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Malpresentation in low- and middle-income countries: associations with perinatal and maternal outcomes in the Global Network

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Abstract

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CONFLICTS OF INTEREST

None of the authors report any conflicts of interest regarding this manuscript.

Introduction: Uncertainty exists regarding the impact of malpresentation on pregnancy outcomes and the optimal mode of delivery in low- and middle-income countries. We sought to compare outcomes between cephalic and non-cephalic pregnancies.

Material and methods: Using the NICHD Global Network's prospective, population-based registry of pregnancy outcomes from 2010–2016, we studied outcomes in 436,112 singleton pregnancies. Robust Poisson regressions were used to estimate the risk of adverse outcomes associated with malpresentation. We examined rates of cesarean delivery for malpresentation and compared outcomes between cesarean and vaginal delivery by region.

Results: Across all regions, stillbirth and neonatal mortality rates were higher among deliveries with malpresentation. In adjusted analysis, malpresentation was significantly associated with stillbirth (adjusted relative risk (aRR) 4.0, 95% confidence interval (CI); 3.7 to 4.5) and neonatal mortality (aRR 2.3, 95% CI; 2.1 to 2.6). Women with deliveries complicated by malpresentation had higher rates of morbidity and mortality. Rates of cesarean delivery for malpresentation ranged from 27% to 87% among regions. Compared to cesarean, vaginal delivery for malpresentation was associated with increased maternal risk, especially postpartum hemorrhage (aRR 5.0, 95% CI; 3.6 to 7.1).

Conclusions: In a cohort of deliveries in low- and middle-income countries, malpresentation was associated with increased perinatal and maternal risk. Further research is needed to determine the best management of these pregnancies.

Keywords

Breech Presentation; Labor Presentation; Obstetric Delivery; Cesarean Section; Pregnancy Outcomes; Developing Countries

INTRODUCTION

Breech presentation and other less common malpresentations affect up to 3–4% of pregnancies at term and are even more common in earlier gestation.¹ Risk factors for malpresentation are diverse and include maternal age, parity, uterine anomalies, prematurity, fetal growth restriction, fetal anomalies, and amniotic fluid abnormalities. Questions exist regarding the independent impact of malpresentation, especially breech presentation, on fetal and neonatal outcomes,^{2, 3} and much attention has been given to the best mode of delivery for these pregnancies. Following publication of the multi-country Term Breech Trial, which showed decreased neonatal morbidity and mortality with planned cesarean delivery compared to planned vaginal delivery for term breech presentations,⁴ most high-income countries have adopted cesarean as the preferred mode of delivery for breech presentation.⁵ Subsequent meta-analyses of additional studies examining mode of delivery have likewise shown an increase in neonatal morbidity and mortality with planned vaginal delivery compared to cesarean for breech presentation, although the absolute risk remains low.^{5, 6}

In low- and middle-income countries (LMIC), there is even more uncertainty as to the significance of malpresentation for pregnancy outcomes and controversy exists over the optimal management of pregnancies affected by malpresentation.^{7, 8} Several factors may influence outcomes. For one, the risk of neonatal morbidity and mortality and stillbirth is

often greater in LMIC compared to high-income countries. Cesarean delivery is also less available in many LMIC settings and may not be uniformly accessible, competently practiced, or routinely performed for breech presentations.⁹ Furthermore, there is heightened concern over the increased maternal risk associated with operative delivery in these settings.¹⁰

Given this knowledge gap, we sought to compare fetal, neonatal, and maternal outcomes between cephalic and non-cephalic pregnancies in LMIC, to examine rates of cesarean delivery for malpresentation and to explore the association between mode of delivery and fetal, neonatal, and maternal outcomes.

MATERIAL AND METHODS

Using the Global Network for Women's and Children's Health Research's prospective, multi-country, population-based maternal-newborn registry of pregnancy outcomes from 2010 to 2016, we analyzed outcomes by presentation and mode of delivery in singleton pregnancies. The Global Network's Maternal and Newborn Health Registry (MNHR) is funded by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD). Investigators at seven rural or semi-urban sites in six LMIC (India [two sites, Nagpur and Belagavi], Pakistan, Guatemala, Zambia, Kenya, Democratic Republic of Congo) oversee the MNHR. The Democratic Republic of Congo site initiated enrollment in the MNHR in 2014, while all other sites began enrollment prior to 2010.

The methods of the MNHR have been previously described.¹¹ In brief, this prospective registry began in 2008 to record pregnancy services and outcomes in low-resource settings where quality health records are often lacking. The MNHR aims to capture all pregnant women in well-defined geographic clusters and follows their care and pregnancy outcomes through six weeks postpartum. Each of the seven study sites comprises between eight to 20 communities with approximately 300 to 500 births annually within the catchment area of a primary healthcare center. The MNHR employs a local registry administrator for each community who, with the aid of local leaders and healthcare providers, seeks to enroll every pregnant woman in their area by 20 weeks gestation. Every pregnant woman who lives in the community is eligible, regardless of whether she delivers at home or in a health center or hospital. Each participant must provide informed consent for study participation prior to enrollment. In total, the MNHR tracks approximately 60,000 pregnancies per year.

For the purposes of the current analyses, pregnancies were excluded from analysis if a miscarriage or medical termination of pregnancy occurred, if a maternal death occurred prior to labor and delivery, if the pregnancy was multiple (including twins and triplets), or if information on fetal presentation or mode of delivery was not available. Gestational age at delivery was characterized as term (≥ 37 weeks gestation) or preterm (<37 weeks gestation) according to the best gestational age estimate. Stillbirth was defined as birth of a fetus greater or equal to 20 weeks gestation with no apparent signs of life such as breathing, crying, heartbeat or movement.¹¹ Our data collection instrument did not distinguish between breech presentations and other malpresentations, such as transverse or oblique lie. We used

the terms malpresentation and non-cephalic presentation synonymously. Other outcomes and covariates were consistent with World Health Organization definitions.¹¹

Statistical analyses

This analysis included descriptive statistics and relative risks of adverse perinatal and maternal outcomes associated with malpresentation compared to cephalic presentation at the time of delivery. We hypothesized that perinatal outcomes would be worse among pregnancies with malpresentations at the time of delivery. Our primary outcomes were stillbirth and neonatal mortality. Secondary outcomes included maternal morbidity and some procedures (postpartum hemorrhage, dilation and curettage, hysterectomy, and unplanned hospitalization) and maternal mortality. These outcomes were analyzed overall, as well as by geographic region (India [two sites], Pakistan [one site], Guatemala [one site], and Africa [three sites]). The decision to combine the two Indian study sites and to combine the three African study sites was undertaken after review of site-specific data which yielded overall similar outcomes among the two Indian sites and then the three African sites. This both allowed for larger numbers in the analyses, as some outcomes by site were small, and for less cumbersome tabular presentation of the data.

We examined outcomes stratified by gestational age and mode of delivery adjusted for each geographic region. We estimated the risk of stillbirth, neonatal mortality, and postpartum hemorrhage associated with malpresentation after adjusting for relevant confounders using Robust Poisson regression analysis. Finally, we examined rates and trends in cesarean delivery for pregnancies with malpresentation by geographic region and year. Indication for cesarean delivery was only available for a portion of the study period, from 2010 to 2013, and therefore, not included in our regression analysis. All analyses were performed using SAS v.9.4 (SAS Institute, Cary, NC).

Ethical approval

The appropriate institutional review boards or ethics research committees of participating centers approved of the MNHR. Data were collected, edited, and entered into research computers locally at each study site and transmitted securely to a central data-coordinating center (RTI International) for further central editing and analyses. An independent data monitoring committee, appointed by the NICHD, oversees and reviews the study semi-annually.

RESULTS

Of the 468,341 women eligible, 99% consented to the MNHR, and outcomes from 436,112 deliveries from 2010 to 2016 met inclusion criteria and were analyzed in this study (Figure 1). Of these, 8,872 (2%) had a non-cephalic presentation at the time of delivery. Baseline maternal demographics and delivery characteristics of pregnancies with cephalic vs non-cephalic presentations are shown in Table 1. Women with malpresentations were similar to women with cephalic presentation in terms of age and education; however, malpresentation was more common among nulliparous women and those with preterm deliveries. Hospital-

based and cesarean deliveries were also more common with malpresentations although there were differences by geographic region.

The overall rate of cesarean delivery in the setting of malpresentation was 63.6%; this rate ranged from 26.9% in Africa to 86.5% in Guatemala. These large differences in cesarean rates by geographic region did not change substantially over the study period. However, the individual trends toward increasing rates of cesarean delivery for malpresentation in Africa, Pakistan and Guatemala were all statistically significant (data not shown) (Figure 2). Indication for the cesarean delivery was available in 61% of the cesareans performed in the setting of malpresentation. For those with malpresentation, 75.8% had malpresentation listed as the indication for cesarean, while another 11.8% had obstructed, prolonged labor, or failure to progress and 4.7% had previous cesarean listed as the indication. No other indication accounted for more than 2% of the cesareans in women with malpresentation.

Across all regions, stillbirth and neonatal mortality rates were higher among deliveries with malpresentations compared to those with cephalic presentations (Table 2). When stratified by term/preterm and mode of delivery, malpresentation remained associated with increased risk for both stillbirth and neonatal mortality in term deliveries and in those with cesarean deliveries (Table 3). Finally, when adjusting for region, maternal age, parity, education, preterm birth, delivery location, and mode of delivery, malpresentation was associated with a significantly increased risk of stillbirth (adjusted relative risk (aRR) 4.0, 95% confidence interval (CI); 3.7 to 4.5) and neonatal mortality (aRR 2.3, 95% CI; 2.1 to 2.6).

In pooled unadjusted analyses, women with malpresentations compared to cephalic presentations at the time of delivery had higher rates of complications and procedures (postpartum hemorrhage, dilation and curettage, hysterectomy, unplanned hospitalization) and maternal mortality (Table 4). Notably, both postpartum hemorrhage and maternal mortality were higher in deliveries with malpresentations and these associations held across all geographic regions. After adjusting for maternal age and parity, malpresentation was associated with a significantly increased risk of postpartum hemorrhage (aRR 3.4, 95% CI; 2.5 to 4.5). In African study sites, these associations were most pronounced. Postpartum hemorrhage in deliveries complicated by malpresentation was increased over nine-fold compared to deliveries with cephalic presentation; maternal mortality was increased over ten-fold.

We next examined mode of delivery by presentation and risk of adverse maternal outcomes. When mode of delivery was examined, women with malpresentations who delivered vaginally had significantly higher rates of postpartum hemorrhage than women who underwent cesarean delivery (15.6% vs 2.3%); this finding was observed across all regions (Table 5). A modest increase in postpartum hemorrhage was also seen in vaginal deliveries compared to cesarean deliveries overall (2.2 vs 1.3%) and in vaginal deliveries of cephalic presentations (2.1% vs 1.2%). When adjusting for region, the relative risk of postpartum hemorrhage associated with a vaginal delivery compared to cesarean delivery in the setting of malpresentation was 5.0 (95% CI; 3.6 to 7.1) (Data not shown). Other maternal complications and procedures such as dilation and curettage, hysterectomy, and unplanned

hospitalization were increased in cesarean deliveries for malpresentation, similar to the trend seen in all presentations (Table 4).

Maternal mortality in general was higher in cesarean compared to vaginal deliveries. However, this association was reversed in the case of malpresentation where the maternal mortality rate was nearly 500 per 100,000 vaginal deliveries, twice that observed in cesarean deliveries (Table 5). When stratifying maternal outcome for malpresentation by mode of delivery and term/preterm status, only vaginal deliveries and term deliveries remained associated with an increased risk for maternal mortality (Table 6). Other maternal outcomes were also increased among the remainder of these stratified subgroups. Of note, unplanned hospitalization was especially increased among term and vaginal deliveries in the setting of malpresentation (Table 6).

DISCUSSION

Using the Global Network's prospectively-collected, population-based MNHR, we found that malpresentation was associated with increased risk of adverse fetal, neonatal, and maternal outcomes in a cohort of deliveries in LMIC. After adjusting for relevant confounders including prematurity, location, and mode of delivery, malpresentation was associated with a four-fold increased risk of stillbirth and a two-fold increased risk of neonatal death. We also found that malpresentation was associated with increased maternal mortality and morbidity, particularly postpartum hemorrhage.

While older literature has emphasized the inherent neonatal risks associated with malpresentation,^{2, 3} more recent epidemiologic studies have tended to refute this association.¹² This question has been infrequently explored in low-resource settings. In more recent decades, international debate has shifted to the best mode of delivery for breech presentation. Meta-analyses of both retrospective and prospective studies have shown increased perinatal risk with planned vaginal delivery compared to planned cesarean for the singleton breech baby at term albeit with relatively small increases in absolute risk.⁵ With the notable exception of the multi-country Term Breech Trial, most studies have focused on populations in high-income countries. The smaller risk reduction with planned cesarean delivery among countries with high perinatal mortality compared to those with low perinatal mortality found in the Term Breech Trial suggests that country setting and resources significantly modify this risk. Multiple authors have suggested that planned cesarean delivery may not be the best option in low-income countries.^{7, 8, 13} Limited retrospective studies of mode of delivery in breech presentation in low-income countries in sub-Saharan Africa, primarily conducted at urban referral hospitals, have had conflicting results, but the majority of the studies demonstrate an increased perinatal risk with vaginal delivery.¹⁴⁻¹⁸ However, the rate of cesarean delivery for malpresentation at African study sites in the Global Network, which represent primarily non-urban, non-referral healthcare facilities, was low and increased only modestly over the study period.

Our study showed increased risk of stillbirth and neonatal mortality with malpresentation even when adjusting for mode of delivery, although relative risk was significantly higher among those delivered vaginally. The elevated risk of stillbirth in vaginal deliveries

compared to cesarean (relative risk 7.5) may be due in part to pregnancies diagnosed with fetal demises prior to labor who were preferentially selected to undergo vaginal delivery, since the MNHR does not differentiate antepartum vs intrapartum fetal demise. However, this does not explain the increased risk of neonatal mortality associated with malpresentation. Vaginal deliveries of antenatal fetal demises may account for some of the difference seen between the risk of stillbirth and that of neonatal demise. Prior studies of breech presentation have generally excluded major fetal anomalies; however, these complications often go undiagnosed in LMIC and may also serve to increase both rates of stillbirth and neonatal mortality in our cohort.

Our study had surprising findings for maternal outcome. In both adjusted and unadjusted analyses, there was a significant increase in risk of postpartum hemorrhage with malpresentation. In addition, women with malpresentation who delivered vaginally were at significantly higher risk of postpartum hemorrhage across all regions. Although risk of bleeding is generally thought to be greater with cesarean, an increased risk of postpartum hemorrhage associated with vaginal delivery in LMIC has previously been reported in the Global Network,¹⁹ though to a much lesser extent. The finding of increased risk of hemorrhage associated with malpresentation and especially vaginal delivery for malpresentation persisted even when adjusting for parity and other maternal factors. We also found an increased risk for maternal mortality associated with malpresentations. When stratified by mode of delivery, only vaginal deliveries of malpresentations were associated with increased risk of maternal death. To our knowledge, these findings have not been previously reported.

Our study has a number of limitations. This is an observational study and the results, especially those associated with mode of delivery, should be interpreted with caution. Our overall rate of malpresentation was 2%, which is somewhat less than that generally reported in the literature. Of note, African study sites reported especially low rates of malpresentation, just 1%. This may be due to both underreporting and lower rates of breech presentation among sub-Saharan African women at term.²⁰ Furthermore, we were not able to distinguish breech presentation from other forms of malpresentation such as transverse and oblique lie in our cohort. Given the rarity of these other forms of malpresentation, these are unlikely to account for our findings. Notably there were significant differences among rates of cesarean delivery for malpresentation among study sites and region, which suggests important differences in pregnancy care provided among these locations. These differences, in turn, may have had significant impacts on pregnancy outcomes. There was also a substantial proportion of home deliveries in our cohort, and while attempts were made to verify all outcomes, some delivery characteristics and outcomes may have been missed. In addition, some relevant confounders are not included in the analysis because the data was incomplete or not captured in the registry. For example, indication for cesarean delivery was only collected from 2010 to 2013. Finally, long-term infant and maternal outcomes and information on future reproductive outcomes were beyond the scope of this study.

This study has several strengths, including a large sample size and prospectively-collected data. We analyzed over 400,000 pregnancies from six countries on three continents. The study sites represent a range of LMIC with varying capacities and resources; however,

outcome data were collected under a uniform research protocol with standard definitions. Although LMIC contribute disproportionately to neonatal and maternal morbidity and mortality, high-quality data is often lacking in these settings, and this registry adds significantly to a limited body of data from these countries.

Given that current evidence from high-income countries suggests that there is not an inherent or insurmountable risk associated with malpresentation,¹² our findings highlight an important area for improvement in obstetric care in LMIC. Identifying pregnancies complicated by malpresentation and standardizing their care through referral to appropriate facilities may lead to improved outcomes for both neonate and mother. Our finding of an association between postpartum hemorrhage and malpresentation, especially vaginal delivery of term pregnancies with malpresentation, is of particular interest. Hemorrhage is the number one cause of maternal mortality in LMIC,^{21, 22} which account for a disproportionate number of maternal deaths worldwide. Our findings suggest that further attention to the prevention and treatment of hemorrhage in pregnancies complicated by malpresentation is an important area for future study in LMIC.

CONCLUSION

Our findings show increased risk for both newborns and mothers in pregnancies complicated by malpresentation at the time of delivery in LMIC. Further research is needed to understand the underlying etiology of this risk and guide the appropriate identification and management of these pregnancies in low-resource settings.

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Abbreviations

MNHR	Maternal and Newborn Health Registry
LMIC	low- and middle-income countries
NICHD	<i>Eunice Kennedy Shriver</i> National Institute of Child Health and Human Development
aRR	adjusted relative risk
CI	confidence interval

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Key Message

Breech presentation and its management is a common problem encountered in obstetrics. In a prospectively-collected cohort of deliveries in low- and middle-income countries, malpresentation was associated with adverse fetal, neonatal, and maternal outcomes.

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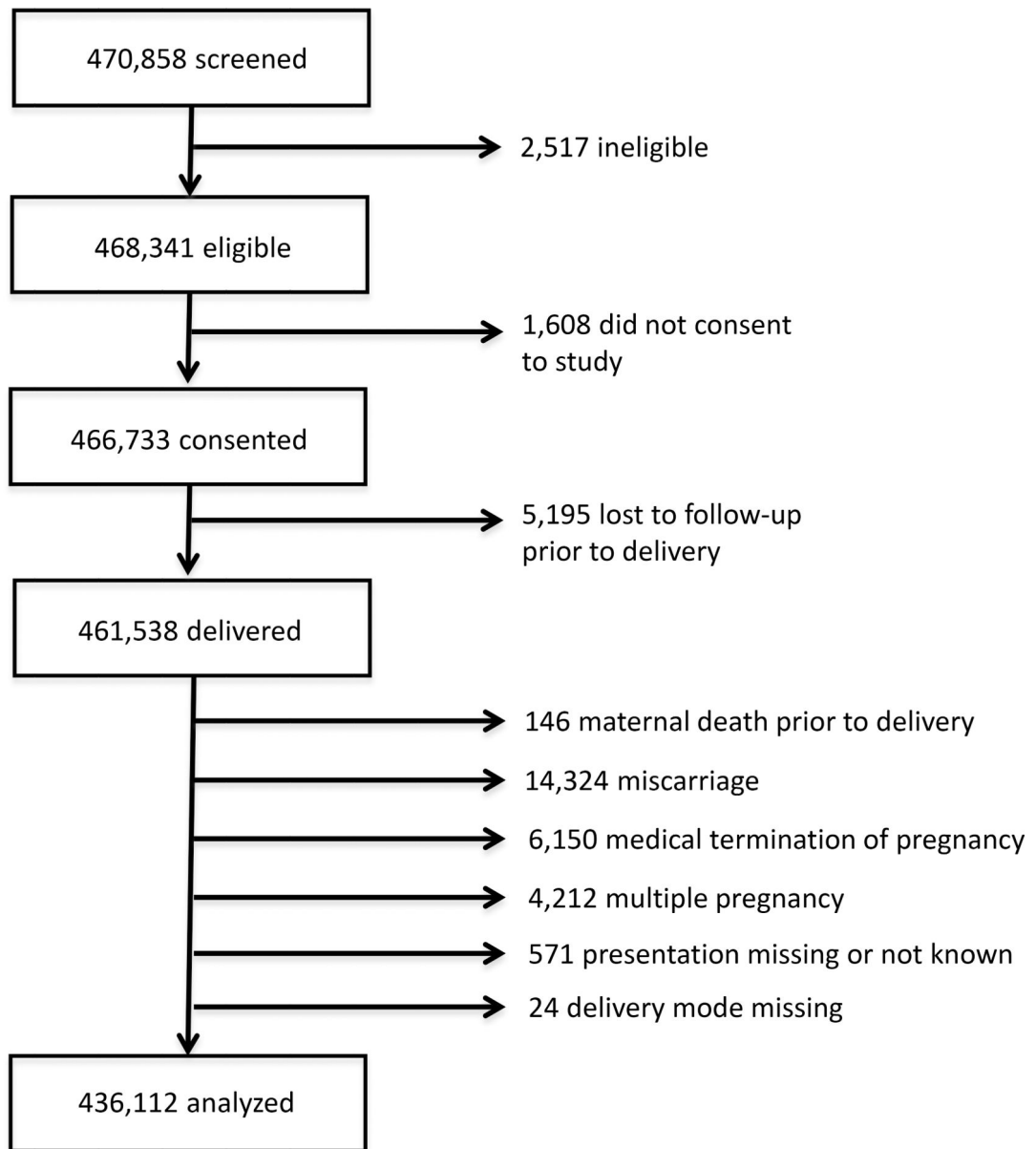


Figure 1.
CONSORT flow diagram.

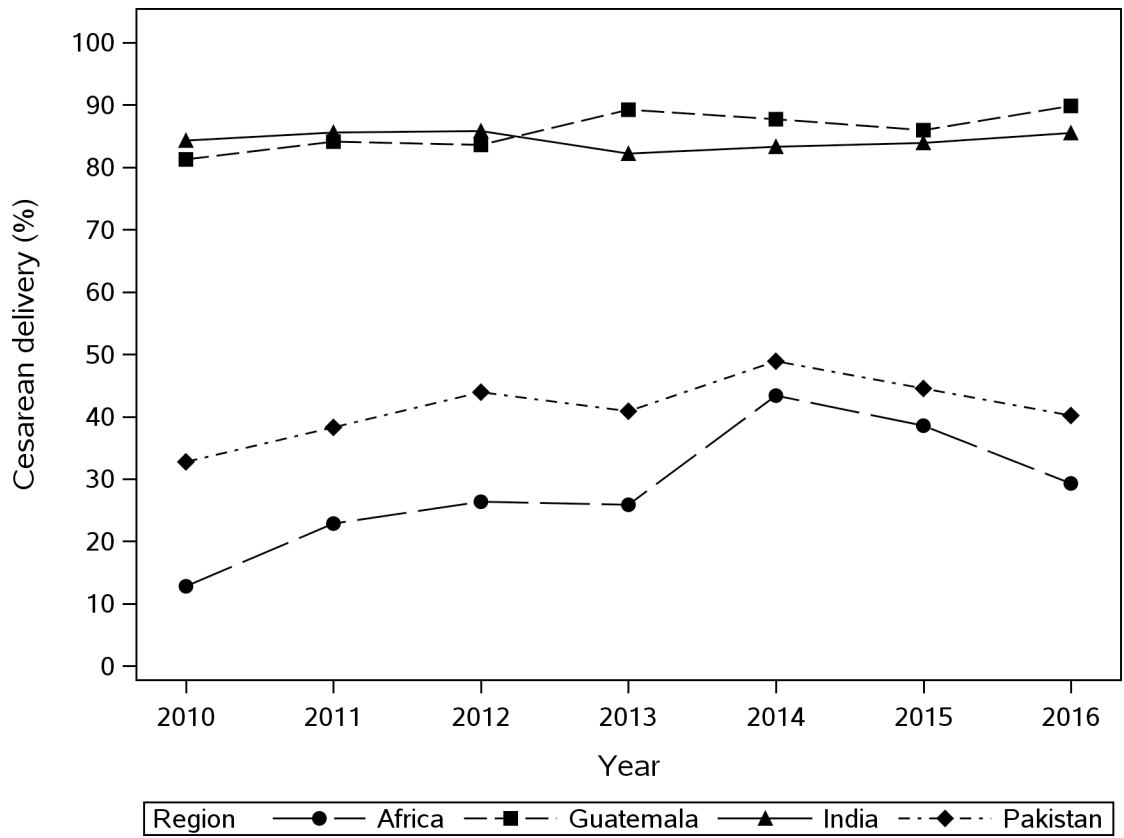


Figure 2.
Cesarean delivery for malpresentation by year and region.

Table 1.

Maternal and delivery characteristics by presentation and region

	Overall		Africa		Guatemala		India		Pakistan	
	Ceph	Malp	Ceph	Malp	Ceph	Malp	Ceph	Malp	Ceph	Malp
Deliveries, N	427,240	8,872	123,037	1,262	59,936	1,836	170,718	3,144	73,549	2,630
Maternal age, %	426,785	8,856	122,855	1,257	59,920	1,836	170,614	3,142	73,396	2,621
< 20	12.3	10.1	22.6	22.3	16.7	14.8	6.8	6.7	4.1	5.0
20–35	83.4	83.9	71.1	68.3	72.8	71.7	92.9	93.0	90.6	89.0
> 35	4.3	6.0	6.3	9.5	10.5	13.6	0.3	0.4	5.2	6.0
Mean (std)	24.7 (5.2)	25.5 (5.5)	24.6 (6.2)	25.5 (6.7)	26.1 (6.6)	27.0 (6.9)	23.2 (3.0)	23.1 (3.2)	27.4 (4.8)	27.3 (5.0)
Parity, %	424,481	8,727	122,928	1,257	59,930	1,836	170,196	3,137	71,427	2,497
Nulliparous	32.2	39.8	26.4	28.2	28.2	32.2	43.6	59.8	18.5	26.1
Multiparous	67.8	60.2	73.6	71.8	71.8	67.8	56.4	40.2	81.5	73.9
Education, %	426,109	8,849	122,772	1,257	59,923	1,834	170,055	3,134	73,359	2,624
No formal education	24.8	30.5	10.6	9.1	16.6	15.7	13.2	7.1	82.2	79.0
Primary	31.6	27.3	45.6	50.0	57.9	56.5	22.4	16.1	8.1	9.4
Secondary	36.9	33.0	40.7	37.1	22.0	22.4	52.2	58.2	7.0	8.4
University+	6.7	9.2	3.1	3.8	3.5	5.4	12.2	18.6	2.8	3.2
Preterm/Term, %	412,605	8,490	117,864	1,166	58,536	1,784	166,379	3,081	69,826	2,459
Preterm	12.2	17.7	13.1	16.3	9.8	14.3	10.2	10.9	17.6	29.1
Term	87.8	82.3	86.9	83.7	90.2	85.7	89.8	89.1	82.4	70.9
Delivery location, %	427,179	8,870	123,036	1,262	59,936	1,836	170,681	3,144	73,526	2,628
Hospital	42.6	75.6	15.4	51.0	45.1	87.7	66.4	93.8	30.9	57.0
Clinic	30.1	12.7	47.3	27.9	2.8	3.6	28.9	5.2	26.4	20.9
Home/Other	27.3	11.7	37.3	21.2	52.1	8.7	4.7	1.0	42.7	22.1
Delivery mode, %	427,240	8,872	123,037	1,262	59,936	1,836	170,718	3,144	73,549	2,630
C/S	11.6	63.6	1.0	26.9	20.0	86.5	17.0	84.4	9.7	40.5
Vaginal	88.4	36.4	99.0	73.1	80.0	13.5	83.0	15.6	90.3	59.5

Ceph, cephalic presentation; Malp, non-cephalic presentation.

Table 2.

Perinatal outcomes by region and presentation

	Overall		Africa		Guatemala		India		Pakistan	
	Ceph	Malp	Ceph	Malp	Ceph	Malp	Ceph	Malp	Ceph	Malp
Deliveries, N	427,240	8,872	123,037	1,262	59,936	1,836	170,718	3,144	73,549	2,630
Stillbirth, N (Rate/1000)	24.2	103.6	20.0	171.2	16.9	67.5	22.7	41.3	40.8	170.7
Neonatal mortality < 28 days, N (Rate/1000)	22.6	68.1	13.7	70.3	22.0	55.2	20.6	35.9	43.0	122.2

Ceph, cephalic presentation; Malp, non-cephalic presentation.

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Table 3.

Relative risk of adverse perinatal outcomes associated with malpresentation stratified by mode of delivery and term/preterm status

	Relative Risk (95% CI) ^a
Deliveries	
Stillbirth	4.0 (3.5, 4.4)
Neonatal mortality < 28 days	2.6 (2.4, 2.9)
Vaginal deliveries	
Stillbirth	7.5 (6.6, 8.5)
Neonatal mortality < 28 days	4.8 (4.2, 5.4)
Cesarean deliveries	
Stillbirth	1.6 (1.4, 2.0)
Neonatal mortality < 28 days	1.3 (1.1, 1.5)
Term deliveries	
Stillbirth	4.7 (4.0, 5.4)
Neonatal mortality < 28 days	2.7 (2.3, 3.1)
Preterm deliveries	
Stillbirth	2.6 (2.4, 2.9)
Neonatal mortality < 28 days	2.1 (1.9, 2.4)

^a Adjusted for region

Table 4.

Maternal outcomes by region and presentation

	Overall		Africa		Guatemala		India		Pakistan	
	Ceph	Malp	Ceph	Malp	Ceph	Malp	Ceph	Malp	Ceph	Malp
Deliveries	427,240	8,872	123,037	1,262	59,936	1,836	170,718	3,144	73,549	2,630
Postpartum hemorrhage, %	2.0	7.1	2.5	23.3	2.0	3.8	0.5	2.5	4.7	7.1
D&C, %	4.7	8.8	3.0	8.5	1.0	0.8	8.8	18.2	0.9	2.0
Hysterectomy, %	0.1	0.4	0.1	1.3	0.1	0.7	0.0	0.1	0.1	0.0
Unplanned hospitalization, %	4.0	26.7	0.9	12.6	9.5	63.7	5.5	16.9	1.0	4.9
Maternal mortality < 42 days, Rate/ 100,000 deliveries	101	329	86	1116	75	110	73	96	210	384

Ceph, cephalic presentation; Malp, non-cephalic presentation; D& C, dilation and curettage.

Table 5.

Maternal outcomes by region, presentation and mode of delivery

	Overall		Africa		Guatemala		India		Pakistan	
	CS	VD	CS	VD	CS	VD	CS	VD	CS	VD
Deliveries	55,124	380,988	1,603	122,696	13,553	48,219	31,752	142,110	8,216	67,963
Postpartum hemorrhage, %	1.3	2.2	5.8	2.6	2.0	2.0	0.4	0.6	2.9	5.0
D&C, %	7.1	4.4	9.0	3.0	0.1	1.2	11.3	8.3	1.5	0.9
Hysterectomy, %	0.2	0.1	1.2	0.1	0.4	0.1	0.1	0.0	0.3	0.0
Unplanned hospitalization, %	14.3	2.7	12.0	0.9	24.0	6.4	10.9	4.0	2.7	0.9
Maternal mortality < 42 days, Rate/ 100,000 deliveries	220	89	1506	79	104	69	126	62	528	178
Malpresentation	5,647	3,225	340	922	1,588	248	2,654	490	1,065	1,565
Postpartum hemorrhage	2.3	15.6	9.0	28.5	2.8	10.6	0.6	12.8	3.6	9.6
D&C, %	10.0	6.1	6.3	9.6	0.2	5.4	19.2	11.1	1.8	2.2
Hysterectomy, %	0.5	0.3	2.5	0.7	0.8	0.0	0.0	0.7	0.0	0.0
Unplanned hospitalization, %	32.0	16.6	12.3	12.7	64.6	57.8	14.4	31.3	5.0	4.8
Maternal mortality < 42 days, Rate/ 100,000 deliveries	231	499	2374	654	63	405	38	408	285	451
Cephalic	49,477	377,763	1,263	121,774	11,965	47,971	29,098	141,620	7,151	66,398
Postpartum hemorrhage, %	1.2	2.1	4.9	2.4	1.9	2.0	0.3	0.5	2.8	4.9
D&C, %	6.8	4.4	9.7	2.9	0.1	1.2	10.6	8.3	1.4	0.8
Hysterectomy, %	0.2	0.1	0.8	0.1	0.3	0.1	0.1	0.0	0.3	0.0
Unplanned hospitalization, %	12.6	2.6	11.9	0.8	19.7	6.2	10.7	3.9	2.4	0.8
Maternal mortality < 42 days, Rate/ 100,000 deliveries	219	85	1273	74	109	67	134	61	563	172

CS, cesarean section; VD, vaginal delivery; D&C, dilation and curettage.

Table 6.

Relative risk of adverse maternal outcomes associated with malpresentation stratified by mode of delivery and term/preterm status

	Relative Risk (95% CI) ^a
Deliveries	
Postpartum hemorrhage	--
D&C	--
Unplanned hospitalization	5.5 (4.8, 6.3)
Maternal mortality < 42 days	2.9 (2.0, 4.2)
Vaginal deliveries	
Postpartum hemorrhage	--
D&C	1.9 (1.5, 2.5)
Unplanned hospitalization	9.0 (7.6, 10.7)
Maternal mortality < 42 days	4.3 (2.6, 7.1)
Cesarean deliveries	
Postpartum hemorrhage	1.5 (1.2, 1.8)
D&C	1.5 (0.9, 2.5)
Unplanned hospitalization	2.3 (2.0, 2.6)
Maternal mortality < 42 days	0.8 (0.5, 1.3)
Term deliveries	
Postpartum hemorrhage	3.6 (2.7, 4.9)
D&C	--
Unplanned hospitalization	6.5 (5.6, 7.5)
Maternal mortality < 42 days	3.8 (2.4, 6.1)
Preterm deliveries	
Postpartum hemorrhage	2.2 (1.7, 3.0)
D&C	1.6 (1.1, 2.2)
Unplanned hospitalization	2.7 (2.3, 3.3)
Maternal mortality < 42 days	1.0 (0.4, 2.4)

^a Adjusted for region, dashes indicate models that did not converge.

D&C, dilation and curettage.