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CLINICAL ARTICLE

The effects of previous cesarean deliveries on severe maternal and adverse perinatal outcomes at a university hospital in Tanzania

Helena Litorp^{a,*}, Mattias Röst^a, Hussein L. Kidanto^{a,b}, Lennarth Nyström^c, Birgitta Essén^a^a International Maternal and Child Health (IMCH), Department of Women's and Children's Health, Uppsala University, Uppsala, Sweden^b Department of Obstetrics and Gynaecology, Muhimbili National Hospital, Dar es Salaam, Tanzania^c Department of Public Health and Clinical Medicine, Epidemiology and Global Health, Umeå University, Umeå, Sweden

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ABSTRACT

Objective: To investigate if multiparous individuals who had undergone a previous cesarean delivery experienced an increased risk of severe maternal outcomes or adverse perinatal outcomes compared with multiparous individuals who had undergone previous vaginal deliveries. **Methods:** An analytical cross-sectional study at a university hospital in Dar es Salaam, Tanzania, enrolled multiparous participants of at least 28 weeks of pregnancy between February 1 and June 30, 2012. Data were collected from patients' medical records and the hospital's obstetric database. Odds ratios (OR) and 95% confidence intervals (CI) were calculated to compare outcomes among patients who had or had not undergone previous cesarean deliveries. **Results:** A total of 2478 patients were enrolled. A previous cesarean delivery resulted in no increase in the risk of severe maternal outcomes (OR 0.86, 95% CI 0.58–1.26; $P = 0.46$), and decreased risk of stillbirth (OR 0.42, 95% CI 0.29–0.62, $P < 0.001$), and intrapartum stillbirth and neonatal distress (OR 0.58, 95% CI 0.38–0.87, $P = 0.007$). **Conclusion:** Previous cesarean delivery was not a risk factor for severe maternal outcomes or adverse perinatal outcomes. The present study was conducted at a referral institution, where individuals with previous cesarean deliveries may constitute a healthy group. Additionally, there could be differences between the study groups in terms of healthcare-seeking behavior, referral mechanisms, intrapartum monitoring, and clinical decision making.

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1. Introduction

In recent years, cesarean-delivery rates have increased worldwide [1]; consequently, the proportion of individuals with scarred uteri is increasing. In subsequent pregnancies, individuals with previous cesarean deliveries are at increased risk of placenta previa [2], placental abruption, placenta accreta, and uterine rupture [3,4] compared with patients with previous vaginal deliveries. Repeat cesarean deliveries are often more complicated than the first cesarean delivery, and have been associated with adhesion development [5,6], long operation times [5], injuries to the bladder and bowel, and blood transfusions [3,7]. Although the indication that resulted in an individual's first cesarean delivery might remain during subsequent pregnancies and affect perinatal outcomes [8], some studies have accounted for this and still reported a higher risk of poor perinatal outcomes among patients with previous cesarean deliveries [9–11].

Although cesarean-delivery rates have increased in many low-income countries [1], few studies have explored outcomes among individuals with previous cesarean deliveries in such settings [12,13]. Considering the high birth rates, and resultant need of repeated cesarean deliveries, as well as the limited access to adequate monitoring during labor, it was hypothesized that cesarean delivery scar complications could be more severe in low-resource settings compared with high-resource settings, potentially leading to life-threatening conditions. Maternal life-threatening conditions, also termed maternal near-miss (MNM), have been defined by WHO as, "a woman who almost dies but survives a complication during pregnancy, childbirth, or within 42 days after termination of pregnancy" [14]. Previous studies have suggested that MNM events and maternal deaths should be coupled to reflect severe maternal outcomes (SMO), providing a more robust variable for study [15]. Previous cesarean delivery in relation to MNM and SMO in low- and middle-income countries has been explored in two previous studies [15,16]; both indicated that individuals with previous cesarean deliveries have an increased risk of MNM and SMO.

In light of a rapid increase in the proportion of patients presenting with cesarean delivery scars at a university hospital in Tanzania [17], the objective of the present study was to explore if multiparous patients

* Corresponding author at: International Maternal and Child Health (IMCH), Department of Women's and Children's Health, Uppsala University, 751 85 Uppsala, Sweden. Tel.: +46 702 542 794; fax: +46 185 080 13.

E-mail address: helena.litorp@kbh.uu.se (H. Litorp).

with previous cesarean deliveries have an increased risk of SMO or adverse perinatal outcomes compared with multiparous individuals with previous vaginal deliveries.

2. Materials and methods

An analytical cross-sectional study was performed over 20 weeks between February 1 and June 30, 2012, at Muhimbili National Hospital in Dar es Salaam, Tanzania. The study enrolled all multiparous patients with a duration of pregnancy of at least 28 weeks who were admitted to, or underwent delivery at, the study hospital during this period. The study was part of a larger research project that included quantitative as well as qualitative data collection [17–19]. Approval for the present study was obtained from the Ethics Board of Muhimbili University of Health and Allied Sciences on December 23, 2011 (reference number MU/RP/AEC/Vol. XIII). The study method entailed the review of routinely gathered, de-identified data; consequently, obtaining informed consent from study participants was waived by the ethics board.

Tanzania is a low-income country with a maternal-mortality rate of 454 maternal deaths per 100 000 live births and a perinatal mortality rate of 36 per 1000 pregnancies [20]. In the Dar es Salaam area, 91% of deliveries are attended by a skilled healthcare professional and prenatal care coverage is 100% [20]. The majority of deliveries take place at health centers and peripheral hospitals, which, despite an upgrade during the last decade, still struggle with a conspicuous lack of human and material resources. Although the study institution, a university hospital, should serve as a teaching and referral institution, 72% of the 9000 annual deliveries constitute self-referred individuals [17]. Since 2004, the obstetric department has operated as a private–public partnership, which allows specialists to admit their private patients to separate wards located at the hospital. During the last decade, there has been a sharp increase in the cesarean-delivery rate to over 50% and, consequently, an increase in the proportion of patients with previous scars from cesarean deliveries [17].

To identify MNM events based on WHO MNM criteria [14], all obstetric wards at the study institution were visited every second day by a researcher (H.L.) throughout the study. Additionally, maternal death files, which are routinely gathered by hospital staff, were reviewed monthly. Data for all patients who experienced SMO were collected by one researcher (H.L.) using a method that has been described in detail previously [18], while data for individuals who had not experienced SMO were extracted from the hospital's obstetric database [17]. Duplicate data for SMO from the hospital-database records were identified using patient admission numbers and were removed before the two datasets were merged.

Patient records were examined for four outcomes. SMO was defined as an MNM event having occurred fulfilling the WHO MNM criteria [14] and maternal deaths that fulfilled the WHO definition [21]. Patients who were discharged alive and having not fulfilled any MNM criteria were designated as “not SMO”. Only one MNM event was considered per patient and the diagnosis considered most likely was registered as the cause. Stillbirths were defined as neonates with a recorded diagnosis of stillbirth in the hospital database, and Apgar scores of zero at 1 and 5 minutes. Neonatal distress was defined as live births with an Apgar score below seven at 5 minutes. Intra-partum stillbirth and neonatal distress was defined as stillbirths where a fetal heart beat was recorded at admission and live births with an Apgar score below seven at 5 minutes. This combined variable reflected adverse perinatal outcomes that occurred during hospital stay and was considered more robust when performing the analyses as a significant number of cases met this definition. Participants were excluded from the study analysis if information was missing for the outcomes under investigation.

Having previously undergone a cesarean delivery was the exposure variable. Patients were regarded as having previously undergone a cesarean delivery if a cesarean scar was recorded on the patient's prenatal card, if previous cesarean delivery was listed as an indication for

cesarean delivery for their present pregnancy in their hospital record, or if an obstetric diagnosis of cesarean scar had been recorded. To control for potential confounders, maternal age, parity, maternal education, area of residence, private/public status, marital status, HIV status, referral status, mode of delivery, cesarean indication (one indication per operation), and complications experienced by participants, such as uterine rupture or placenta previa, were recorded.

Statistical analyses were performed using SPSS version 20.0 (IBM, Armonk, NY, USA). A Pearson χ^2 test was used to make comparisons between groups and $P < 0.05$ was considered statistically significant. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to compare outcomes among patients with and without previous cesarean deliveries. The Cohen kappa coefficient [22] was calculated for selected variables in a randomly chosen sample of patients to check the inter-rater agreement between the data collected by the study researcher (H.L.) and that obtained from the hospital database.

Following the completion of the primary analysis, it was hypothesized that patients at the study hospital with previous vaginal deliveries had experienced more complications and more delays than patients with previous cesarean deliveries. A further analysis was conducted using three sub-groups, emergency cesarean deliveries, self-referred patients, and referred patients.

3. Results

Among the 2478 patients included (Fig. 1), 820 (33.1%) had undergone previous cesarean deliveries. Individuals with and without previous cesarean deliveries were comparable in terms of socioeconomic status; however, patients with previous cesarean deliveries had been referred from other hospitals more frequently (32.6% vs 23.0%; $P < 0.001$) and underwent a cesarean delivery for their present pregnancy more often (92.2% vs 38.4%; $P < 0.001$) (Table 1). Among 756 patients who had previously undergone a cesarean delivery and were undergoing a cesarean delivery for their present pregnancy, prior cesarean scar was the indication for cesarean delivery in 670 individuals (88.6%), while obstructed labor was the most common indication for cesarean delivery among the 637 patients who had undergone vaginal deliveries previously (381 [59.8%]) (Supplementary Material S1). Elective cesarean deliveries were more common among patients who had undergone cesarean delivery previously (240/756 [31.7%] vs 147/637 [23.1%]; $P < 0.001$). The prevalence of maternal complications was lower among individuals who had previously undergone cesarean delivery (164/820 [20.0%]) compared with patients with previous vaginal deliveries (663/1658 [40.0%]) ($P < 0.001$); a diagnosis of prenatal hemorrhage was less common among patients who had undergone cesarean deliveries previously (90/820 [11.0%] vs 365/1658 [22.0%]; $P < 0.001$), as was a diagnosis of hypertensive disorders (8/820 [1.0%] vs 81/1658 [4.9%]; $P < 0.001$), and a diagnosis of uterine rupture (10/820 [1.2%] vs 35/1658 [2.1%]; $P = 0.12$). Labor was induced in 5 (0.6%) individuals who had previous cesarean deliveries and 32 (1.9%) patients with previous vaginal deliveries ($P = 0.01$).

Among the 2478 patient records included in the study, 110 MNM events (4.4%) and 10 maternal deaths (0.4%) were identified; of these 120 SMO, 36 (30%) individuals had previous cesarean deliveries and 84 (70%) had previous vaginal deliveries. Many patients fulfilled more than one MNM criterion. The most common MNM criteria fulfilled by patients with previous cesarean deliveries were shock (14/35 [40.0%]) and hysterectomy (14/35 [40.0%]), while the most common MNM criterion among patients with previous vaginal deliveries was fits (30/75 [40.0%]) (Supplementary Material S2). The main causes of SMO among patients with previous cesarean deliveries were ablatio placentae, uterine rupture, and postpartum hemorrhage; among patients with previous vaginal deliveries, hypertensive disorders were the primary cause of SMO (Table 2).

Individuals with previous cesarean deliveries demonstrated no increase in risk of SMO ($P = 0.46$), as well as lower risks of stillbirth

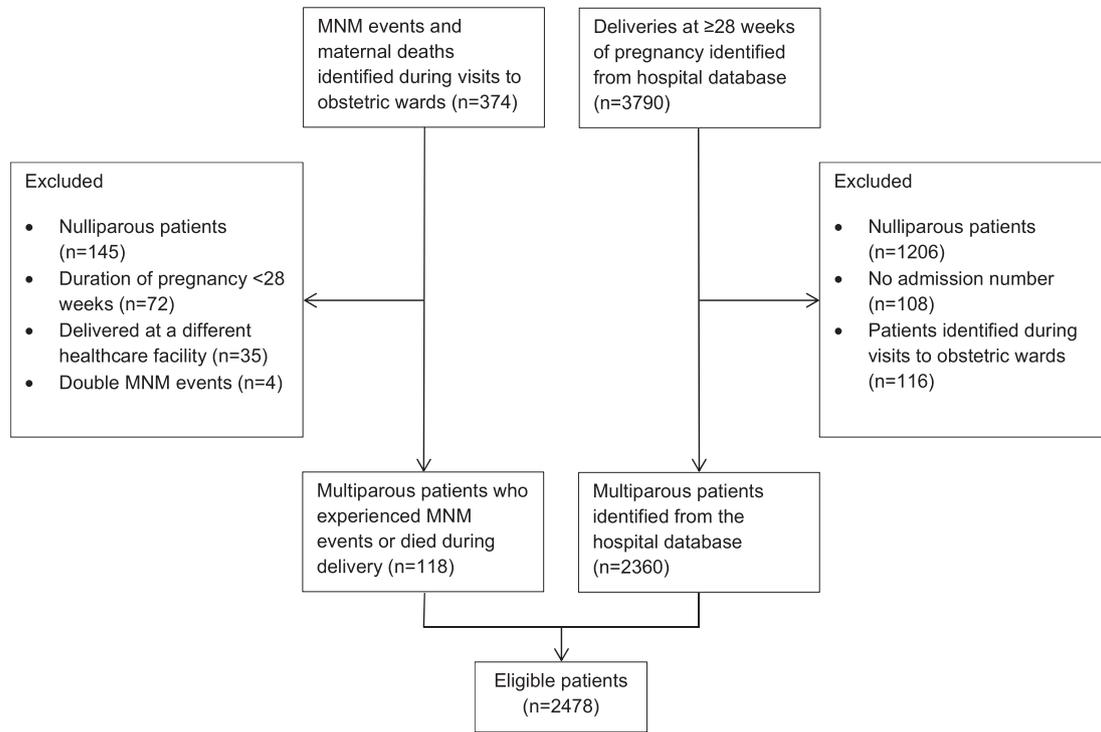


Fig. 1. Flow diagram of the inclusion of participants. Abbreviation: MNM, maternal near miss.

Table 1 Patient characteristics.^a

Characteristics	Patients with previous cesarean deliveries (n = 820)	Patients with previous vaginal deliveries (n = 1658)	Total (n = 2478)
Maternal age, y	30 ± 5 (17–48) ^b	30 ± 5 (16–45) ^c	30 ± 5 (16–48) ^d
Parity	3 ± 1 (2–8)	3 ± 1 (2–11)	3 ± 1 (2–11)
Education completed			
None	10 (1.2)	11 (0.7)	21 (0.8)
Primary school	518 (63.2)	977 (58.9)	1495 (60.3)
Secondary school	190 (23.2)	429 (25.9)	619 (25.0)
Higher	100 (12.2)	233 (14.1)	333 (13.4)
Data missing	2 (0.2)	8 (0.5)	10 (0.4)
Area of residence			
Urban	764 (93.2)	1524 (91.9)	2288 (92.3)
Semi-urban	45 (5.5)	100 (6.0)	145 (5.9)
Rural	6 (0.7)	20 (1.2)	26 (1.0)
Data missing	5 (0.6)	14 (0.8)	19 (0.8)
Patient status			
Private	104 (12.7)	296 (17.9)	400 (16.1)
Public	716 (87.3)	1362 (82.1)	2078 (83.9)
Marital status			
Married	808 (98.5)	1615 (97.4)	2423 (97.8)
Single	11 (1.3)	36 (2.2)	47 (1.9)
Data missing	1 (0.1)	7 (0.4)	8 (0.3)
HIV status			
Positive	41 (5.0)	78 (4.7)	119 (4.8)
Negative	770 (93.9)	1559 (94.0)	2329 (94.0)
Data missing	9 (1.1)	21 (1.3)	30 (1.2)
Referral status			
Referred	267 (32.6)	382 (23.0)	649 (26.2)
Not referred	553 (67.4)	1276 (77.0)	1829 (73.8)
Mode of delivery			
Vaginal	63 (7.7)	993 (59.9)	1056 (42.6)
Cesarean	756 (92.2)	637 (38.4)	1393 (56.2)
Data missing	1 (0.1)	28 (1.7)	29 (1.2)

^a Values are given as mean ± SD (range) or number (percentage), unless indicated otherwise.

^b Data were missing for 4 patients.

^c Data were missing for 7 patients.

^d Data were missing for 11 patients.

($P < 0.001$) and intrapartum stillbirth and neonatal distress ($P = 0.007$) than patients with previous vaginal deliveries (Table 3). Similar results were found in the subgroup of patients who were undergoing an emergency cesarean delivery for their current pregnancy (Table 3). The age, parity, HIV status, and sociodemographic characteristics of the groups were comparable so a multivariate regression analysis was not performed.

In the sub-analysis of self-referring patients ($n = 1835$), a lower risk of stillbirth was observed among patients with previous cesarean deliveries (OR 0.44, 95% CI 0.22–0.88; $P = 0.017$) but the risk of intrapartum stillbirth and neonatal distress did not differ compared to patients with previous vaginal deliveries (OR 0.77, 95% CI 0.41–1.47; $P = 0.44$). However, among patients referred to the study hospital ($n = 643$), patients with previous cesarean deliveries had a lower risk of SMO (OR 0.55, 95% CI 0.34–0.89; $P = 0.013$), stillbirth (OR 0.27, 95% CI 0.16–0.43; $P < 0.001$), neonatal distress (OR 0.33, 95% CI 0.18–0.58; $P < 0.001$), and intrapartum stillbirth and neonatal distress (OR 0.29, 95% CI 0.17–0.49; $P < 0.001$).

Table 2 Recorded causes of severe maternal outcomes among study patients.^a

Cause	Patients with previous cesarean deliveries (n = 36)	Patients with previous vaginal delivery (n = 84)	Total (n = 120)
Hypertensive disorders	5 (13.9)	29 (34.5)	34 (28.3)
Ablatio placentae	8 (22.2)	18 (21.4)	26 (21.7)
Uterine rupture	7 (19.4)	15 (17.9)	22 (18.3)
Postpartum hemorrhage	7 (19.4)	7 (8.3)	14 (11.7)
Other direct causes ^b	3 (8.3)	8 (9.5)	11 (9.2)
Placenta previa	2 (5.6)	3 (3.6)	5 (4.2)
Obstetric infections	1 (2.8)	2 (2.4)	3 (2.5)
Perioperative complications ^c	1 (2.8)	1 (1.2)	2 (1.7)
Placenta accrete	2 (5.6)	0	2 (1.7)
Indirect causes ^d	0	1 (1.2)	1 (0.8)

^a Values are given as number (percentage).

^b Including anemia, intrauterine fetal death, peripartum cardiomyopathy, intoxication, ectopic pregnancy.

^c High spinal anesthesia and internal hemorrhage.

^d Epilepsy.

Table 3
Association of severe maternal outcomes and adverse perinatal outcomes with previous cesarean deliveries or previous vaginal deliveries.^a

Outcome	All study patients (n = 2478)	Odds ratio (95% confidence interval)	Patients who underwent emergency cesarean deliveries (n = 1006)	Odds ratio (95% confidence interval)
Severe maternal outcomes ^b				
Patients with previous vaginal deliveries	84 ^c /1574	Ref.	21/469	Ref.
Patients with previous cesarean deliveries	36 ^d /784	0.86 (0.58–1.26)	21/495	0.95 (0.49–1.85)
Stillbirth				
Patients with previous vaginal deliveries	150 ^e /1504	Ref.	31/458	Ref.
Patients with previous cesarean deliveries	33 ^f /784	0.42 (0.29–0.62)	20/495	0.60 (0.32–1.10)
Neonatal distress ^g				
Patients with previous vaginal deliveries	78/1419	Ref.	37/420	Ref.
Patients with previous cesarean deliveries	29/751	0.70 (0.46–1.10)	22/470	0.53 (0.29–0.94)
Intrapartum stillbirth and neonatal distress ^h				
Patients with previous vaginal deliveries	108/1421	Ref.	43/420	Ref.
Patients with previous cesarean deliveries	33/751	0.58 (0.38–0.87)	26/470	0.54 (0.31–0.92)

Abbreviation: MNM, maternal near-miss.

^a Values are given as number who experienced outcome/number unaffected.

^b Defined as a MNM events or maternal death.

^c Of these, 39 (49%) patients fulfilled the MNM criteria on arrival and 43 (51%) fulfilled the MNM criteria after arrival.

^d Of these, 13 (36%) patients fulfilled the MNM criteria on arrival and 23 (64%) fulfilled the MNM criteria after arrival.

^e Of these, 30 (20%) patients had a recorded fetal heart rate on arrival and 118 (78%) had no recorded fetal heart rate on arrival.

^f Of these, 4 (12%) patients had a recorded fetal heart rate on arrival and 29 (88%) had no recorded fetal heart rate on arrival.

^g Defined as an Apgar score <7 at 5 minutes among live births.

^h Defined as stillbirths with fetal heart rate on arrival and live births with an Apgar score <7 at 5 minutes.

The analysis of inter-rater agreement for the 130 SMO demonstrated that there was “substantial agreement” or better (a Cohen kappa coefficient ≥ 0.61) [22] across most variables (Supplementary Material S3).

4. Discussion

In the present study, patients with previous cesarean deliveries had no increase in the risk of SMO, and a lower risk of adverse perinatal outcomes compared with individuals with previous vaginal deliveries.

The present study had several strengths. WHO criteria allowed the identification of patients with signs and symptoms of organ dysfunction, and have higher specificity for identifying life-threatening conditions than other criteria [23]. Data collection was performed in a structured and consistent manner and having all medical records reviewed by the same researcher prevented different interpretations of MNM criteria and causes of SMO. The analysis of inter-rater agreement indicated that there was good agreement between the researcher’s assessment of patients and the outcome recorded by the study hospital. Another strength was that patient age, parity, HIV status, and sociodemographic characteristics were comparable between the two groups of patients.

One significant limitation of the present study was the hospital’s status as a tertiary institution; patients with previous cesarean deliveries could have been admitted owing to their cesarean scars, while patients with previous vaginal deliveries could have been admitted owing to delivery complications. To interpret the data, information on the proportion of institutional deliveries in each group, reasons for hospital admission, and the status of patients at admission would have been useful; however, this information was not available in the database. Another limitation was that it was not possible to access information on the number of previous cesarean deliveries and their indications among patients with cesarean scars. Additionally, only one indication was recorded for each cesarean delivery and, with many patients having multiple indications, interpreting cesarean-delivery indications was difficult, especially in patients with cesarean scars. Finally, given the small number of SMO, the sample size could have been too small to detect any association between SMO and previous cesarean scars, supported by the wide CIs calculated. General limitations of follow-up and the applicability of the MNM criteria in this setting have been discussed in detail elsewhere [18].

The present findings deviate from those of the literature, where cesarean scars have been associated with higher risks of obstetric complications [2–5,7], MNM events and SMO [15,16], and adverse perinatal

outcomes [8–11]. As discussed above, there was a risk of systematic bias in the present study owing to the hospital being a tertiary institution. However, the majority of patients in both groups had referred themselves, indicating that a large proportion of study patients were low-risk individuals who bypassed health centers and peripheral hospitals. Consequently, it was hypothesized that the present findings could be related to differences between the study groups in terms of healthcare-seeking behavior, referral mechanisms, intrapartum monitoring, and clinical decision making.

Individuals with previous cesarean deliveries are often urged to present early at hospitals when labor starts; a qualitative study performed in Tanzania [24] found that community members regarded previous abdominal deliveries as a serious risk factor and a cesarean scar increased an individual’s tendency to accept referral advice [24]. The present study demonstrated that patients with previous cesarean deliveries who referred themselves had a lower risk of stillbirth than patients with previous vaginal deliveries who referred themselves, and that the majority of stillbirths had occurred before patients arrived at the hospital. Although concerns have been expressed previously [25] that patients with previous cesarean deliveries would unsuccessfully attempt home delivery, the results of the present study suggest that these patients sought health care early, while individuals with previous vaginal and uncomplicated deliveries might view early admission during labor as unnecessary [26].

Additionally, it was hypothesized that patients with previous cesarean deliveries could be prioritized when they arrive at hospital. A previous study that interviewed caregivers and recorded participant observations found that there was an awareness among caregivers that cesarean scars entail risks, and that this awareness affects clinical decisions [19]. Caregivers at health centers and peripheral hospitals are often unwilling to treat patients with cesarean scars at their facilities, where access to emergency cesarean delivery can be inadequate, preferring to refer them to a higher level of care more promptly [19]. In the present study, patients with previous cesarean deliveries who were referred had a lower risk of all outcomes compared with referred individuals with previous vaginal deliveries. The sub-analysis of emergency cesarean deliveries demonstrated that the lower risk of adverse perinatal outcomes among patients with previous cesarean deliveries could not be explained solely by a larger proportion of cesarean deliveries in this group being performed electively. Rather, individuals with previous cesarean deliveries could be prioritized during labor, for example through closer monitoring, faster cesarean-delivery decision making, and being prioritized in the operating

queue. However, data for time intervals and potential delays were not available and this theme need to be explored further in future studies.

In conclusion, patients with previous cesarean deliveries seemed to have sought care at the study hospital more promptly, and earlier referrals, more thorough intrapartum monitoring, and faster decision making could have counteracted the risks entailed by cesarean scars. These results illustrate that obstetric risks are context dependent, and that planning interventions to improve maternal and perinatal health should consider local factors. These findings could be of particular interest to similar institutions in other low-income countries.

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.ijgo.2015.10.009>.

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Conflicts of interests

The authors have no conflicts of interest.

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