

# Research and Evaluation WORKING PAPER

## Why are maternal mortality rates lower in the MCH-FP Area of Matlab, Bangladesh? The role of pregnancy outcomes

Mizanur Rahman, Julie DaVanzo, Abdur Razzaque

December 2009





## Why are maternal mortality rates lower in the MCH-FP area of Matlab, Bangladesh? The role of pregnancy outcomes

Mizanur Rahman\*  
Pathfinder International  
9 Galen St., Ste. 217  
Watertown, MA 02472  
U.S.A.

Julie DaVanzo  
RAND Corporation  
1776 Main Street  
Santa Monica, CA 90406  
U.S.A.

Abdur Razzaque  
ICDDR,B Centre for Health and Population Research  
GPO Box 128  
Dhaka 1000  
Bangladesh

\*Corresponding author, email [MizanurRahman@pathfind.org](mailto:MizanurRahman@pathfind.org).

### **Pathfinder International Research and Evaluation Working Paper Series**

The purpose of the Working Paper Series is to disseminate work in progress by Pathfinder International staff on critical issues of population, reproductive health, and development.

Unless otherwise indicated, working papers may be quoted and cited without permission of the author(s), provided the sources is clearly referenced as a working paper. Full responsibility for the content of the paper remains with the author(s). Comments from readers are welcomed and should be sent directly to the corresponding author.

Published by Pathfinder International. Copyright by the author(s). ©2009.

### **Pathfinder International**

Pathfinder International places reproductive health services at the center of our work around the world, providing women, men, and adolescents access to a range of quality health services—from contraception and maternal care to the prevention and care of sexually transmitted infections. Pathfinder strives to halt the spread of HIV and AIDS, strengthen access to family planning, advocate for sound reproductive health policies, and, through all of our work, improve the rights and lives of the people we serve.

Pathfinder International/Headquarters  
9 Galen Street, Suite 217  
Watertown, MA 02472 USA  
Tel: 617-924-7200  
Fax: 617-924-3833  
[www.pathfind.org](http://www.pathfind.org)



### **Acknowledgements**

Support was provided by the Office of Population and Reproductive Health, Bureau for Global Health, U.S. Agency for International Development (USAID) under the terms of Cooperative Agreement No. HRN-A-00-00-00003-00 awarded to the CATALYST Consortium. The Consortium, which ended in 2005, was a partnership between Pathfinder International and the Academy for Educational Development, the Centre for Development and Population Activities, Meridian Group International, Inc., and PROFAMILIA/Colombia. ICDDR,B acknowledges with gratitude the commitment of USAID and CATALYST consortium to the Centre's research efforts. The authors thank Dan Pellegroni and Maureen Norton for their comments and encouragement of the research. The views expressed are those of the authors and do not reflect the opinions of USAID, Pathfinder International, RAND, or ICDDR,B.

## ***Abstract***

**Background** The Matlab Maternal Child Health-Family Planning (MCH-FP) project provides maternity-care as a part of its reproductive health services. We examine whether this project has had any impact on maternal mortality and, if so, the extent to which differences between the areas in pregnancy outcomes and their case-fatality rates explain the maternal mortality difference.

**Methods** We analyze longitudinal data from the Matlab Demographic Surveillance System on 142,966 pregnancies during 1982-2002 and compare maternal mortality in the MCH-FP and government-served Comparison Areas.

**Results** Women in the MCH-FP Area experienced 19% (95% CI 3%-32%) lower maternal mortality than those in the Comparison Area. Rates of maternal mortality for women whose pregnancies resulted in live births do not differ significantly between the two areas (157 vs. 138 per 100,000 live births). In both areas the risk of maternal mortality is considerably higher for pregnancies that resulted in induced abortion, miscarriage, and stillbirth compared to those that resulted in live births, and this is especially the case in the Comparison Area. Incidence of pregnancy outcomes other than live births was 24% (95% CI 21%-26%) lower in the MCH-FP than Comparison Area, and the likelihood of maternal death following such pregnancies was 40% (95% CI 12%-59%) lower in the MCH-FP Area than in the Comparison Area (557 vs. 919 deaths/100,000 pregnancies). The lower maternal mortality rate in the MCH-FP Area is mainly due to the lower case-fatality rates for pregnancies that resulted in induced abortion, miscarriage, and stillbirth there than in the Comparison Area.

**Interpretation** Interventions to prevent or reduce induced abortion, miscarriage, and stillbirth and effective management of such outcomes can substantially reduce maternal mortality in Bangladesh and similar countries.

## Introduction

Over half a million women die from pregnancy- or delivery-related causes each year. The vast majority of these deaths occur in developing countries [1]. The reduction in maternal mortality is one of the Millennium Development Goals (MDGs) for developing countries.

Pregnancy outcomes other than live births (induced or spontaneous abortions and stillbirths) are a risk factor for maternal mortality [2, 3, 4]. Most induced abortions in developing countries are performed unsafely and carry a high risk of maternal mortality.

In this paper, we analyze high-quality longitudinal data on 142,966 pregnancy outcomes obtained from the Matlab Demographic Surveillance System (DSS) during 1982-2002 to examine (i) whether maternal mortality was lower in the MCH-FP than in the Comparison Area and (ii), if so, to what extent the difference can be explained by differences in the distributions of pregnancy outcomes or in their case-fatality rates. The large-scale Matlab data on maternal mortality are unique in a developing country setting, and allow an analysis of the risk of mortality following each type of pregnancy outcome.

Previous research has shown that the MCH-FP Area has lower incidences than the Comparison Area of all three types of pregnancy outcomes other than live births [5] and that abortion-related maternal mortality was lower in the former [6, 7]. Maternal mortality during 1977-2005 was lower in the MCH-FP Area than the Comparison Area [8]. We hypothesize that the former area's lower incidence of induced abortion, miscarriage, and stillbirth and its better management of pregnancies and deliveries, especially those that did not result in a live birth, helps explain the mortality difference.

## Background

Matlab, a rural sub-district of Bangladesh, is well known for its DSS and its MCH-FP project, which operates in half of the area covered by DSS to provide intensive and quality family planning, maternal and child health services [9, 10, 11]. The other half, known as Comparison Area, is typical of much of Bangladesh in contraceptive use [5], fertility and childhood mortality [12], and maternal mortality [13]. Contraceptive prevalence has increased, and fertility and infant and child mortality have decreased in both areas of Matlab [5]. All of these trends are more pronounced in the MCH-FP Area.

### *Maternity Care Service in Matlab*

Most deliveries in Matlab take place at home attended by traditional birth attendants, though, as we will see below, institutional deliveries have been increasing in the MCH-FP Area in recent years. Both the areas of Matlab have access to Chandpur government district hospital and some private clinics that provide emergency and intensive services including caesarian section and blood transfusion. However, about half of the villages of both areas are relatively more remote and the residents have less access to transportation to Chandpur. Matlab residents also seek

higher-level health services from Narayanganj, a commercial town reachable in 4-5 hours by road or river transportation.

Since 1977, the Matlab MCH-FP Area has received a series of carefully designed reproductive health interventions that may directly and indirectly impact maternal health and mortality. Between 1978 and 2001, female community health workers (CHWs) provided family-planning counseling and supplies of injectable contraceptives, pills, and condoms at the doorstep during fortnightly or monthly visits. Four health centers were established in 1987 in the MCH-FP Area. Since 2001, health and family planning services have been provided from these health centers. Tetanus immunization was introduced in 1979, and coverage has been universal since 1990.

Between 1987 and 2001 a number of safe motherhood interventions were introduced in the MCH-FP Area. In 1987, four trained midwives were posted in two of the four health centers; their tasks were to attend deliveries on call at home on a 24-hour basis and provide basic obstetric care. Midwives also encouraged family members of the pregnant women with complications to send them to Matlab Health Center, where emergency care (but without caesarian section or blood transfusion) were available. Seriously complicated cases are transported to the district hospital in Chandpur. In 1990, additional midwives were posted in the other two health centers to provide the above-mentioned services. Pregnant women in the MCH-FP Area receive information about antenatal care, including danger signs of pregnancy, in a pictorial card; they are advised to contact the midwife for counseling, antenatal, and delivery services. CHWs refer women with danger signs or pregnancy complications to midwives or paramedics. Between 1996 and 2001, maternity care was gradually redesigned to be facility-based, with basic obstetric care in the four health centers, and home-based delivery care by midwives was withdrawn. The project has made systematic efforts to increase institutional deliveries in the four health centers [8, 10, 14, 15, 16].

During the 1996-2002 period 58% women in the MCH-FP Area received at least one antenatal check-up, and 52% received an antenatal check-up during the third trimester [17]. Institutional deliveries have increased remarkably in the MCH-FP Area recently [16]. In the early 1990s only a few of births were delivered in the ICDDR,B health centers; by 2005 the percentage had increased to over 30% and then it further increased to over 75% in 2009. (There are no comparable data for the Comparison Area, but it is expected that it was around 5-10% during this same period.)

### ***Pregnancy Outcomes***

While induced abortion is illegal in Bangladesh, early pregnancy terminations within eight weeks of conception are permitted, with the husband's consent, if performed by "manual vacuum aspiration" or "menstrual regulation (MR)." MR is available from trained female paramedics at the government and private health centers in both areas. MR abortions have a considerably lower risk of maternal mortality than abortions performed by traditional healers, which are common in both areas. The incidences of stillbirth, miscarriage, and induced abortion are all lower in the MCH-FP Area than in the Comparison Area [5, 18]. The induced abortions that do occur in the MCH-FP Area tend to use the safer method of abortion [19].

## Data and Methods

### *Data*

The Matlab DSS contains longitudinal records of pregnancy outcomes and deaths in both areas. During their regular visits to each household, fortnightly between 1966 and 1996 and monthly since 1997, the CHW records pregnancy status at the time of the visit and pregnancy outcome of each woman prior to the visit. In the DSS, a *live birth* is the delivery of a live baby at any gestational age; a *stillbirth* is a fetal loss at 28 weeks or longer gestation; a *spontaneous abortion, or miscarriage*, is a spontaneous fetal loss prior to 28 weeks; and *induced abortion* is self-reported. The data on induced and spontaneous abortion (miscarriage) are likely to be of high quality and not to suffer from underreporting. In their many years of work in the community the CHWs have established themselves as trustworthy and in a good position to collect reliable information on pregnancy outcomes and, because of their frequent household visits, they are likely to elicit accurate information [9]. Even if some underreporting of spontaneous or induced abortion exists, it should not differ between the MCH-FP and Comparison Areas [20].

The DSS records causes of death. In general, the completion of death enumeration is very high, especially for adults, but maternal death may be underreported due to misclassification of cause of death. According to the Tenth Revision of the International Classification of Diseases (ICD-10), a maternal death is “the death of a woman during pregnancy or within 42 days of pregnancy outcome from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes” [21].

Investigators studying maternal mortality in Matlab have collected further information to improve the identification of maternal deaths that occurred between 1976 and 2001 [8, 15, 16, 22, 23, 24] and have updated the DSS death files accordingly. These investigators followed the extended definition of maternal death -- a death within 90 days of a pregnancy outcome [25] -- and this is the definition we use here.

We analyze maternal mortality for a sample of 142,966 singleton pregnancy outcomes that occurred in Matlab during the period 1982-2002. We matched death records with the pregnancy outcomes through the unique DSS identification numbers. We exclude 1,519 pregnancies (just over 1% of all pregnancies) that had multiple outcomes (twins and triplets) because these outcomes carry a special risk of maternal deaths that should be separately studied.<sup>1</sup>

We consider a total of 503 maternal deaths during the period 1982 to 2002. Of these, 186 women died during pregnancy, before having a pregnancy outcome; 258 died within 42 days of the end of the pregnancy; and 59 died between 43 and 90 days of the pregnancy outcome. Though these 59 deaths would not be classified as maternal deaths according to ICD-10, we have kept them in the analysis since they are recorded as maternal deaths in the DSS. We repeated the analysis without these 59 cases being considered maternal deaths and found that the main findings basically

---

<sup>1</sup> We consider 186 women who died during pregnancy. We don't know whether any of them were carrying multiple fetuses.

remain unaltered. There were 14 accidental deaths that occurred either during pregnancy or within 90 days of pregnancy outcome; these are not considered as maternal deaths in this study but are included in the sample.

### Methods of Analysis

We examine how the risk of maternal mortality, defined as maternal deaths per 100,000 pregnancies, varies by pregnancy outcome (induced abortion, spontaneous abortion [miscarriage], stillbirth, live birth, and death while pregnant before having any outcome) and area (MCH-FP or Comparison). Mortality risks are calculated for each type of pregnancy outcome (this is equivalent to the case-fatality rate for women with that outcome), and odds ratios and their 95% confidence intervals are constructed. We also calculate adjusted odds ratios measuring the mortality risks associated with different types of pregnancy outcomes in the MCH-FP and Comparison Areas using a logistic regression model that controls for the effects of demographic and socioeconomic variables.

Finally, we perform a simulation exercise to assess the extent to which the mortality difference between the areas is attributable to differences between them in the distribution of pregnancy outcomes or to differences between them in the case-fatality rates associated with various pregnancy outcomes. The case-fatality rates of each area are applied to the pregnancy-outcome distribution of the other area, and these simulated rates are compared to the observed mortality rates in each area.

### Results

Maternal mortality risk was 313 per 100,000 pregnancies in the MCH-FP Area -- 19% (95% CI 3%-32%) lower than the rate of 384 in the Comparison Area (Table 1).

Pregnancies in the MCH-FP Area were more likely than those in the Comparison Area to result in live births and 24% (95% CI 21%-26%) less likely to end in outcomes other than live births (Table 2). The likelihood of dying during pregnancy was 20% (95% CI -2%-44%) lower in the MCH-FP than Comparison Area. In the MCH-FP Area, 2.17% of pregnancies were terminated by induced abortion, which is 49% (95% CI 46%-52%) lower than in the Comparison Area (4.21%). The incidence of miscarriage was 10% (95% CI 6%-14%) lower in the MCH-FP Area (5.32%) than in the Comparison Area (5.88%), and the incidence of stillbirth was 6% (95% CI 1%-12%) lower (2.91% vs. 3.07%).

**Table 1. Number of pregnancies and maternal deaths and risk of death by area, Matlab, 1982-2002**

Area	Number		Deaths/100,000 pregnancies
	Pregnancies	Maternal Deaths	
Comparison	77,507	298	384
MCH-FP	65,459	205	313
Both areas	142,966	503	352

**Table 2. Distribution of pregnancy outcomes by area, Matlab, 1982-2002**

Outcome	Percent of outcomes			Number of outcomes (Number of deaths)	
	Comparison	MCH-FP	Odds Ratio [MCH-FP/Comparison] (95% confidence interval)	Comparison	MCH-FP
Woman died during pregnancy	0.14	0.11	0.80 (0.60-1.07)	§ (111)	§ (75)
Induced abortion	4.21	2.19	0.51 (0.48-0.54)	3,263 (23)	1,434 (3)
Miscarriage	5.89	5.32	0.90 (0.86-0.94)	4,563 (17)	3,484 (9)
Stillbirth	3.10	2.91	0.94 (0.88-0.99)	2,404 (54)	1,907 (26)
All pregnancies that did not result in a live birth	13.34	10.54	0.76 (0.74-0.79)	10,230 (94)	6,825 (38)
Live birth	86.66	89.46	1.31 (1.26-1.35)	67,165 (93)	58,555 (92)
All	100.0	100.0	--	77,507¶ (298)	65,459¶ (205)

§ These women died during pregnancy, before having a pregnancy outcome. In a sense, all pregnant women are at risk of this outcome.

¶ Pregnancy outcomes of one woman in the MCH-FP Area and four in the Comparison Area were not reported.

Maternal mortality risks by pregnancy outcome, or case-fatality rates, by area are shown in Table 3. (The numbers of deaths and pregnancy outcomes underlying these rates are shown in Table 2.) The first two columns of Table 3 show the mortality risks associated with different types of outcomes for both areas together. The maternal mortality risk was 147 per 100,000 pregnancies for women who had singleton live births. This is 58% lower than the overall maternal mortality risk of 352 per 100,000 in both areas. At 774 per 100,000, the maternal mortality risk was 5.29 (95% CI 4.23-6.62) times higher among women whose pregnancies ended in an induced abortion, miscarriage, or stillbirth than for women who had a singleton live birth. Maternal mortality was 554 (per 100,000) among women with induced abortion, 331 among women with miscarriage, and 1,855 among women with stillbirth. The odds ratios in the second column show that the risks of dying following an induced abortion, miscarriage, and stillbirth were 3.77 (95% CI 2.50-5.70), 2.20 (95% CI 1.46-3.32), and 12.83 (95% CI 9.85-16.71) times higher, respectively, than following a singleton live birth.

**Table 3. Maternal mortality risks, by pregnancy outcome and area, Matlab, 1982-2002**

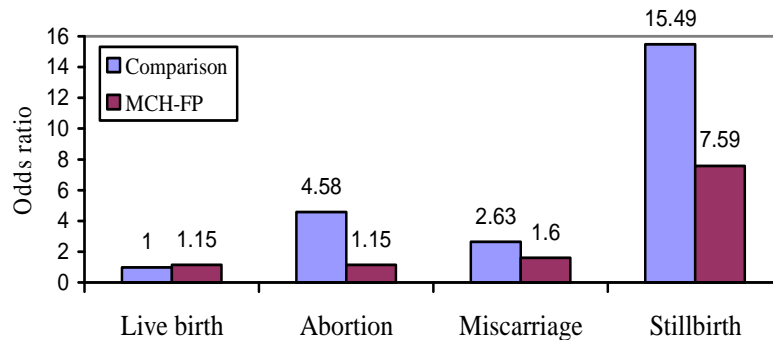
Outcomes	Both areas		Deaths/100,000 pregnancies		Odds ratio [MCH-FP/ Comparison] (95% CI)
	Deaths/100,000 pregnancies	Odds ratio [compared to live births] (95% CI)	Comparison Area	MCH-FP Area	
Woman died during pregnancy, before an outcome§	130	0.88 (0.72-1.08)	143	114	0.80 (0.60-1.07)
Induced abortion	554	3.77 (2.50-5.70)	705	209	0.30 (0.09-0.99)
Miscarriage	331	2.20 (1.46-3.32)	373	258	0.69 (0.31-1.56)
Stillbirth	1,855	12.83 (9.85-16.71)	2,245	1,363	0.61 (0.37-0.96)
All pregnancies that did not result in a live birth	774	5.29 (4.23-6.62)	919	557	0.60 (0.41-0.88)
Live births	147	1.00	138	157	1.13 (0.85-1.51)
All pregnancies	352	--	384	313	0.81 (0.68-0.97)

§ We treat all pregnant women as being at risk of this outcome.

The last three columns of Table 3 compare outcome-specific mortality risks between areas. There is very little inter-area difference in the mortality of women who had singleton live births -- 157 (per 100,000) in the MCH-FP Area versus 138 in the Comparison Area, a difference that is not statistically significant. In contrast, mortality among women with pregnancy outcomes other than a live birth was 40% (95% CI 12%-59%) lower in the MCH-FP Area (557 per 100,000) than in the Comparison Area (919 per 100,000). Overall, maternal mortality was 19% (95% CI 3%-32%) lower in the MCH-FP Area than in the Comparison Area (313 vs. 384 per 100,000). Thus the lower maternal mortality in the MCH-FP Area is largely due to the area's lower risk of dying from each type of pregnancy outcome other than live births. The difference is largest for induced abortions (70% lower) followed by stillbirths (39% lower). The rate of maternal mortality associated with stillbirths in the Comparison Area is very

high—2,245 maternal deaths/100,000 stillbirths. The mortality risk for miscarriages does not differ significantly between the areas.

**Figure 1. Adjusted odds ratios (OR) by type of pregnancy outcome and area, Matlab, 1982-2002**



Live birth in the Comparison Area is the reference category. ORs for the live birth, abortion, and miscarriage in the MCH-FP Area are not significantly different from 1.00 but those for others are significant at 5% or higher levels.

Adjusted odds ratios (OR), showing the risk of mortality of women having abortions, miscarriages, or stillbirths, are presented in Figure 1. These come from a logistic regression model that controls for maternal age, parity, interpregnancy interval, prior child deaths, prior history of pregnancy losses, maternal education, household space (a proxy for household wealth), religion, and the calendar year of pregnancy outcome. The adjusted odds are similar to those seen in Table 3; the risks of dying from abortion and stillbirth remain significant after the adjustment for background characteristics.

Observed and simulated maternal mortality rates are shown in Table 4. Risks in cells *a* and *d* are the observed rates in the MCH-FP and Comparison Areas, respectively. The rate in the cell *c* is calculated by applying the case-fatality rates of the MCH-FP Area to the pregnancy outcomes distribution of the Comparison Area. Similarly, that in cell *b* is calculated by applying the case-fatality rates of the Comparison Area to the pregnancy outcomes distribution of the MCH-FP Area. The third column (M - C) shows the extent to which the overall difference in maternal mortality between the two areas is due to differences in case-fatality rates, whereas the third row shows the extent to which the difference is due to differences in the distribution of pregnancy outcomes.

**Table 4. Simulation of maternal mortality risks among at-risk women assuming distribution of pregnancy outcomes or case-fatality rates (per 100,000) of the other area**

Distribution of pregnancy outcomes of	Case-fatality rate of		M - C
	MCH-FP Area (M)	Comparison Area (C)	
MCH-FP Area (M)	313 (a)	367 (b)	-54
Comparison Area (C)	316..... (c)	384 (d)	-68
M - C	-3	-17	

The difference between the actual maternal mortality rates in the two areas = -71

Most of the maternal mortality difference is due to differences in case-fatality rates. If the case-fatality rates of the Comparison Area remained the same but the pregnancy outcome distribution were changed to that of the MCH-FP Area, mortality would have reduced from 384 to 367, or by only 4%. In contrast, if the distribution of pregnancy outcomes in the Comparison Area remained the same but the case-fatality rates were changed to those of the MCH-FP Area, maternal mortality would be reduced from 384 to 316, or by about 18%. Similarly, if MCH-FP Area had the pregnancy-outcome distribution of the Comparison Area, its maternal mortality risk would change negligibly (from 313 to 316). If the case-fatality rate changed to that of the Comparison Area, mortality in the MCH-FP Area would increase from 313 to 367, or by 17%. Of the difference of 71 maternal deaths per 100,000 pregnancies between the two areas, 4-24% is due to differences in the distribution of pregnancy outcomes, while 76-96% is due to differences in case-fatality rates.

## Discussion

We have been able to analyze a large sample of pregnancy outcomes and maternal deaths over a period of two decades using data, from the Matlab DSS, that are unlikely to suffer from the underreporting usually encountered in data on maternal mortality and stillbirths and pregnancy losses.

Maternal mortality risks in Matlab as a whole were 5.29 times higher for pregnancies that did not end in a live-birth than for pregnancies that resulted in a singleton live birth. (Compared to singleton live births, the risks were 2.20 times higher for miscarriages, 3.77 times higher for induced abortions, and 12.83 times higher for stillbirths.) If all pregnancies in Matlab resulted singleton live births or if women with other pregnancy outcomes had a mortality risk the same as those after singleton live births and no women died during pregnancy, maternal mortality would have been 147 deaths per 100,000 pregnancies, a 59-percent reduction from the overall maternal mortality risk of 352 per 100,000 pregnancies in Matlab, achieving an MDG goal. If the risk of dying during pregnancy remained the same but all other pregnancies resulted in a live birth, maternal mortality could still be reduced by a sizable 34%.

The very high risk of maternal mortality associated with stillbirths deserves public health attention. Stillbirths are defined in DSS as an outcome after pregnancy

duration of 7 months or more, and some of these may occur at full term or near full term of pregnancies. Such cases are likely to be associated with delivery complications that do not receive appropriate and timely interventions. Most births in Bangladesh are delivered at home by untrained birth attendants, and, when there are complications, the relatives may adopt a wait-and-see approach or seek help from untrained or traditional health care providers, and the mother's condition may worsen because of this. As in all societies, Bangladeshi families are happy after a successful childbirth, and the newborn and the mother are likely to receive attention and care. When the outcome is a still birth, the mother may not receive appropriate attention and care, when it is most needed, because family members may not feel the necessity. It is not known to what extent women receive post-natal care after pregnancy outcomes other than live births. This is a topic that merits further study.

Between 1982 and 2002 maternal mortality was 19% lower in the MCH-FP Area than in the Comparison Area. Relatively more pregnancies ended in live births in the MCH-FP Area (86.7%) than in the Comparison Area (89.5%). The incidence of induced abortion was 49% lower in the MCH-FP Area, of miscarriage 10% lower; and of stillbirth 6% lower. The risk of dying from outcomes other than live births was 40% lower in the MCH-FP than Comparison Area (70% lower for induced abortions, 31% lower for miscarriages, and 39% lower for stillbirths). In contrast, risk of dying from pregnancies that resulted in singleton live births was similar in the two areas.

Despite the fact that pregnancies in the Comparison Area are more likely to result in outcomes other than live births and such pregnancies have higher risks of maternal mortality on average, the majority of the overall difference in maternal mortality rates between the areas is due to the higher case-fatality rates in the Comparison Area for each type of outcome other than live birth.

The lower incidence in the MCH-FP Area of pregnancy outcomes other than live births and the reduced risk of dying from such pregnancies can be explained by several factors. The incidence of unintended pregnancy was lower in the MCH-FP Area because of its better family planning services, and this led to a lower level of induced abortion [18]. In addition, women in the MCH-FP Area have greater access to reproductive health services and information, and pregnant women are more likely to get health care from the community- and facility-based providers, which presumably results in fewer miscarriages and stillbirths. Perinatal mortality (stillbirth and early neonatal mortality) declined during the 1979-1986 period in the MCH-FP Area of Matlab, but not in the Comparison Area [26].

Lower mortality among women whose pregnancies ended in induced abortion, miscarriage, and stillbirth in the MCH-FP than Comparison Area suggests that the former area's maternity-care program has been able to more effectively manage pregnancies that do not result in live births, especially stillbirths. As mentioned above, women in the MCH-FP area are more likely to use antenatal care and maternity services, both at home and hospitals, especially in recent years, and a substantial proportion of deliveries took place in ICDDR,B hospitals, which can tackle complications and have a strong referral system to higher-level facilities. Because of greater accessibility to antenatal and maternity services, women in the MCH-FP Area

with miscarriages and stillbirths are likely to seek health care more often and more quickly; this is likely to reduce the risk of dying from such outcomes.

Several factors help explain the lower maternal mortality risk associated with induced abortions in the MCH-FP Area. The maternity centers equipped with post-abortion care services in the MCH-FP Area are likely to reduce the risk of women dying from unsafe abortions, which are still quite common in Bangladesh. MCH-FP maternity center staff and community-based midwives play a life-saving role in channeling cases with induced abortion and serious cases for blood transfusion and D&C to nearby district hospital in Chandpur [7] These services are not available in the Comparison Area. Furthermore, the abortions that do occur in the MCH-FP Area tend to use a safer method of menstrual regulation [19].

Better family planning services, in terms of access and quality, can reduce the incidence of induced abortion by reducing unintended pregnancies. Greater accessibility to maternity-care services if linked with high-level obstetric care could reduce the incidence of miscarriage and stillbirth thus causing a decline in risks of dying from pregnancy complications of such outcomes. More effective policies and safer management of induced abortion, miscarriage, and stillbirth would have strong and positive impact in substantially reducing maternal mortality in Bangladesh and similar countries. Maternity-care providers and community health workers should counsel pregnant women about the mortality risks associated with unsafe abortion, miscarriage, and stillbirth and should advise them to immediately contact trained providers when women encounter such outcomes, and providers should give focused care for such cases. Better management of these outcomes can further reduce maternal mortality.

## **Contributors**

MR and JD designed the study, analyzed the data, and wrote the manuscript. AR implemented the study at ICDDR,B and supervised data management and analysis, and collaborated to interpret results and write the manuscript.

## **Conflict of interest statement**

We declare that we have no conflict of interest.

## References

- 1 WHO, UN Children's Fund, UN Population Fund. Maternal mortality in 2000: estimates developed by WHO, UNICEF, UNFPA. Geneva: WHO, 2004.
- 2 Gissler M, Berg C, Bouvier-Colle MH, Buekens P. Pregnancy-associated mortality after birth, spontaneous abortion or induced abortion in Finland, 1987-2000. *Am J Obstet Gynecol* 2004; 190:422-427.
- 3 Reardon DC et al. Deaths associated with pregnancy outcome: a record linkage study of low income women. *South Med J* 2002; 95(8):834-41.
- 4 Hurt LS, Alam N, Dieltiens G, et al. Duration and magnitude of mortality after pregnancy in rural Bangladesh. *Int J Epidemiol* 2008; 37:397-404.
- 5 International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). Health and demographic surveillance system, Matlab: Registration of health and demographic events (1983-2205). Dhaka, Bangladesh. 2006. Also available at [www.icddrb.org](http://www.icddrb.org).
- 6 Fauveau V, Blanchet T. Deaths from injuries and induced abortion among rural Bangladeshi women. *Soc Sci Med* 1989; 29(9): 1121-27.
- 7 Maine D, Akalin MZ, Chakraborty J, de Francisco A, Strong M. Why did maternal mortality decline in Matlab? *Stud Fam Plann* 1996; 27: 179-87.
- 8 Chowdhury M.E., R. Botlero, M. Koblinsky, et al. Determinants of reduction in maternal mortality in Matlab, Bangladesh: a 30-year cohort study. *Lancet* 2007; 370:1320-28.
- 9 D'Souza S. A population laboratory for studying disease processes and mortality -- the demographic surveillance system, Matlab Bangladesh. Special Publication. #13. 1981.
- 10 Fauveau V. Matlab: women, children, and health. Dhaka, Bangladesh: International Centre for Diarrhoeal Disease Research (ICDDR,B). 1992.
- 11 Van Ginneken J, Bairagi A, De Francisco A, Sarder AM, Vaughan P. Health and Demographic Surveillance in Matlab: Past, Present, and Future. Scientific Publication. No. 72. 1998.
- 12 National Institute of Population and Research and Training (NIPORT), Mitra Associates, ORC Macro. Bangladesh demographic and health survey 2004. Dhaka, Bangladesh and Calverton, Maryland, USA, 2005.

- 13 National Institute of Population and Research and Training (NIPORT), ORC Macro, Johns Hopkins University, ICDDR,B. Bangladesh maternal health services and maternal morbidity survey 2001. Dhaka, Bangladesh and Calverton, Maryland, USA, 2003.
- 14 Ronsmans C, Vanneste AM, Chakraborty J, van Ginneken J. Decline in maternal mortality in Matlab, Bangladesh: a cautionary tale. *Lancet* 1997; 350: 1810-14.
- 15 Fauveau V, Stewart K, Khan SA, Chakraborty J. Effect on mortality of community-based maternity-care programme in rural Bangladesh. *Lancet* 1991; 338: 1183-86.
- 16 Chowdhury ME, Ronsmans C, Killew J, et al. Equity in use of home-based or facility-based skilled obstetric care in rural Bangladesh: observational study. *Lancet* 2006; 367: 327-332.
- 17 Razzaque A, DaVanzo J, Rahman M, et al. Pregnancy spacing and maternal morbidity in Matlab, Bangladesh. *Int J Gynaecol Obstet* 2005; 89 (Suppl 1):S41-49.
- 18 Rahman M, DaVanzo J, Razzaque A. Do better family planning services reduce abortion in Bangladesh? *Lancet* 2001; 358: 1051-56.
- 19 DaVanzo J, Grammich C, Rahman M, Razzaque A. Do family planning services affect choice of abortion method in Bangladesh? Paper presented at the annual meeting of the Population Association of America, Boston. 2004.
- 20 Ahmed K, Sarkar AH, Rahman M. Determinants of induced abortion in rural Bangladesh. *Demography India* 1996; 25(1):105-118.
- 21 World Health Organization. International statistical classification of diseases and related health problems. Tenth revision. Geneva: WHO, 1992.
- 22 Koenig MA, Fauveau V, Chowdhury AI, et al. Maternal mortality in Matlab, Bangladesh. *Stud Fam Plann* 1988; 19 (2): 69-80.
- 23 Ronsmans C, Campbell O. Short birth intervals don't kill women: evidence from Matlab, Bangladesh. *Stud Fam Plann* 1998; 29: 282-90.
- 24 Dieltiens G, Dewan H, Botlero R, Biswas K, Begum SN, Shahjahan M. Met need for life-saving obstetric surgery in Bangladesh: the Matlab-ICDDR,B cohort-study of maternal mortality 1990-2001 and the results for a new indicator to assess met need for life-saving obstetric surgery. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh. 2005.

25 AMA Committee on Maternal and Child Care. A guide for maternal death studies. Council of Medical Services. Chicago: American Medical Association. 1964.

26 Fauveau V, Wojtyniak B, Mostafa G, et al. Perinatal mortality in Matlab, Bangladesh: a community-based study. *Int J Epidemiol* 1990; 19(3): 606-12.

Pathfinder International/Headquarters  
9 Galen Street, Suite 217  
Watertown, MA 02472 USA  
Tel: 617-924-7200  
Fax: 617-924-3833  
[www.pathfind.org](http://www.pathfind.org)



a global leader in reproductive health