.6)	4 (0.6)			23(3.7)	12 (1.9)		31 (4.9)	25 (4.0)			42 (6.7)
Secondary outcomes	Resuscitation of newborn	22(3.5)	13(2.9)	9(5.5)	0.5(0.2–1.3)	0.7(0.3–1.8)[a]	21(4.6, 4.0)	0.8(0.7–1.0)*	0.9(0.7–1.0)[a]	493(97.2)	91(93.8)	0.4(0.2–1.2)	0.4(0.2–1.2)[a]
	No resuscitation of newborn	604(95.9)	442(96.7)	162(94.7)			597(6.3, 3.1)			14(2.8)	6(6.2)		
	Missing n(%)	4(0.6)	4 (0.6)			23 (3.7)	12		31(4.9)	26(4,1)			43(6.8)
	Transfer to neonatal unit	36(5.7)	23(5.0)	13(7.6)	0.7(0.3–1.3)	0.7(0.4–1.5)[a]	35(6.1, 3.6)	1.0(0.9–1.1)	1.0(0,9–1.1)[a]	21(4.1)	12(12.4)	0.3(0.2–0.6)**	0.3(0.1–0.7)**[a]
	No transfer to neonatal unit	591(93.8)	433(95.0)	158(92.4)			584(6.3, 3.1)			487(95.9)	85(87.6)		
	Missing n(%)	3(0.5)	3(0.5)			22(3.5)	1(0.2)		30(4.8)	25(4.0)			43(6.8)
	PPH over 500 ml	19(3.0)	11(2.4)	8(4.7)	0.5(0.2–1.3)	0.7(0.3–2.0)[a]	19(5.8, 2.6)	1.0 (0.8–1.1)	1.0(0.8–1.1)[a]	15(3.0)	4(4.2)	0.7(0.2–2.2)	0.7(0.2–2.3)[a]
	PPH under 500ml	605(96.0)	445(97.6)	163(95.3)			597(6.3, 3.1)			491(97.0)	92(95.8)		
	Missing n(%)	6(1.0)	6 (9.5)			25(4.0)	14(2.2)		33(5.2)	28(4.4)			45(7.4)
	Skin to skin within 1min	604(95.9)	449(97.6)	158(91.9)	3.6(1.6–8.1)**	3.1(1.4–7.4)**[a]	594(6.3, 3.1)	1.4(1.2–1.6)***	1.4(1.2–1.7)***[a]	493(97.2)	80(92.8)	2.7(1.1–7.0)*	2.8(1.0–7.4)*[a]
	No skin-to-skin within 1min	25(4.0)	11(2.4)	14(8.1)			24(3.4, 3.3)			14(2.8)	7(7.2)		
	Missing n(%)	1(0.2)	1 (0.2)			23(3.7)	12(1.9)		31(4.9)	26(4.1)			43(6.8)
	Skin to skin for the first hour	24(3.8)	18(3.9)	6(3.5)	1.1(0.4–2.9)	1.2(0.5–3.1)[a]	23(5.6,2.3)	0.9(0.8–1.0)	0.9(0.8–1.1)[a]	5(5.2)	18(3.5)	0.7(0.3–1.9)	0.8(0.3–2.3)[a]
	Skin-to-skin less than one hour/ no skin-to-skin	603(95.7)	440(96.1)	166(96.5)			596(6.3,3.1)			92(94.8)	490(96.5)		
	Missing n(%)	3(0.5)	3 (0.5)			22(3.5)	11(1.7)		30(4.8)	25(3.9)			42(6.6)
	Breastfeeding within one hour	593(94.1)	435(96.0)	158(94.0)	1.5(0.7–3.4)	1.5(0.7–3.3)[a]	586(6.3,3.1)	1.0 (0.9–1.1)	1.0(0.9–1.2)[a]	488(96.3)	84(90.3)	2.8(1.2–6.3)*	3.0(1.3–7.0)*[a]
	Breastfeeding initiated after one hour/No breastfeeding	28(4.4)	18(4.0)	10 (6.0)			27(6.3,3.6)			19(3.7)	9(9.7)		
	Missing n (%)	9 (1.4)	9 (1.4)			25(4.0)	17(2.7)		33(5.2)	30(4.8)			45(7.1)

* <0.05

** <0.01

*** <0.001

[a] Adjusted for parity and birth weight

[b] Adjusted for parity, birth weight and perineal protection

Our study also confirms previous research linking intrapartum support to reduced rates of low Apgar scores [19, 21]. However, in contrast to other studies that have not shown a clear relationship between intrapartum support and perineal injuries, our findings suggest that intrapartum support positively impacts the reduction of perineal tears [21, 46]. Our findings might, however, be connected to studies suggesting that compassionate and respectful care during birth can alleviate feelings of anxiety and stress, potentially improving labour progression and decreasing the need for instrumental interventions, which in turn could reduce the risk of perineal injuries [19, 21, 47, 48]. Although our study did not include cases of instrumental births, the relationship between stress, anxiety, and intrapartum support may help explain the lower rates of perineal injuries observed in our findings.

The perineal protection measures in this study—hands-on perineal support, the two-step birth approach, and spontaneous pushing—have generally shown favourable outcomes for maternal and newborn health in previous studies, although the results are sometimes inconclusive.

The use of hands-on versus hands-off perineal protection has been debated. Some studies report a possible reduction of injuries with the hands-off techniques [49–51] or hands-on techniques [52]. According to a WHO review, there is no clear evidence of whether hands-on or hands-off techniques are most effective in reducing perineal injuries, although a hands-on approach might be linked to fewer first-degree tears while also being generally acceptable to women [43]. Consequently, the WHO recommends using hands-on techniques, as women might be more likely to seek healthcare services when healthcare professionals actively try to prevent tears with a hands-on approach. The WHO recommendation aligns with our study results, which demonstrate a protective effect of the hands-on technique on perineal injuries. Notably, our findings also show that hands-on perineal support is significantly associated with higher 5-min Apgar scores, highlighting the dual benefits of this approach.

Data on the prevalence of using a one-step or a two-step birth method is scarce, although, in some Western obstetric care settings, the one-step extraction of the fetal body remains the most performed technique [53]. While studies exploring the standard practices in Uganda and similar settings are lacking, our study indicates that even before the QI intervention, a two-step birth approach was already commonly used [30]. This is encouraging, as our findings align with previous studies [33] showing that a two-step birth approach reduces the risk of perineal injuries. Moreover, our results demonstrate that using a two-step birth approach does not significantly impact the Apgar score. This is a positive finding, as it challenges the misconception among some birth attendants that rushing the birth using a one-step approach will shorten the second stage of labour and decrease perinatal mortality and morbidity [54]. Similarly, the use of a two-step approach is supported by previous research indicating that it does not negatively influence other newborn health outcomes, such as umbilical artery pH, and is believed to enhance fetal circulation and prevent shoulder dystocia [55, 56].

The choice between spontaneous and directed pushing is widely discussed, with clinicians using various methods based on their preferences and workplace culture [34–59]. This variation in use may stem from the inconclusive nature of previous research on this topic. In line with our results, some studies report no significant difference in the incidence of perineal tears [34, 57, 58] or episiotomies [34, 59]. In contrast, other studies suggest spontaneous pushing may decrease these rates [57] by allowing a slower, more controlled descent of the fetus's head, gradually stretching the perineum [34]. Concerning newborn outcomes, it has been suggested that directed pushing may reduce venous blood return, leading to decreased uterine, placenta, and fetus oxygenation [60]. However, most studies, except for one that indicates improved Apgar scores with spontaneous pushing [61], find no significant differences between the two methods regarding Apgar scores [34, 57, 58]. Our study adds valuable insights to this uncertain area, indicating that spontaneous pushing is linked to better 5-min Apgar scores.

The secondary outcomes indicate that complete perineal protection is associated with fewer NICU transfers and higher breastfeeding rates within one hour. These findings may be related to the same underlying rationale affecting Apgar scores, such as the possibility that spontaneous pushing improves venous blood return [60]. The secondary outcomes also indicate that all three areas of improvement were associated with more newborns being placed skin-to-skin within one minute. The increase may be attributed to the overall QI project, which, through the improvement areas, introduced a new approach and encouraged staff to facilitate a slower, more deliberate birth process. Additionally, the improved health outcomes for the babies likely contributed to the increased use of skin-to-skin contact. This highlights the interconnectedness of QI efforts and their positive spillover effects on other areas, as well as the need to approach healthcare improvement in a comprehensive and multifaceted manner [62].

Strengths and limitations

A key strength of this study is its prospective design, enabling real-time data collection and reducing recall bias for more accurate information [63]. The combination of observational data and structured interviews

enriched the dataset, enhancing the reliability of the findings. However, the Hawthorne effect, where clinicians modify their behaviour due to being observed, posed a limitation. This was mitigated by the extended data collection period, allowing for habituation [64], which was likely further intensified by the midwife research assistants integrating smoothly into the busy ward environment.

Trained and experienced research assistants ensured systematic and consistent data recording, further enhancing data reliability [65]. However, not all women giving birth were included, such as those who gave birth in the triage area or when no research assistant was present, potentially introducing selection bias [65]. To minimise this, data were collected across different shifts.

In planning the improvement areas of the QI, one evidence-based perineal protection practice, using a warm compress on the perineum during birth, was not included due to the lack of clean, warm water at the study site. However, if a similar QI intervention is conducted in the future, ways of incorporating warm compresses should be considered due to their proven effectiveness in reducing injuries [19].

It is important to note that the use of dynamic birth positions, intrapartum support, and perineal protection measures are higher in this study's sample than in non-intervention studies [30], making the results most applicable to the context of a midwife-led QI interventions. Also, as a single-site study, we cannot definitively apply the findings to other contexts, as differences in patient populations, staffing, and resource availability could affect care and outcomes [66]. However, the demographics (as shown in Table 1) and study site description suggest that this setting reflects a typical birthing environment in many low-income areas and may be transferable to similar contexts.

Conclusion

This study demonstrates that low 5-min Apgar scores and perineal injuries decreased during a midwife-led Quality Improvement intervention focusing on dynamic birth positions, intrapartum support, and perineal protection strategies.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-024-21137-w.

Additional file 1.

Additional file 2.

Additional file 3.

Additional file 4.

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Patient and public involvement

Women and birth companions were included in the co-creation of the intervention, where they took part in defining the improvement areas, especially considering the need for improved intrapartum support [20]. This approach ensured that the intervention was customised to meet the specific needs and preferences of the target population, which likely enhanced its acceptability and effectiveness [67]. The co-creation is described in detail in Blomgren, et al. [20].

Author reflexivity statement

As a multidisciplinary team, we acknowledge that our diverse backgrounds and experiences have influenced this study's design, implementation, and interpretation. Our research team consists of midwives, obstetricians, a physiotherapist, and a public health professional from Sweden, Uganda, and Ghana, bringing together varied clinical and research expertise in maternal healthcare across both high- and low-resource settings. The Swedish authors contributed their experience in clinical improvement work and methods for implementing evidence-based practices, while the authors from Uganda and Ghana ensured that the intervention and data collection were contextually appropriate, relevant, and feasible within the specific sociocultural and resource constraints of the study setting. While we recognise the influence of our backgrounds, we believe that our diverse expertise and collaborative approach across multiple countries have strengthened this research, enabling us to explore the health outcomes of midwife-led QIs in a way that is both contextually sensitive and broadly applicable to global maternal healthcare.

Authors' contributions

JB: Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. MBW: Writing – review & editing, Supervision, Methodology, Funding acquisition, Formal analysis. DA: Writing – review & editing, Supervision, Project administration. KE: Writing – review & editing, Supervision, Conceptualization, Funding acquisition. JW: Writing – review & editing, Project administration. DAA: Writing – review & editing, Formal analysis. HL: Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. Project administration, Investigation. Analysis, Conceptualization.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Makerere SPH Research and Ethics Committee (Ref. nr: SPH-2021–174), Uganda National Council for Science and Technology (Ref. nr: HS1885ES), and the Swedish Ethical Review Authority (Ref. nr: 2021–05539-01). Permission was also granted by the hospital where the study took place. Women who were in late labour when asked to participate received a brief explanation of the study and data collection, as we did not want to disturb their birthing process. After birth, they were provided with more detailed information about the study. All individuals who agreed to participate signed an informed consent form.

To ensure women felt comfortable declining participation if they did not want to be observed during birth, research assistants made it clear that they were conducting research independently and were not hospital staff, assuring them that opting out would not impact their care. Furthermore, the research

assistants, who were also junior midwives, were instructed to minimise disruptions and blend seamlessly into the busy ward environment with other staff, students, interns, cleaners and birth companions.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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