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## CLINICAL ARTICLE

Cesarean delivery outcomes from the WHO global survey on maternal and perinatal health in Africa<sup>☆</sup>

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## ABSTRACT

**Objective:** To assess the association between cesarean delivery rates and pregnancy outcomes in African health facilities. **Methods:** Data were obtained from all births over 2–3 months in 131 facilities. Outcomes included maternal deaths, severe maternal morbidity, fresh stillbirths, and neonatal deaths and morbidity. **Results:** Median cesarean delivery rate was 8.8% among 83 439 births. Cesarean deliveries were performed in only 95 (73%) facilities. Facility-specific cesarean delivery rates were influenced by previous cesarean, pre-eclampsia, induced labor, referral status, and higher health facility classification scores. Pre-eclampsia increased the risks of maternal death, fresh stillbirths, and severe neonatal morbidity. Adjusted emergency cesarean delivery rate was associated with more fresh stillbirths, neonatal deaths, and severe neonatal morbidity—probably related to prolonged labor, asphyxia, and sepsis. Adjusted elective cesarean delivery rate was associated with fewer perinatal deaths. **Conclusion:** Use of cesarean delivery is limited in the African health facilities surveyed. Emergency cesareans, when performed, are often too late to reduce perinatal deaths.

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## 1. Introduction

Good maternal and perinatal outcomes can be ensured through essential obstetric and newborn care provided by skilled attendants during pregnancy and childbirth [1–4]. In many resource-poor settings, access to skilled care and crucial interventions is limited. Cesarean delivery is a marker for the availability and use of obstetric services in these situations [5].

Although usually lifesaving, cesarean delivery increases maternal and newborn risks [6,7] and costs [8]. Ill health related to poor socioeconomic

and nutritional status is worsened by other co-morbidities. Delays in seeking, accessing, and receiving quality care in facilities also contribute to lower cesarean delivery rates and increase risks of adverse outcomes. African women may refuse surgery because of fear of suffering [9] and other cultural perceptions of womanhood [10]. Paradoxically, in Africa, where more cesarean deliveries are needed to improve maternal and perinatal survival, its availability and utilization are low [11].

The present survey was designed to study the mode of delivery and maternal and perinatal outcomes in selected African health facilities, and the association of institutional cesarean delivery rates with maternal and perinatal morbidity and mortality.

## 2. Materials and methods

The detailed methodology of the WHO Global Survey on Maternal and Perinatal Health has been published [12]. Data from all women

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delivered in selected facilities in 7 African countries between September 2004 and March 2005 were collected within 24 hours by trained staff [12]. These included, at individual level, maternal risk indicators, mode of delivery, and maternal and newborn outcomes until discharge or up to a maximum stay of 7 days; and at institutional level, laboratory tests, anesthesiology resources, intrapartum care including emergency obstetric care, and human resources.

Cesarean delivery was classified as elective if the decision to perform the operation was made before onset of labor, even when labor started before the operation. All others were considered as emergency.

After verification, data were entered online and managed by MedSciNet AB, Stockholm and the WHO coordinating unit [12]. Data were analyzed by the Urban Research and Development Centre for Africa (URADCA), Nairobi, and the WHO coordinating unit using Stata software version 9.2 (StataCorp LP, College Station, TX, USA).

Maternal outcomes were maternal death before discharge from hospital, and severe maternal morbidity if any of the following occurred: admission to intensive care unit, hysterectomy, postpartum fistula, antibiotic treatment excluding prophylaxis. Perinatal outcomes were neonatal death before discharge from hospital, fresh stillbirths, delayed breast feeding (initiation >1 hour after birth), and severe neonatal morbidity if any of the following were recorded: 5-minute Apgar score less than 4, referral to higher level or special care unit, admission to intensive care unit for 7 days or more.

Analyses were based on institutional level variables, with individual data summarized by calculating proportions within each institution. Indicators of risk among the pregnant population served by each facility were calculated as the proportions of women delivering in the facility

who had specific risk factors before or during the index pregnancy, or during childbirth.

A health facility classification score (HFCS) was developed to summarize the facility's capacity to provide services, based on ratings for 6 domains: basic services, general medical services, screening tests, emergency obstetric care, intrapartum care, and human resources ([http://www.who.int/making\\_pregnancy\\_safer/health\\_systems/health\\_facility\\_classification\\_score\\_africa.pdf](http://www.who.int/making_pregnancy_safer/health_systems/health_facility_classification_score_africa.pdf)). Each domain was classified (and scored) as basic (1), comprehensive (2), or advanced (3). The sum of scores for the domains comprised the HFCS.

Facilities were considered to have an economic incentive for cesarean delivery if higher fees were charged than for vaginal delivery (institutional benefit) or it provided additional income for staff (staff benefit).

Crude associations between cesarean delivery and risk factors were assessed: the proportion of outcomes and cesarean delivery rates at each facility were initially transformed to the logit scale, to improve normality. For each subgroup of risk factors (sociodemographic factors and previous pregnancy, current pregnancy, delivery, and characteristics of health facilities), individual factors judged to be associated with cesarean delivery were fitted in multiple linear regression models. Significant risk factors from these multiple regression models were considered as possible confounders for the association between cesarean delivery rates and outcomes in further analyses.

The association between cesarean delivery rates and maternal and perinatal outcomes was analyzed with linear multiple regression models, with these outcomes as the dependent variables and cesarean delivery rates as the main independent variable adjusting for possible confounding effects. A step-wise regression analysis was then carried

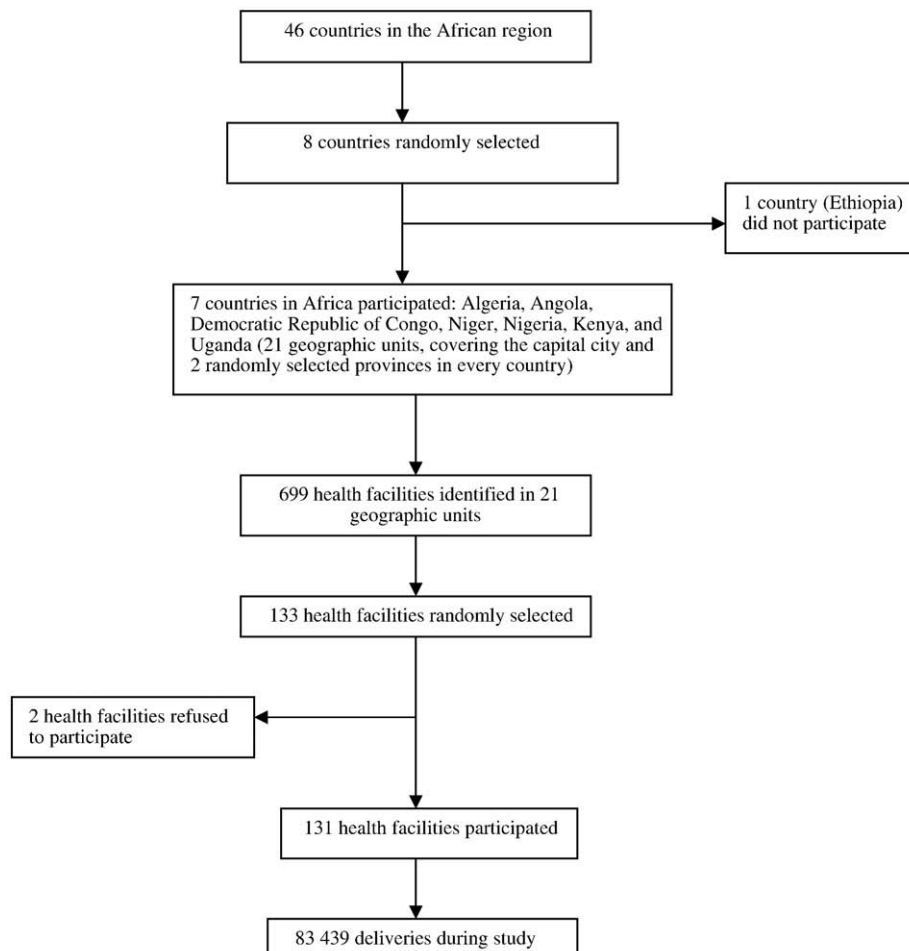
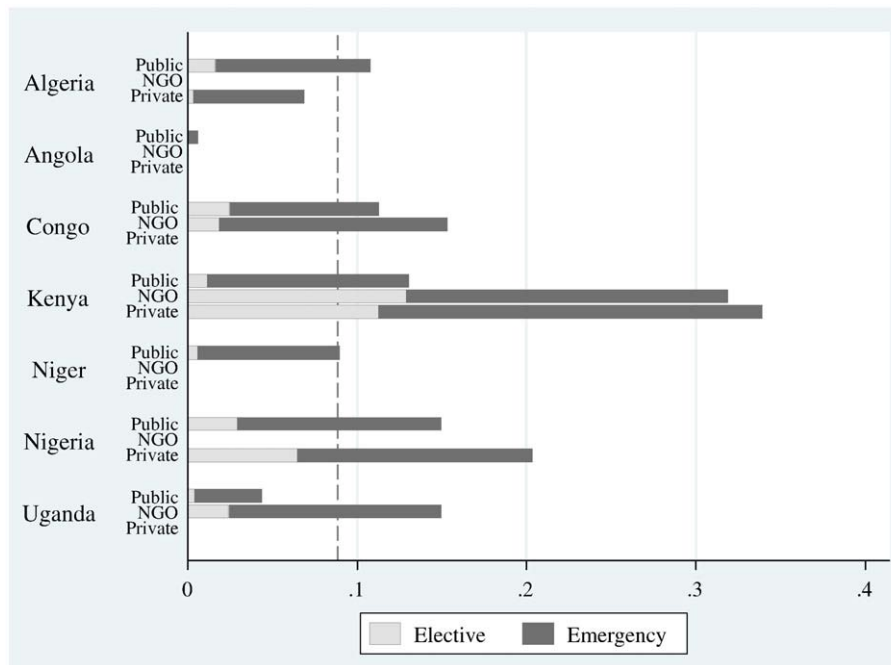


Fig. 1. Flow chart of the study.



**Fig. 2.** Proportion of elective and emergency cesarean deliveries (x-axis) according to ownership of facilities and countries (broken line denotes median cesarean delivery rate for all facilities).

out to study the interplay of significant risk factors in explaining the variability in facility cesarean delivery rates. Significant correlates were identified and carried forward as possible confounders of the association between adverse maternal and perinatal outcomes and institutional cesarean delivery rates.

The study was approved by institutional review committees, where available, or by national committees and by WHO's Scientific and Ethics Review Group and the Ethics Review Committee [12].

### 3. Results

There were 83 439 births in the 131 facilities surveyed (Fig. 1), ranging from 6432 in Angola to 20 343 in Kenya.

Forty-eight (37%) facilities were in capital cities. The median number of maternity beds per facility ranged from 13 in Uganda to 75 in the Democratic Republic of Congo. Most births (81.7%) occurred in governmental facilities; 13% were in facilities maintained by nongovernmental organizations. Births in private facilities ranged from 0% in Angola and the Democratic Republic of Congo to over 10% in Kenya. Most births (73%) in the Democratic Republic of Congo occurred in nongovernmental facilities.

Overall 30 facilities had low HFCS, while 54 and 47 facilities had medium and high scores, respectively. Most facilities (61%) charged fees for delivery; cesarean delivery provided "institutional benefit" in 74% and "staff benefit" in 20% of facilities.

Cesarean deliveries accounted for 8.8% of all births, but were performed in only 95 (72.5%) of the 131 facilities. Cesareans were performed in 96% of facilities with high HFCS and in only 17% with low scores. Cesarean deliveries were performed in all facilities surveyed in Kenya, but not in Algeria (2/18), Angola (13/20), Democratic Republic of Congo (3/21), Niger (6/11), Nigeria (1/21), and Uganda (11/20). Facilities not performing cesarean delivery reported 12 149 births.

Fig. 2 summarizes the distribution of elective and emergency cesarean by ownership of facilities and country. Among facilities performing cesarean delivery, the overall median (10th–90th) cesarean delivery rate was 13.4% (2.3%–27.3%). Median rates were 11.9%

**Table 1**

Characteristics of women delivered in the health facilities surveyed.

Characteristics	Institutional rates of facilities performing cesarean delivery	
	Yes (n = 95)	No (n = 36)
	Median (10th–90th)	Median (10th–90th)
<b>Sociodemographic characteristics</b>		
Proportion of single mothers	5.8 (0.4–23.1)	7.1 (0.0–82.3)
Age ≤ 16 y or age > 40 y	3.8 (1.4–9.5)	5.1 (0.0–10.1)
< 7 years of education	25.8 (3.6–76.5)	60.0 (13.8–84.9)
<b>Previous history</b>		
Primigravidas	29.3 (21.5–42.3)	25.2 (14.3–41.8)
Previous child with low birth weight	6.7 (2.6–16.9)	6.2 (0.0–25)
Previous neonatal death or stillbirth	11.0 (5.8–19.4)	5.9 (0.0–12.8)
Previous fistula	0.0 (0.0–0.4)	0.0 (0.0–0.4)
Previous uterine, cervix surgery	2.7 (0.0–12)	0.0 (0.0–1.2)
Previous cesarean	5.2 (0.4–11.6)	0.0 (0.0–0.7)
<b>Current pregnancy</b>		
Any pathology before index pregnancy <sup>a</sup>	7.3 (1.4–46.8)	13.7 (0.3–43.5)
Any pathology during current pregnancy <sup>a</sup>	1.2 (0.0–13.5)	0.1 (0.0–10.5)
Pregnancy induced hypertension	1.3 (0.0–6.7)	0.0 (0.0–1.5)
Pre-eclampsia	0.7 (0.0–5.2)	0.0 (0.0–0.13)
Eclampsia	0.3 (0.0–1.6)	0.0 (0.0–0.14)
Vaginal bleeding in second half of pregnancy	0.9 (0.0–2.6)	0.0 (0.0–1.1)
Urinary tract infection	1.2 (0.0–13.5)	0.1 (0.0–10.5)
Condyloma acuminata	0.0 (0.0–0.4)	0.0 (0.0–0.3)
Suspected intrauterine growth restriction	0.2 (0.0–2.3)	0.0 (0.0–0.6)
Rupture of membranes	5.3 (0.6–19.6)	0.0 (0.0–5.2)
Other medical condition	1.0 (0.0–7.6)	0.0 (0.0–11.1)
Any prenatal antibiotic treatment	41.3 (7.7–92.8)	2.4 (0.0–67.8)
Multiple pregnancy	3.7 (1.1–7.1)	1.8 (0.0–4.3)
Breech or other noncephalic presentations	3.6 (1.7–7.7)	1.2 (0.0–3.9)
Less than 4 prenatal visits	32.9 (9.7–69.3)	54.7 (19.4–76.6)
<b>Delivery</b>		
Referred from other institution for pregnancy complications or delivery	7.7 (0.6–32.7)	0.95 (0.0–15.8)
Induced labor	3.8 (0.3–14.2)	0.0 (0–7.7)
Induced with oxytocin (as proportion of induced labor)	80.0 (34.8–100)	80.0 (16.7–100)
Epidural anesthesia during labor	0.1 (0.0–2.7)	0.0 (0.0–7.7)
Birth weight < 2.5 kg	9.4 (4.5–17.4)	7.6 (0.0–14.0)
Birth weight > 4.5 kg	2.6 (0.4–8.8)	13.3 (0.0–4.1)

<sup>a</sup>Includes pathologies of very low incidence not listed independently.

**Table 2**  
Median cesarean delivery rates by types of health facilities.

	Institutional rates Median (10th–90th)
Health facility classification score <sup>a</sup>	
Low (n = 5)	11.2 (0.1–16.7)
Medium (n = 45)	8.1 (0.6–17.9)
High (n = 45)	21.8 (10.4–39.9)
Ownership <sup>b</sup>	
Public facility (n = 69)	11.6 (1.1–26.6)
NGO facility (n = 17)	19.9 (6.4–27.2)
Private facility (n = 6)	22.2 (6.9–42.3)
Availability of economic incentives for cesarean delivery	
Yes (n = 73)	14.8 (3.3–30.7)
No (n = 22)	7.4 (1.1–18.8)

<sup>a</sup> Health facility classification score is available at: [http://www.who.int/making\\_pregnancy\\_safer/health\\_systems/health\\_facility\\_classification\\_score\\_africa.pdf](http://www.who.int/making_pregnancy_safer/health_systems/health_facility_classification_score_africa.pdf).

<sup>b</sup> Missing (n = 3).

in Algeria, 1.1% in Angola, 18% in the Democratic Republic of Congo, 14.6% in Kenya, 11.7% in Niger, 14% in Nigeria, and 15.7% in Uganda.

Most (75%) normal deliveries were conducted by midwives; less than 5% were conducted by physicians. Specialist and trainee obstetricians performed 60% of cesarean deliveries, general physicians performed 33%, and nonphysicians performed less than 6%. In contrast, almost 50% of operative vaginal deliveries (3% of all deliveries) were performed by midwives, nurses, and/or other paramedics.

Characteristics of women delivered in the surveyed facilities were grouped by reported cesarean delivery performance (Table 1). Cesarean delivery rates were higher in facilities with higher HFCS, nongovernmental and private facilities, and where economic incentives were available (Table 2).

Cesarean deliveries were performed mostly for cephalopelvic disproportion, dystocia, or failure to progress (median 30.9%); fetal distress (median 25%); previous cesarean (median 21.5%); and malpresentations (median 13.5%) (Table 3). Laparotomy for uterine rupture was uncommon (median 0.08%).

Facilities with higher proportions of women with previous cesarean, pre-eclampsia, induced labor, referrals, and higher HFCS had higher cesarean delivery rates (Table 4). Cesarean deliveries were less in facilities with lower proportions of single women, and women with any pathology before the index pregnancy, less than 4 prenatal visits, cephalic presentation, and labor induced with oxytocin, or if the facility was in the capital. Sociodemographic characteristics, past reproductive history, variables in the current pregnancy and

**Table 3**  
Proportions of individual indications for cesarean delivery in the 95 facilities performing the procedure.

Indication	Median incidence rate (10th–90th)
Cephalopelvic disproportion, dystocia, failure to progress	30.9 (6.7–53.7)
Fetal distress	25.0 (4.8–50.0)
Previous cesarean	21.5 (0.0–38.3)
Breech or other malpresentations	13.3 (0.0–25.0)
Other pregnancy complications	3.2 (0.0–12.5)
Pre-eclampsia or eclampsia	2.1 (0.0–10.0)
Failed induction	2.9 (0.0–9.5)
Other fetal indications	2.6 (0.0–13.3)
Other maternal medical complications	1.2 (0.0–11.6)
Tubal ligation or sterilization	1.5 (0.0–8.0)
Intrauterine growth restriction	1.0 (0.0–6.8)
Third trimester vaginal bleeding	5.4 (0.0–13.3)
Multiple pregnancy	2.9 (0.0–9.4)
Post-term (> 42 weeks)	2.1 (0.0–10.0)
Genital herpes or extensive condyloma acuminata	0.0 (0.0–1.1)
Suspected or imminent uterine rupture	1.3 (0.0–9.4)
HIV positive	0.0 (0.0–3.8)
Maternal request without any other indication	0.0 (0.0–3.9)
Previous repaired fistula	0.0 (0.0–0.4)

**Table 4**  
Association between risk factors and institutional cesarean delivery rates for the 95 facilities performing the procedure.

Characteristics	Coefficient	Standard Error	P value	% variance explained (R <sup>2</sup> )
<b>Socio-demographic and previous pregnancy</b>				
Proportion of single mothers	-2.224	0.635	0.001	63.6
<7 years of education	-0.020	0.401	0.961	
Previous child with low birth weight	-0.931	1.454	0.524	
Previous neonatal death or stillbirth	2.837	1.587	0.077	
Previous uterine, cervix surgery	-2.285	2.174	0.296	
Previous cesarean	23.331	2.648	<0.001	
Primiparity	3.032	1.352	0.027	
Constant	-4.316	0.567	<0.001	
<b>Current pregnancy</b>				
Any pathology before index pregnancy	-2.086	0.781	0.009	40.8
Hypertension	7.145	4.274	0.098	
Pre-eclampsia	12.403	5.630	0.03	
Eclampsia	1.657	15.705	0.916	
Vaginal bleeding in second half of pregnancy	14.208	13.365	0.291	
Pyelonephritis or urinary infection	1.056	2.373	0.657	
Condyloma acuminata	-10.275	43.131	0.812	
Multiple pregnancy	5.395	5.728	0.349	
Breech/other noncephalic presentations	-22.754	11.753	0.056	
Cephalic	-23.988	10.414	0.024	
Pre-labor rupture of membranes	1.797	1.784	0.317	
Other medical condition	-4.840	1.964	0.016	
Constant	19.958	10.244	0.055	
<b>Delivery</b>				
Less than 4 prenatal visits	-2.313	0.616	<0.001	35.3
Induced labor	4.266	1.916	0.029	
Referred from other institution for pregnancy complications or delivery	3.131	0.733	<0.001	
Induced with oxytocin	-1.305	0.417	0.002	
Constant	-1.038	0.443	0.022	
<b>Health facility</b>				
Classification score				
Medium	1.567	0.560	0.006	44.2
High	3.059	0.568	<0.001	
<b>Ownership</b>				
NGO facility	0.358	0.304	0.242	
Private facility	0.606	0.467	0.198	
<b>Incentive for cesarean</b>				
Yes	0.274	0.280	0.330	
<b>Facility in capital city</b>				
Yes	-0.567	0.25	0.026	
Constant (Low, Public, No incentive, noncapital)	-4.520	0.553	<0.001	

during childbirth, and facility characteristics accounted for 64%, 41%, 35%, and 44% of variances in institutional cesarean delivery rates, respectively.

During the study, 245 maternal deaths, 1199 macerated and 1855 fresh stillbirths, 565 neonatal deaths within the first 24 hours, and 385 neonatal deaths after the first 24 hours and before discharge from hospital were reported. Seventeen (6.9%) maternal deaths, 47 (3.9%) macerated and 133 (7.2%) fresh stillbirths, 7 (1.2%) neonatal deaths within the first 24 hours, and 6 (1.6%) after the first 24 hours occurred in facilities not performing cesarean delivery. The overall maternal mortality ratio was 305 per 100 000 live births while the overall stillbirth rate was 36.6 per 1000 births. Facility maternal mortality ratios and stillbirth rates ranged from 39 and 25.4 in Algeria to 923 and 70.7 in Nigeria, respectively. Nearly 60% of neonatal deaths recorded before discharge from hospital occurred within 24 h of birth.

The step-wise regression analyses included all risk factors in Table 4. Results of that analyses are not shown here, but significant

**Table 5**  
Association between overall cesarean delivery rates and maternal and perinatal outcomes at institutional level.

Outcome	Model covariates											
	Constant		Overall cesarean delivery rate		Proportion of single mothers		Proportion of women with pre-eclampsia		Proportion of women with previous surgery on uterus or cervix		Proportion of women with cesarean at last pregnancy	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Maternal mortality	-5.881	0.292	-0.858	2.417	1.716 <sup>a</sup>	0.681	15.360 <sup>a</sup>	6.761	-5.448	3.459	6.892	6.699
Maternal morbidity	-0.647	0.284	2.361	3.234	-4.422 <sup>a</sup>	0.835	5.557	9.383	0.851	4.597	6.673	8.654
Fresh stillbirths	-4.184	0.162	2.812	1.768	0.600	0.449	9.093	5.121	-1.940	2.517	-5.615	4.728
Severe neonatal morbidity	-3.145	0.112	4.227 <sup>a</sup>	1.271	0.267	0.293	8.491 <sup>a</sup>	3.688	-1.792	1.809	-4.759	3.396
Neonatal death	-5.107	0.162	1.850	1.495	1.312	0.677	2.320	4.359	-4.662 <sup>a</sup>	2.168	4.718	4.125
Delayed breastfeeding	-0.578	0.317	2.890	3.679	-4.147 <sup>a</sup>	0.962	-2.117	10.696	3.921	5.409	3.206	9.889

Abbreviations: Coef, coefficient; SE, standard error.

<sup>a</sup>  $P < 0.05$ .

correlates were identified and carried forward as possible confounders of the association between adverse maternal and perinatal outcomes and institutional cesarean delivery rates.

Tables 5–7 summarize the associations between institutional cesarean delivery rates and maternal and perinatal outcomes. Risk of maternal death was increased in facilities with high rates of pre-eclampsia and single mothers, but was not related to cesarean delivery rates. High elective cesarean delivery rates reduced the risk of fresh stillbirths, but high pre-eclampsia rates increased it. High facility rates of postcesarean pregnancies were associated with reduced risk of fresh stillbirth; high emergency cesarean delivery rates increased this risk. Similarly, risk of neonatal death was lower in facilities with high elective cesarean rates and high proportions of women with previous surgery on the uterus (other than cesarean), but higher in facilities with high postcesarean pregnancy rates. Neonatal deaths increased with high emergency cesarean delivery rates and high proportions of single mothers in facilities. Babies born to women with pre-eclampsia were at increased risk of severe morbidity irrespective of the type of cesarean; high emergency cesarean delivery rates further exacerbated this risk.

When adjusted for other risk factors, increased overall cesarean delivery rates were only associated with increased severe neonatal morbidity (Table 5). Increased emergency cesarean delivery rates were associated with fresh stillbirths, neonatal deaths, and severe neonatal morbidity (Table 7). In contrast, increased elective cesarean delivery rates were associated with fewer fresh stillbirths and neonatal deaths (Table 6).

#### 4. Discussion

There was no association between overall cesarean delivery rates and maternal and perinatal outcomes in African health facilities,

except for increased neonatal morbidity after adjustment for potential confounders (Table 5). However, high emergency cesarean delivery rates were associated with poor perinatal outcomes unlike high elective cesarean rates (Table 6 and 7).

Most women (median 80%; 10th–90th centiles, 34%–90%) in this survey were discharged from the facility 7 days or more after delivery and hence, unlike the similar study in Latin American countries [6], prolonged hospital stay was not considered to indicate severe maternal morbidity.

Cesarean deliveries were performed in only 95 (72.5%) of the 131 African facilities, which reported over 85% of births. Marked inter-country differences were observed in cesarean delivery rates (1.1% to 18%) (Fig. 2). Reported cesarean delivery rates in Sub-Saharan Africa have ranged from 5% to 21.8% [11], with significant socioeconomic differences [13]. Higher rates observed in nonpublic facilities in 4 countries further confirm differential access and utilization linked to resources. Elective cesarean deliveries were less common in public facilities as in other countries [6,14–17].

Maternal indications were the most common reasons for cesarean delivery in our study (Table 3), similar to other reports from Africa [11] and Latin America [6]. Rates for different indications ranged widely; cephalopelvic disproportion, dystocia, and failure to progress ranged from 6.7% to 53.7% and fetal distress ranged from 4.8% to 50%. Unlike Latin America [6], fewer cesarean deliveries were performed for women with a previous cesarean (median 21.5%). Fetal indications were relatively uncommon except for malpresentations (13.3%). Cesarean delivery for HIV positive cases, previously repaired fistula, and on maternal request alone were uncommon, as was laparotomy for uterine rupture.

Higher cesarean delivery rates were seen in facilities with more primigravid women, postcesarean pregnancies, and induced labors and lower rates in facilities with more single women. Nearly two-

**Table 6**  
Association between elective cesarean delivery rates and maternal and perinatal outcomes at institutional level.

Outcome	Model covariates											
	Constant		Elective Cesarean delivery rate		Proportion of single mothers		Proportion of women with pre-eclampsia		Proportion of women with previous surgery on uterus or cervix		Proportion of women with cesarean at last pregnancy	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Maternal mortality	-5.926	0.275	3.278	8.492	1.798 <sup>a</sup>	0.658	13.869 <sup>a</sup>	6.139	-4.974	3.271	3.917	5.096
Maternal morbidity	-0.598	0.276	-0.894	6.275	-4.559 <sup>a</sup>	0.821	9.359	8.318	0.041	4.469	12.260 <sup>a</sup>	5.706
Fresh stillbirths	-4.131	0.156	-6.775 <sup>a</sup>	3.394	0.398	0.437	15.417 <sup>a</sup>	4.508	-2.861	2.426	3.562	3.117
Severe neonatal morbidity	-3.059	0.114	-1.845	2.566	0.053	0.300	15.361 <sup>a</sup>	3.407	-3.245	1.831	5.324 <sup>a</sup>	2.334
Neonatal death	-5.038	0.153	-6.945 <sup>a</sup>	2.958	0.913	0.663	6.918	3.741	-5.003 <sup>a</sup>	2.063	11.323 <sup>a</sup>	2.741
Delayed breastfeeding	-0.503	0.306	10.115	7.079	-4.201 <sup>a</sup>	0.937	-1.028	9.409	2.799	5.234	5.061	6.482

Abbreviations: Coef, coefficient; SE, standard error.

<sup>a</sup>  $P < 0.05$ .

**Table 7**  
Association between emergency cesarean delivery rates and maternal and perinatal outcomes at institutional level.

Outcome	Model covariates											
	Constant		Emergency cesarean delivery rate		Proportion of single mothers		Proportion of women with pre-eclampsia		Proportion of women with previous surgery on uterus or cervix		Proportion of women with cesarean at last pregnancy	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Maternal mortality	-5.872	0.290	-1.172	2.489	1.699 <sup>a</sup>	0.678	15.607 <sup>a</sup>	6.660	-5.570	3.450	7.173	6.174
Maternal morbidity	-0.663	0.286	2.847	3.389	-4.424 <sup>a</sup>	0.829	5.740	8.972	1.044	4.614	6.884	7.713
Fresh Stillbirths	-4.244	0.159	5.119 <sup>a</sup>	1.813	0.675	0.436	7.305	4.790	-1.106	2.470	-8.354 <sup>a</sup>	4.125
Severe neonatal morbidity	-3.176	0.111	5.224 <sup>a</sup>	1.310	0.280	0.286	8.667 <sup>a</sup>	3.467	-1.404	1.784	-4.608	2.977
Neonatal death	-5.158	0.156	4.147 <sup>a</sup>	1.568	1.327 <sup>a</sup>	0.651	-0.035	4.114	-3.694	2.131	1.300	3.749
Delayed breastfeeding	-0.522	0.321	0.159	3.864	-4.299 <sup>a</sup>	0.958	1.990	10.269	3.004	5.451	9.273	8.865

Abbreviations: Coef, coefficient; SE, standard error.

<sup>a</sup>  $P < 0.05$ .

thirds of the variance in institutional cesarean delivery rates was due to sociodemographic characteristics and postcesarean pregnancies.

Cesarean delivery rates were higher in facilities with medium or high HFCS, but lower in facilities within the capital city. No significant differences were observed in cesarean rates between public, private, or nongovernmental facilities, or when there was an incentive for cesarean delivery, after adjusting for confounders.

Overall maternal mortality and stillbirths were high in these facilities, many of which received referrals. However, data analyzed included information only from women who sought care at these facilities, and excluded information on those referred out before delivery. Moreover, the data are restricted to maternal and perinatal deaths that occurred in hospital; therefore, maternal and perinatal mortality in the population cannot be inferred.

Pre-eclampsia was a significant risk factor for maternal death, fresh stillbirth, and severe neonatal morbidity. Increasing proportions of single mothers increased risk of maternal and neonatal mortality, but decreased risk of severe maternal morbidity and delayed breast feeding. The reasons for the latter finding are unclear.

High emergency cesarean delivery rates were associated with increased fresh stillbirths, neonatal deaths, and severe neonatal morbidity, which remained significant even after adjusting for other factors (Table 7). High elective cesarean delivery rates were associated with fewer fresh stillbirths and neonatal deaths (Table 6). Since the majority of emergency cesarean deliveries were performed for dystocia and fetal distress, it is highly likely that a significant proportion of the perinatal deaths and severe newborn morbidity was related to birth asphyxia secondary to prolonged labor, and that the interventions may have been performed too late. Close monitoring of labor, early detection of complications, and timely decision for cesarean delivery are crucial. However, the study is limited for want of these details.

While high emergency cesarean delivery rates increased the risk of neonatal death (Table 7), high rates of elective cesarean and previous uterine surgery other than cesarean delivery reduced this risk (Table 6). A cesarean scar may rupture during labor and result in neonatal death. Elective cesarean will reduce this risk if performed after the fetus is mature.

High rates of antibiotic usage in the postpartum period may suggest that sepsis was a contributing factor, adding to the burden of newborn morbidity. Prematurity may have added to the problem but gestational age data were not sufficiently robust to make conclusions. Prematurity seems a less plausible cause for severe neonatal morbidity as the median low birth weight rate was only 9.4%. The limitations of the survey include the possibility of selection bias [12]—all capital cities were automatically included and only facilities with at least 1000 deliveries were considered. Time-related effects, and follow-up after discharge were not addressed and standardization of

diagnoses was limited. Analyses were focused on few known markers of morbidity and mortality.

Unlike other countries [6,14,18] with worrying increases in cesarean deliveries, there is apparent underutilization of a potentially lifesaving procedure in some African facilities. Thirty-six of 131 facilities (delivering nearly 15% of women), did not perform cesarean delivery during the study period for reasons probably related to inadequate health system resources. Emergency cesarean delivery may have been performed too late to prevent perinatal deaths and morbidity.

Sixty percent of stillbirths occurred during labor and nearly 60% of all newborn deaths before discharge occurred during the first 24 hours. Ensuring better access to quality care during pregnancy and childbirth is essential to reduce the large number of stillbirths and early neonatal deaths seen in Africa.

Finally, the average operative vaginal delivery rates were low. Vacuum and forceps deliveries are less invasive and inexpensive options for assisted delivery in many situations. Compared with cesarean, vacuum extraction can be safely performed by midwives and carries lower risk in future pregnancies, which are significant considerations in settings where cesarean delivery is not readily available and close follow-up in subsequent pregnancies is not assured. Although, the proportion of cesarean deliveries that could have been avoided with vacuum extraction in this study cannot be estimated, it is possible that training, equipping, and empowering midwives to perform vacuum extraction may further contribute to improving maternal and perinatal health in Africa.

## 5. Conflict of interest

We declare that we have no conflicts of interest.

## Acknowledgements

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## References

- [1] World Health Organization. WHO Recommended Interventions for Improving Maternal and Newborn Health. WHO/MPS/07.05. Geneva: WHO; 2007.
- [2] World Health Organization. Managing Complications in Pregnancy and Childbirth. Geneva: World Health Organization; 2000.
- [3] World Health Organization. Managing Newborn Problems: A guide for doctors, nurses, and midwives. Geneva: WHO; 2003.
- [4] World Health Organization. Pregnancy, Childbirth, Postpartum and Newborn Care: A Guide for Essential Practice. Geneva: WHO; 2006.

- [5] World Health Organization, UNFPA, UNICEF and AMDD. *Monitoring Emergency Obstetric Care: a Handbook*. Geneva: WHO; 2009.
- [6] Villar J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A, et al. Caesarean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America. *Lancet* 2006;367(9525):1819–29.
- [7] Villar J, Carroli G, Zavaleta N, Donner A, Wojdyla D, Faundes A, et al. Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study. *BMJ* 2007;335(7628):1025.
- [8] Henderson J, McCandlish R, Kumiega L, Petrou S. Systematic review of economic aspects of alternative modes of delivery. *BJOG* 2001;108(2):149–57.
- [9] Essen B, Johnsdotter S, Hovellius B, Gudmundsson S, Sjoberg NO, Friedman J, et al. Qualitative study of pregnancy and childbirth experiences in Somalian women resident in Sweden. *BJOG* 2000;107(12):1507–12.
- [10] Ezechi OC, Fasubaa OB, Kalu BE, Nwokoro CA, Obiesie LO. Caesarean delivery: why the aversion? *Trop J Obstet Gynaecol* 2004;21:164–7.
- [11] Dumont A, De Bernis L, Bouvier-Colle MH, Breart G. Caesarean section rate for maternal indication in sub-Saharan Africa: a systematic review. *Lancet* 2001;358(9290):1328–33.
- [12] Shah A, Faundes A, Machoki M, Bataglia V, Amokrane F, Donner A, et al. Methodological considerations in implementing the WHO Global Survey for Monitoring Maternal and Perinatal Health. *Bull World Health Organ* 2008;86(2):126–31.
- [13] Ronsmans C, Holtz S, Stanton C. Socioeconomic differentials in caesarean rates in developing countries: a retrospective analysis. *Lancet* 2006;368(9546):1516–23.
- [14] Belizan JM, Althabe F, Barros FC, Alexander S. Rates and implications of caesarean sections in Latin America: ecological study. *BMJ* 1999;319(7222):1397–400.
- [15] Pai M, Sundaram P, Radhakrishnan KK, Thomas K, Muliylil JP. A high rate of caesarean sections in an affluent section of Chennai: is it cause for concern? *Natl Med J India* 1999;12(4):156–8.
- [16] Sreevidya S, Sathiyasekaran BW. High caesarean rates in Madras (India): a population-based cross sectional study. *BJOG* 2003;110(2):106–11.
- [17] Wanyonyi S, Sequeira E, Obura T. Caesarian section rates and perinatal outcome at the Aga Khan University Hospital, Nairobi. *East Afr Med J* 2006;83(12):651–8.
- [18] World Health Organization. *The World Health Report 2005: Make every mother and child count*. Geneva: WHO; 2005.