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Effects of a Skilled Care Initiative on pregnancy-related mortality in rural Burkina Faso

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Summary

OBJECTIVE The aim of this paper is to assess to what extent a Skilled Care Initiative (SCI) was associated with pregnancy-related mortality in Ouargaye district, Burkina Faso.
METHODS We used a quasi-experimental design to compare pregnancy-related mortality within the intervention district (health facility areas covered by the SCI *vs.* areas not covered) and between the intervention district (Ouargaye) and a comparison district (Diapaga). Population-based data were used to examine differences in pregnancy-related mortality levels, their determinants and how they related to uptake of care, as well as examining contexts and mechanisms of pregnancy-related deaths that occurred. Data analyses included descriptive statistics, univariate and multivariate regression analyses.
RESULTS The main risk factors for pregnancy-related mortality in rural Burkina Faso were age (extreme ages of reproductive period), low coverage of antenatal care and low institutional delivery. The introduction of the SCI, as implemented within the study reference period, had no appreciable effect on pregnancy-related mortality.
CONCLUSION Although the SCI was conceptually well designed and implemented, structural constraints may have limited its effectiveness for reducing pregnancy-related mortality within its period of implementation. Lessons have been identified which might enable similar skilled attendance strategies to make their full potential impact on pregnancy-related mortality in remote and rural settings.

keywords maternal mortality, pregnancy-related mortality, skilled attendance at delivery, effectiveness, Burkina Faso

Introduction

National levels of maternal mortality in Burkina Faso are high, although imprecise, with estimates ranging from 484 (Institute National de la Statistique et de la Démographie *et al.* 2000) to 1000 maternal deaths per 100 000 live births in 1999–2000 (WHO *et al.* 2004). The government of Burkina Faso considered this level too high and decided to promote a strategy of skilled attendance at delivery. The main strategic objective of the 2004–2007 national safe motherhood programme was to reach 50% of skilled attendance at delivery (DSF 2003).

Although skilled attendance at delivery has been widely recommended for pregnancy-related mortality reduction (WHO 2005; Horton 2006), there remain questions about the best means for implementing this strategy, and the magnitude of its impact on pregnancy-related mortality remains uncertain. The Skilled Care Initiative (SCI) developed by Family Care International (FCI) in Burkina Faso offers an opportunity to examine whether and how a skilled attendance strategy, as implemented within the constraints of an existing health system, might affect pregnancy-related mortality (Graham *et al.* 2008). In this paper, we evaluate the SCI in two ways: (1) we examine whether pregnancy-related mortality is associated with uptake of obstetric care (institutional birth, antenatal care and Caesarean section) at the aggregate level, and (2) we assess whether levels and trends in pregnancy-related mortality differ in health facility catchment areas targeted by the SCI compared to other areas.

Methods

Study design, participants and areas

We used a quasi-experimental design comparing (1) outcomes from SCI health facility catchment areas (intervention), with catchment areas not covered by the SCI in Ouargaye district; (2) outcomes from SCI health facility catchment areas (intervention) of Ouargaye with a comparison district (Diapaga); (3) outcomes from catchment areas of Ouargaye not covered by the SCI with the comparison district (Diapaga). The comparisons were made over time on two periods: 2002–03 (2 full years) with 2004–06 (2 full years and the first trimester of 2006). Participants were all women aged 15–49 who had experienced a pregnancy outcome between January 2002 and March 2006.

Ouargaye and Diapaga districts are remote, rural districts located in south-eastern Burkina Faso. Both districts for the most part lack electricity, running water, paved roads and an effective transport system. Diapaga district covers an area of 14 780 km^2, 2.6 times bigger than Ouargaye. In 2001, before the implementation of the SCI, there were 213 690 inhabitants in Ouargaye and 268 366 in Diapaga. Populations were covered by 19 health centres (increased to 21 in 2002) in Ouargaye and 18 (increased to 21 in 2002) in Diapaga.

In 2000, Diapaga had an institutional birth coverage of 24% and an antenatal care (ANC) coverage of 62% (two or more visits) while the complete vaccine coverage of children was around 54% (Diallo *et al.* 2003). Two doctors were working at the district hospital and able to perform Caesarean sections. Ouargaye had similar performances with institutional birth coverage of 18%, antenatal care coverage of 63% and complete vaccine coverage of children around 43% (Diallo *et al.* 2002). There was only one doctor with surgical competence. Further details of the evaluation settings have been presented elsewhere (Hounton *et al.* 2008a).

Contexts and mechanisms

In the intervention district (Ouargaye), the SCI was a comprehensive skilled attendance at delivery strategy designed and implemented by FCI in 14 out of 21 health facilities (13 health centres and the district hospital). The SCI aimed to improve skilled delivery care by strengthening the first level health facilities, by improving the referral system and by developing community based activities to improve utilisation of maternal health services (Graham *et al.* 2008). However, the SCI was not the only safe motherhood programme in place in Ouargaye district during the study period. Other partners, such as the UNFPA, implemented supply side activities similar to that of the SCI (equipment, drugs, training of providers) in four of the seven remaining health centres. A third partner, the non-Governmental organisation World Neighbours, mainly focused its activities on family planning and training for Traditional Birth Attendants in the catchment area of five SCI health centres and in two others. The main difference between FCI and the other partners in terms of implementation of their facility-based interventions lay in FCI's emphases on the intensity and close supervision of training, conditions for health personnel (solar panels for electricity in delivery rooms and their housing) and patient care (caring behaviour). In addition, the SCI included an intensive community mobilisation intervention (awareness, behavioural communication change, social marketing, capacity strengthening) throughout the whole district (including health facility areas outside the SCI intervention) aimed at increasing the coverage of institutional births. The SCI also contributed to the development of the district hospital and functioning of its operating theatre through equipment, support for the recruitment and posting of an anaesthetist and assistant surgeon. Finally, FCI contributed to the setting up of a cost-sharing mechanism for improving financial access to comprehensive emergency obstetric care (CEmOC) in 2004 [originally developed by UNICEF in Bogande and Diapaga districts (Nacoulma *et al.* 2003)]. The functionality of Ouargaye district hospital, where women could access life saving surgery, remained limited however, and women sought care from the regional referral hospital, thereby increasing delays to accessing care.

Diapaga, selected by FCI as a comparison district, was mainly assisted by UNICEF to set up a cost-sharing mechanism aimed at decreasing financial and geographical barriers to emergency obstetric care in 2001. UNICEF also contributed to improve skilled delivery care through training of health personnel (partograph, management of third stage of labour, birth preparedness, post-abortion care, and prevention of infections). It received assistance from UNFPA (similar intervention as in Ouargaye district) to four health centres in 2002, two more in 2004 and to the district hospital. In addition, there was a community radio service (covering most of the district and well listened to) that broadcast weekly in 2004 and 2005, sensitising the population to reproductive health in general, family planning, birth preparedness and prevention of HIV. Unlike Ouargaye district, there was a long-standing functional referral facility where women could access life-saving surgery. The leadership at District level that promoted continuity of care, including emergency obstetric care, has been nationally recognised by three consecutive 'Best Health District' prizes (2003–05) (DGS 2005).

Data sources and data collection

Population and facility based data were collected. A geo-referenced census was conducted from February to May 2006 in Ouargaye and Diapaga districts (Hounton *et al.* 2008a). A general pregnancy-related mortality module recommended for data collection on household deaths was used (Hill *et al.* 2001). The census questionnaire, administered to the head of household, was designed to collect household assets and socio-demographic characteristics of all household members (age, sex, occupation, education, marital status, etc.) in every household. The exact location of each household was recorded using a global positioning system. All female deaths aged 15–49 were recorded. Further information on age at death and whether or not the death occurred during pregnancy, during delivery, or within 6 weeks of pregnancy ending was asked to the most appropriate person (an adult woman close to the deceased person. The causes of maternal death were identified using a newly developed and tested probabilistic model for interpreting verbal autopsy data. Data were directly entered into personal digital assistant devices at the point of interview. Further details about the methods and tools used are described elsewhere (Byass *et al.* 2008; Hounton *et al.* 2008a). All women aged 12–49 years were asked about all live and stillbirths over the last 5 years (between 2001 and 2006). The questionnaire was modified from the standard Demographic and Health Survey questionnaire, including questions on the outcome of the pregnancy, number of antenatal care visits, place of and attendant at delivery and whether the birth was by Caesarean section. An institutional birth was defined as a birth in a health centre or hospital. In Burkina Faso each village or urban sector has been assigned to a health facility and we used this administrative definition to associate births with health facility catchment areas.

Data analysis

A pregnancy-related death was defined as a death in women age 15–49 years during pregnancy or within 42 days of pregnancy termination, regardless of the cause (Hounton *et al.* 2008a). All 387 pregnancy-related deaths recorded during the census between January 2002 and March 2006 were included in the study. The 57 pregnancy-related deaths with unknown year of death were assigned a year of death through multiple imputation using PROC MI of sas 9.1 (SAS Institute Inc. 2004). Missing data for possible predictors of pregnancy related death occurred infrequently (≤2% of cases) and were handled either by available case method (e.g. for maternal age), available item method (e.g. for calculation of asset indices), or were used at the aggregate health-facility level (e.g., for uptake of care) and consequently had no missing data at the analysis stage (McKnight *et al.* 2007).

To assess the effects of the SCI intervention, we compared the periods 2002–2003 and 2004–2006. This choice was driven by the intensity of the SCI implementation: the first 2 years being the period of training, upgrading infrastructure, equipment and supplies and the last 2 years a period of fuller SCI implementation (except for community mobilisation that achieved its full implementation only in 2005). As data on uptake of care could not be collected for the women who died, the effects of uptake of care were analysed at the aggregate (health facility) level. For each health facility and analysis period (2002–2003 and 2004–2006), the percent of births with antenatal care, in an institution or with a Caesarean section that were reported by the women aged 12–49 years living in each catchment area was calculated.

The risk factors for pregnancy-related deaths were assessed using a logistic regression model, adjusting for clustering at the level of health facility catchment areas using generalised estimating equations (Hardin & Hilbe 2003). Confidence intervals and significance tests were calculated using the empirical ('robust') standard error. The analysis included all reported pregnancies of more than 6 months with an outcome between January 2002 and March 2006. For women who died as a result of pregnancy only the last pregnancy was noted. Univariate logistic regression models were used to identify factors associated with pregnancy-related mortality. Multivariate models were used to assess if these risk factors and any effects of SCI persisted after adjustment for socio-demographic factors (age, socio-economic status, distance to health facility and hospital). All statistical analyses were performed with sas 9.1 (SAS Institute Inc.) and r 2.3 (R Foundation for Statistical Computing, Vienna, Austria).

The overall Immpact research proposal was approved by the Ministry of Health National Health Research Ethics Committee (Ouagadougou, Burkina Faso) (Hounton *et al.* 2008a). Immpact research was developed to improve methods and tools for measuring maternal mortality, identify cost-effective strategies to reduce maternal and perinatal mortality, and build capacity for robust evaluation and for evidence-based decision-making (http://www.immpact-international.org).

The specific Evaluation and Evidence Research Group protocol was approved by Centre MURAZ (Bobo-Dioulasso, Burkina Faso) Institutional Review Board. Administrative authorizations were obtained at all level of the administrative chain (Ministry of Health, Region Governorates, Regional Directorates of Health, National and

Regional Hospital Directorates, Province High Commissioners, District Health Management Teams, Heads of Clinical Services in Hospitals and village community leaders.

Results

SCI and pregnancy-related mortality

Table 1 and Figure 1 show the levels of pregnancy-related mortality risk by period and area. In the period 2002–2003, the pregnancy-related mortality risk was 5.8 per 1000 pregnancies in Diapaga, 3.7 per 1000 in the Ouargaye non SCI-intervention area and 4.9 per 1000 in the SCI-intervention area; with no significant differences between the areas. The pregnancy-related mortality risk declined over time in the SCI intervention area (34% reduction, $P = 0.074$), but the speed of decline was not significantly different from that seen in the non-SCI area (2% reduction, $P = 0.933$) or in Diapaga (10% reduction, $P = 0.488$). Adjusting for socio-demographic factors attenuated the strength of the associations, but conclusions were not altered (Figure 1).

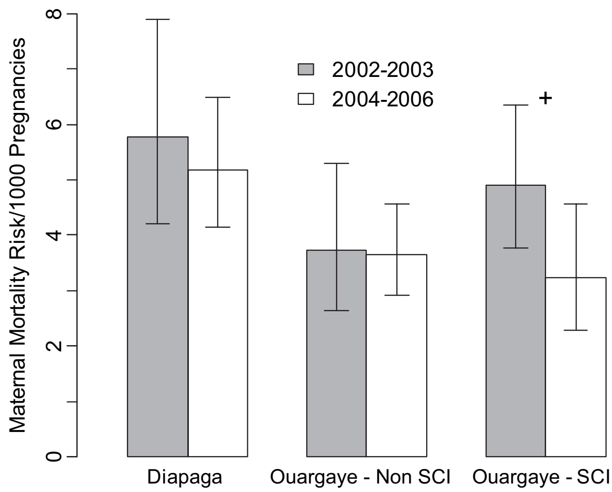

Figure 1 Maternal Mortality Risk in Diapaga and Ouargaye districts, Burkina Faso, comparing 2002–2003 with 2004–2006. + *P*-value for change in maternal mortality risk (raw/adjusted for maternal age, socio-economic status and distance to health facility and district hospital) = 0.074/0.131. All mortality figures are adjusted for deaths with year of death missing by multiple imputation.

Uptake of obstetric care and pregnancy-related mortality

The overall level of institutional birth was 38%; 81% of women had received at least one antenatal visit and 0.4% of women had given birth by Caesarean section. The pregnancy-related mortality risk decreased with increasing proportions of women attending antenatal care ($P = 0.032$) or giving birth in an institution ($P = 0.065$) within the health facility catchment area (Figure 2). For example, women living in an area where more than 90% of women received antenatal care had a 38% lower odds of pregnancy-related mortality (95% CI: 8 to 42) than women living in areas where only 70% or fewer had attended

Table 1 Trends in maternal mortality risk in women aged 15 to 49 in Diapaga and Ouargaye districts in Burkina Faso (2002–2006) – univariate and adjusted analyses

	Univariate			Adjusted for demographic characteristics†		
Risk factor	OR	95% CI	*P*-value	OR	95% CI	*P*-value
District/Intervention/Period						
2002–2003						
Diapaga	1.18	(0.78, 1.77)	0.433	1.17	(0.72, 1.89)	0.528
Ouargaye – Non SCI	0.76	(0.49, 1.18)	0.222	0.77	(0.49, 1.20)	0.253
Ouargaye – SCI	Ref.			Ref.		
2004–2006						
Diapaga	1.60	(1.06, 2.44)	0.027	1.59	(1.02, 2.48)	0.041
Ouargaye – Non SCI	1.13	(0.75, 1.71)	0.566	1.10	(0.70, 1.73)	0.686
Ouargaye – SCI	Ref.			Ref.		
Change 2002–2003 to 2004–2006						
Diapaga	0.90	(0.67, 1.21)	0.488	0.88	(0.65, 1.18)	0.382
Ouargaye – Non SCI	0.98	(0.58, 1.66)	0.933	1.03	(0.60, 1.75)	0.913
Ouargaye – SCI	0.66	(0.42, 1.04)	0.074	0.70	(0.44, 1.11)	0.131
Diapaga *vs.* Ouargaye – SCI			0.274			0.439
Ouargaye – Non SCI *vs.* SCI			0.274			0.278

†Maternal age, socio-economic status, distance to health facility and district hospital.

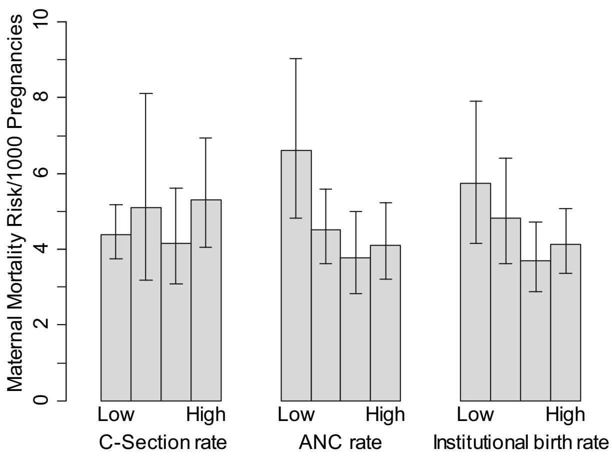

Figure 2 Maternal mortality risk in 42 health facility catchment areas in Diapaga and Ouargaye districts in Burkina Faso during the period 2002–06 by Caesarean section rate, ante-natal care coverage and institutional birth rate – quartiles, univariate analysis. *P*-values for trend (raw/adjusted for maternal age, socio-economic status and distance to health facility and district hospital): Caesarean section rate $P = 0.395/0.216$, ante-natal care coverage $P = 0.032/0.042$, institutional birth rate $P = 0.065/0.095$. All mortality figures are adjusted for deaths with year of death missing by multiple imputation.

antenatal care. Similarly, women living in an area where more than 60% of women gave birth in an institution had a 28% lower odds of pregnancy-related mortality (95% CI −5 to 51) than women living in areas where only 30% or fewer had given birth in a facility. Population based Caesarean section rates, on the other hand, were not associated with levels of pregnancy-related mortality. These associations persisted when adjusted for demographic characteristics (Figure 2).

Socio-demographic and contextual determinants of pregnancy-related mortality

Age at birth was a risk factor for pregnancy-related mortality with women older than 35 being at higher risk (Table 2). Women with greater asset ownership had lower levels of pregnancy-related mortality, but differences were not significant. Distance from home to the health centre or to the nearest district hospital were not associated with pregnancy-related mortality ($P = 0.931$ and 0.363 respectively).

Discussion

We did not find a significant association between the timing of implementation of the SCI and pregnancy-related mortality in rural Burkina Faso. The fall in mortality over time in the area receiving the intervention was consistent with an effect of the skilled attendance strategy, but these trends did not reach statistical significance. The lower pregnancy-related mortality in the health facility areas with higher institutional birth rates and higher antenatal coverage also supports the hypothesis that the mortality decline is mediated through a skilled attendance strategy. The lack of an association with Caesarean sections was surprising but maybe due to the remarkably low levels of population-based Caesarean sections in the setting.

The absence of an effect on pregnancy-related mortality may be due to a number of factors. Firstly, there may have been a recall bias with fewer deaths remembered in the earlier period (2002–2003), leading to an attenuation of the time trends, though this bias is unlikely to have differed between areas. Secondly, skilled attendance interventions also took place in the areas not covered by FCI, and this may have diluted the effect. Finally, the intervention was staggered over time, and the time between full implementation of all SCI activities and the evaluation may have been too short to observe an impact. Countries successfully reducing their levels of maternal mortality have done so over long periods of time, and the short period observed here (2002–2006) may not have been sufficient to show an effect (Van Lerberghe & De Brouwere 2001; Dieltiens *et al.* 2005).

Distance from home to the health centre, or to the nearest district hospital, was not associated with pregnancy-related mortality. Distance has been shown elsewhere (Chowdhury *et al.* 2006) and in Burkina Faso (Hounton *et al.* 2008b) to be a determinant of uptake of skilled care and we were surprised by the absence of any effect on pregnancy-related mortality. In this particular context, the absence of an effect of distance from home to a health facility on maternal mortality may be due to the relatively poor capacity of health centres and district hospitals to deal with complications, but the number of known institutional deaths is low (9% of all pregnancy-related deaths). The distance measured was the distance between the district hospital and the home; however, in Ouargaye, the hospital utilised in more than half of the Caesarean sections was not the district hospital but the regional hospital in Tenkodogo, 65 km north of Ouargaye hospital, to which women were transferred from Ouargaye hospital. This may have had an effect on the relationship between mortality and distance to hospital, but not on distance to health centre, suggesting that the poor capacity of the health centre team or enduring low institutional delivery coverage may be factors at stake.

The extremely low Caesarean section rates in the two districts suggest that the unmet need for surgical care is huge. At such low levels of access and utilisation of

Table 2 Univariate analysis of maternal mortality risk in women aged 15–49 in Diapaga and Ouargaye districts in Burkina Faso (2002–2006)

		Pregnancy-related deaths				
	n†	Deaths	‰	OR	(95% CI)	*P*-value¶
Maternal age						
≤20 years	20 628	85	4.14	1.08	(0.80, 1.47)	0.605
>20 to ≤25 years	23 103	88	3.82	Ref.		
>25 to ≤30 years	16 331	87	5.34	1.40	(1.01, 1.94)	0.045
>30 to ≤35 years	10 316	52	5.06	1.32	(0.91, 1.91)	0.138
>35 years	8571	74	8.72	2.28	(1.61, 3.23)	<0.001
Asset index quintile						0.194
Most poor	17 395	88	5.07	1.41	(0.75, 2.62)	
Very poor	15 825	86	5.44	1.51	(0.97, 2.35)	
Poor	15 699	87	5.55	1.54	(1.06, 2.24)	
Less poor	16 609	67	4.03	1.12	(0.81, 1.54)	
Least poor	16 459	59	3.61	Ref.		
Distance to hospital						0.363
≤10 km	5277	21	3.90	0.68	(0.35, 1.33)	
>10 to ≤20 km	9263	50	5.42	0.95	(0.60, 1.49)	
>20 to ≤30 km	16 135	77	4.79	0.84	(0.51, 1.37)	
>30 to ≤40 km	15 784	55	3.46	0.61	(0.38, 0.98)	
>40 to ≤50 km	14 473	65	4.48	0.79	(0.46, 1.34)	
>50 km	21 055	120	5.71	Ref.		
Distance to health facility						0.931
≤1 km	8100	51	6.32	1.28	(0.63, 2.59)	
>1 to ≤2.5 km	10 115	43	4.31	0.87	(0.56, 1.37)	
>2.5 to ≤5 km	14 498	53	3.64	0.74	(0.42, 1.29)	
>5 to ≤7.5 km	15 965	80	5.01	1.02	(0.73, 1.42)	
>7.5 to ≤10 km	12 971	60	4.62	0.94	(0.60, 1.46)	
>10 km	20 337	100	4.93	Ref.		
Health facility catchment areas: Caesarean section rate‡						0.395
≤0.2%	30 919	135	4.40	0.83	(0.61, 1.12)	
>0.2% to ≤0.4%	18 701	95	5.09	0.96	(0.56, 1.65)	
>0.4% to ≤0.6%	13 352	56	4.17	0.79	(0.52, 1.19)	
>0.6%	19 014	100	5.29	Ref.		
Health facility catchment areas: Antenatal care coverage‡						0.032
≤70%	18 001	118	6.61	1.61	(1.08, 2.40)	
>70% to ≤85%	28 277	127	4.50	1.10	(0.79, 1.53)	
>85% to ≤90%	14 657	55	3.77	0.92	(0.64, 1.32)	
>90%	21 051	86	4.10	Ref.		
Health facility catchment areas: Institutional birth rate‡						0.065
≤30%	24 317	139	5.74	1.39	(0.95, 2.03)	
>30% to ≤40%	23 038	110	4.81	1.16	(0.81, 1.68)	
>40% to ≤50%	13 305	49	3.69	0.89	(0.65, 1.23)	
>60%	21 326	88	4.13	Ref.		

†Number of pregnancies of more than 6 months.
‡In the year of delivery, as determined from the household surveys.
¶*P*-value *vs.* reference category (nominal variables or maternal age) or linear trend (continuous or ordinal variables).
All mortality figures are adjusted for deaths with year of death missing by multiple imputations. A maternal death is defined as a definite pregnancy-related death in women age 15–49 years old based on the verbal autopsy.

CEmOC it is perhaps not surprising not to find any differentials in pregnancy-related mortality. However, about 400 Caesarean sections per 100 000 births were performed, most of them (85–95%) for life saving indication (data not shown). This means that without life-saving surgery the level of pregnancy related deaths could have doubled. Nevertheless, CEmOC utilisation was clearly not sufficient to markedly reduce pregnancy-related deaths. Studies on major obstetric interventions on a cumulative population of 65 million people (23 343 major obstetric interventions) showed that a minimum of 1% of life-saving surgery is required to deal with maternal indications of Caesarean sections (UONN 2002, Koblinsky *et al.* 2006).

We did not find an association between asset ownership and pregnancy-related mortality, thereby challenging the view that the socio-economic status of the family is an important determinant of mortality (Graham *et al.* 2004). In these poor and remote areas of Burkina Faso, very few households own modern assets, and asset ownership was highly clustered among those living in the main town (data not shown). Differentials by assets ownership are therefore difficult to assess in these settings because households are very similar and it is also very difficult to assess the socio-economic status of a rural population whose main source of income and food is farming. Finally, the assumptions and categorisation of asset ownership may not be reliable in these settings.

In spite of challenges in measuring maternal mortality (Hill *et al.* 2006), tracking progress toward maternal mortality reduction should remain the main target of all safe motherhood evaluations. However, complex public health strategies effectiveness cannot solely be judged on impact on health outcomes (Victora *et al.* 2005) because the pathway to outcomes is a continuum. Nonetheless, unless strategies are in place to ensure that women can access timely life saving drugs, techniques and CEmOC when needed, efforts to curtail pregnancy-related deaths will remain unsuccessful. These findings highlight the complexity of maternal deaths between settings but also that emergency obstetric care alone is not likely to curtail maternal mortality.

Conclusion

We did not find any significant impact of the SCI on pregnancy-related mortality within the reference period of the study. This study highlights the challenges in evaluating progress in safe motherhood even with resources available to carry out a census of about 2.5 million person-years. Although the SCI contributed to an increased utilisation of basic obstetric care, the success of such a skilled attendance strategy is contingent on full population coverage and on 24-h availability of transport, life saving drugs, treatment and CEmOC for pregnant women. The extremely low Caesarean section rate attests to the substantial barriers in accessing CEmOC. Although the SCI intervention made an impact on utilisation of skilled care at delivery, we have not yet seen a significant impact on pregnancy-related deaths reduction. Unless the persisting barriers to safe motherhood can be removed pregnancy-related mortality will remain high.

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Conflicts of interest

The authors have declared no conflicts of interest.

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