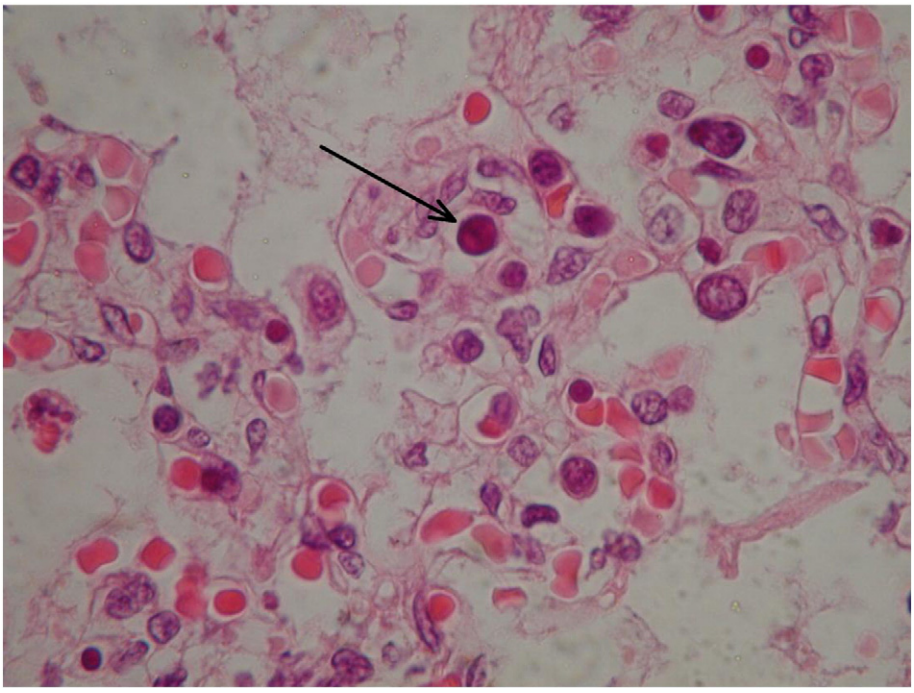

Fig. 1. Fetal lung tissue showing eosinophilic nuclear inclusions with chromatin margination at the periphery of nuclei (arrow). Hematoxylin and eosin stain (1000 x magnification).

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The relationship between facility-based delivery and maternal and neonatal mortality in Sub-Saharan Africa

Cheryl A. Moyer [a,*], Richard M. Adanu [b], Cyril M. Engmann [c]

[a] *Global REACH and Department of Medical Education, University of Michigan Medical School, Ann Arbor, USA*
[b] *School of Public Health, College of Health Sciences, University of Ghana, Accra, Ghana*
[c] *Departments of Pediatrics and Maternal and Child Health, University of North Carolina, Chapel Hill, USA*

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* Corresponding author at: Global REACH and Department of Medical Education, University of Michigan Medical School, 5115 Med Sci 1, 1301 Catherine Street, Ann Arbor, MI 48109, USA. Tel.: +1 734 615 2838; fax: +1 734 615 6300.
E-mail address: camoyer@umich.edu (C.A. Moyer).

Each year, approximately 275 000 women die during and shortly after pregnancy, while 2.9 million infants die in the first 28 days of life [1]. The vast majority of these deaths occur in low- and middle-income countries, with disproportionately high rates in Sub-Saharan Africa.

It is estimated that having universal skilled birth attendance—defined not only by the presence of a skilled provider but also by an "enabling environment" that includes adequate supplies and a viable referral chain [2]—could reduce maternal mortality (MM) by 13%–33% and neonatal mortality (NM) by 20%–30% globally [3,4].

The aim of the present study was to examine whether this estimation held true in Sub-Saharan Africa by examining the relationship between national facility-based delivery (FBD) percentages and national MM and NM ratios, including early neonatal mortality (ENM: deaths between 0 and 6 days), late neonatal mortality (LNM: deaths between 7 and 28 days), and overall neonatal mortality (deaths between 0 and 28 days).

Data for FBD were collected from the most recent Demographic and Health Surveys conducted in 36 nations in Sub-Saharan Africa. Facility-based delivery percentages were assessed by asking women who

reported pregnancies within the most recent Demographic and Health Survey data collection window, for each child delivered, "where did you give birth to [child's name]?" [5]. "Facility" deliveries were those that occurred at any building designed for the provision of healthcare, regardless of the size or quality of the facility. Data for MM and NM (including ENM and LNM) were collected from recently published data by Lozano et al. [1], who used surveys, censuses, vital registration, and verbal autopsy data—in combination with statistical modeling—to determine the ratio of maternal deaths per 100 000 live births and the ratio of neonatal, early neonatal, and late neonatal deaths per 1000 live births.

Data were entered into Excel (Microsoft, Redmond, WA, USA) and imported into Stata/IC version 11.0 (StataCorp, College Station, TX, USA). Pearson correlation coefficients were calculated for FBD, MM, NM, ENM, and LNM. Correlations were conducted by region and stratified to include examination across all years and for 2005–2011. A P value of ≤ 0.05 was considered to be statistically significant.

Table 1 illustrates the FBD percentages and ratios of MM and NM for 36 nations in Sub-Saharan Africa stratified by region. Table 2 illustrates the correlation coefficients when FBD percentages were compared with MM and NM ratios.

The FBD percentages were significantly negatively correlated with MM ($P = 0.004$), NM ($P = 0.019$), and LNM ($P = 0.004$). There was also a negative overall correlation of FBD and ENM; however, it was not statistically significant ($P = 0.062$). When only the data from 2005 onward were included in the analysis, FBD was significantly associated with LNM ($P = 0.043$) (Table 2).

By region, western and central Africa showed the strongest relationship between FBD and ratios of MM, NM, ENM, and LNM (Table 2).

The present study demonstrated a significant relationship between higher utilization of FBD in Sub-Saharan Africa and lower MM and NM. However, this relationship seems to be attenuating over time. The study also showed that the relationship between FBD and mortality is stronger in western and central Africa than in other regions of the continent. Further research is needed to explore the factors associated with both changes over time, as well as regional variability in these associations. Additional research is also warranted to determine whether similar results would be found when looking at skilled birth attendance in general, rather than only deliveries occurring in facilities.

Correlation is not causation, and many of the factors associated with higher utilization of FBD (e.g. greater wealth, higher rates of insurance coverage, and greater female education) might also be related to lower MM and NM. The quality of available data for the variables included in the analyses is also worth addressing. Facility-based delivery was estimated based on self-reports of women, without regard for the differences in the quality of facilities attended. Furthermore, despite improvements in NM data collection and estimation in recent years, underreporting and misclassification are likely to have impacted the quality of the estimates available. It is also clear that the lack of current data on FBD rates throughout Sub-Saharan Africa hampers the ability to draw firm conclusions. Nonetheless, these preliminary findings indicate that, in Sub-Saharan Africa, global estimates hold true and regional policies and programs should continue to emphasize FBD.

Table 1
FBD percentages and ratios of MM and NM by region in Sub-Saharan Africa.

Region	FBD, %	MM per 100 000 live births	NM per 1000 live births	ENM per 1000 live births	LNM per 1000 live births	DHS year
Eastern Africa						
Burundi	59.5	894.2	29.2	19.6	9.6	2010
Eritrea	26.3	1081.3	22.1	17.4	4.7	2002
Ethiopia	9.9	528.8	33.6	24.9	8.7	2011
Kenya	42.6	294.2	24	19	5	2008
Madagascar	35.3	424.4	19.2	14.3	4.9	2008–2009
Malawi	73.2	421.6	27.2	20.6	6.6	2010
Mozambique	47.6	509.8	38.7	27.9	10.8	2003
Rwanda	68.9	335	25.7	19.8	5.9	2010
Tanzania	50.2	417.5	24.3	18.5	5.8	2010
Uganda	41.8	274.2	27.1	21.1	6	2006
Zambia	47.7	293	26.3	17.6	8.7	2007
Western Africa						
Benin	78.1	329	29.3	23.4	5.9	2006
Burkina Faso	66.3	353.6	39	25.5	13.5	2010
Cameroon	61.2	531.2	33.9	25.9	8	2011
Cape Verde	54.7	127.1	14	11	3	1998
Chad	11.7	608.3	45.8	31.7	14.1	2004
Cote D'Ivoire	47.1	452	37.5	26.9	10.6	1999
Ghana	57.1	328.3	25	20.2	4.8	2008
Guinea	29	664.1	39.8	29.2	10.6	2005
Liberia	36.9	906	31.9	24.1	7.8	2007
Mali	45.1	418.8	45.9	33.5	12.4	2006
Mauritania	48.5	550.1	31.9	25.4	6.5	2000–2001
Niger	17.2	522.4	32.4	20.5	11.9	2006
Nigeria	35	487.1	39	28.7	10.3	2008
Sao Tome and Principe	78.8	266.4	21.3	17.1	4.2	2009
Senegal	72.8	368.4	26.3	19.5	6.8	2010–2011
Sierra Leone	24.6	616.4	36.4	27.1	9.3	2008
Central Africa						
Angola	45.7	334.8	39.2	28.7	10.5	2006–2007
Congo (Brazzaville)	82.2	571.2	32.3	24.6	7.7	2005
Democratic Republic of the Congo	70.1	480.6	33.4	25	8.4	2007
Gabon	84.7	430.1	26.8	22.8	4	2000
Southern Africa						
Lesotho	58.7	238.6	39.2	30.9	8.3	2009
Namibia	80.8	132.6	23	18.8	4.2	2006–2007
South Africa	83.4	91.3	14.3	10.8	3.5	1998
Swaziland	47.1	281.6	23.5	18.4	5.1	2006–2007
Zimbabwe	65.1	329.2	22.5	16.5	6	2010–2011

Abbreviations: DHS, Demographic and Health Survey; ENM, early neonatal mortality; FBD, facility-based delivery (percentage of women delivering); LNM, late neonatal mortality; MM, maternal mortality; NM, neonatal mortality.

Table 2
Correlation between FBD percentage and ratios of maternal and neonatal mortality in Sub-Saharan Africa.

	Pearson correlation coefficient against FBD, all years (*P* value)	Pearson correlation coefficient against FBD, 2005–2011 (*P* value)	Pearson correlation coefficient against FBD by region, all years (*P* value)	Pearson correlation coefficient against FBD by region, 2005–2011 (*P* value)
Maternal mortality[a]	−0.46 (0.004)	−0.36 (0.063)	West: −0.63 (0.008) East: −0.24 (0.478) Central: 0.75 (0.246) Southern: −0.80 (0.101)	West: −0.69 (0.013) East: 0.04 (0.919) Central: 0.99 (0.037) Southern: −0.67 (0.327)
Neonatal mortality[b]	−0.39 (0.019)	−0.30 (0.119)	West: −0.55 (0.027) East: −0.04 (0.912) Central: −0.92 (0.080) Southern: −0.52 (0.369)	West: −0.53 (0.079) East: −0.24 (0.539) Central: −0.98 (0.116) Southern: −0.23 (0.773)
Early neonatal mortality[b]	−0.31 (0.062)	−0.22 (0.254)	West: −0.47 (0.064) East: −0.08 (0.803) Central: −0.96 (0.034) Southern: −0.49 (0.401)	West: −0.44 (0.156) East: −0.26 (0.496) Central: −0.97 (0.154) Southern: −0.18 (0.820)
Late neonatal mortality [b]	−0.47 (0.004)	−0.39 (0.043)	West: −0.59 (0.014) East: 0.05 (0.877) Central: −0.84 (0.156) Southern: −0.59 (0.295)	West: −0.55 (0.063) East: −0.11 (0.787) Central: −0.99 (0.056) Southern: −0.37 (0.627)

Abbreviation: FBD, facility-based delivery.
[a] Ratio per 100 000 live births.
[b] Ratio per 1000 live births.

Conflict of interest

The authors have no conflicts of interest.

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Bakri balloon tamponade for the management of postpartum hemorrhage

Nikolaos Vrachnis [a,*], Nikolaos Salakos [a], Christos Iavazzo [a], Charalampos Grigoriadis [a], Zoe Iliodromiti [a], Charalampos Siristatidis [b], Christos Katsetos [c], George Creatsas [a]

[a] *Second Department of Obstetrics and Gynecology, University of Athens Medical School, Aretaieion Hospital, Athens, Greece*
[b] *Third Department of Obstetrics and Gynecology, University of Athens Medical School, Attiko Hospital, Athens, Greece*
[c] *Department of Obstetrics and Gynecology, Tzaneio General Hospital of Piraeus, Piraeus, Greece*

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* Corresponding author at: Second Department of Obstetrics and Gynecology, University of Athens Medical School, Aretaieion Hospital, 124B Vasilisis Sofias Av., 115 26 Athens, Greece. Tel.: +30 6974441144; fax: +30 2107777390.
E-mail address: nvrachnis@hotmail.com (N. Vrachnis).

Postpartum hemorrhage (PPH) remains the main cause of maternal death worldwide (associated with a mortality rate of approximately 140 000 deaths per year). Obstetric hysterectomy—which is the last resort in the management of PPH—occurs in 0.35 per 1000 births [1].

If conservative management of PPH fails, surgical treatment is needed. Ligation of uterine or internal iliac arteries, application of uterine compressive sutures (B-Lynch), and hysterectomy can be performed in order to control massive PPH and restore hemodynamic stability. However, obstetric hysterectomy is an undesirable method, especially among primiparas, because it leads to irreversible loss of fertility. Hence the growing attraction of new conservative techniques such as the Bakri intrauterine balloon tamponade, which is associated with high success rates.

The present paper reports on a case series of women diagnosed with PPH who underwent Bakri balloon tamponade between January 1, 2008, and December 31, 2011. Because Bakri balloon is not the