Duration and magnitude of mortality after pregnancy in rural Bangladesh

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Background
Women remain at increased risk of mortality for some time after pregnancy although the length of this period is unclear. The aim of this study is to examine mortality after pregnancy in rural Bangladesh using data from a unique demographic surveillance system.

Methods
We included all person-time in women aged 15–50 between 1983 and 2001 and compared mortality rates by time since pregnancy outcome (live birth, stillbirth, induced and spontaneous abortion) using Poisson regression, adjusting for socio-demographic factors.

Results
Mortality was highest on the first day after pregnancy (adjusted RR compared with third to fourth year post-partum 105.74, 95% CI: 76.08, 146.95) and remained elevated until 180 days (adjusted RR 1.55, 95% CI: 1.13, 2.11). Pregnancies ending in abortions and stillbirths accounted for 50% of deaths in women within 6 weeks of the end of pregnancy, and mortality after these outcomes was between two and four times as high as mortality after a livebirth.

Conclusion
The high mortality rates immediately after birth provide strong support for a skilled attendance strategy. After abortions or stillbirths, women should be under surveillance for up to 1 week. Further work on the cause of deaths in the late post-partum period is required to understand the mechanisms behind increased mortality risks at these times.

Keywords
Abortion induced, abortion spontaneous, maternal mortality, parturition, post-partum period, pregnancy outcome, stillbirth

Introduction
Pregnancy is known to be a vulnerable period in a woman’s life, and 529,000 women worldwide are estimated to die each year as a result of childbearing. 1 Although maternal deaths can occur at any time during pregnancy, most deaths occur in the last trimester and the first week following the end of pregnancy. 2–4 Women also remain at increased risk of mortality for some time following childbirth, although the exact length of this time interval is not known. 5

The adverse effects associated with pregnancy have long been thought to extend up to 6 weeks post-partum, and maternal deaths are conventionally defined as occurring within 42 days of a pregnancy outcome. 6 However, longer term intervals have been proposed. For example, a 90 day post-partum risk...
period has been commonly used in the United States\textsuperscript{7} and the British confidential enquiries have suggested a 12 month period after termination of pregnancy.\textsuperscript{8} The ICD-10 now recognizes a category of ‘late’ maternal deaths, defined as deaths from direct or indirect obstetric causes more than 42 days but <1 year after the termination of a pregnancy.\textsuperscript{6}

Empirical evidence in support of these definitions is limited because few studies have examined mortality rates by time since pregnancy.\textsuperscript{9} Many studies report the number of maternal deaths by post-partum time interval but only three studies have compared actual death rates. A study in Nepal suggested that women were at increased risk of mortality for up to 12 weeks post-partum,\textsuperscript{9} although the number of deaths in the 7–12 week period was small. Findings from Guinea Bissau, on the other hand, showed that mortality was elevated between days 43 and 91 post-partum compared with the period from 6 months to 1 year after the pregnancy.\textsuperscript{10} An analysis in Bangladesh showed that mortality was higher in women who had experienced a birth in the current or previous 2 years compared with women 3–5 years following birth, but only pregnancies ending in a live birth were included and numbers were small.\textsuperscript{11}

Much uncertainty remains as to the exact length of time for which pregnant women remain at an increased risk of death. The aim of this study is to examine the duration and magnitude of mortality after pregnancy in women of reproductive age in rural Bangladesh, using data from a large demographic surveillance system.

**Methods**

**Study population**

This is a prospective cohort study using longitudinal data from a rural area in Bangladesh (Matlab). The population is predominantly Muslim, and the major sources of income are fishing and agriculture.

The International Centre for Diarrhoeal Diseases Research, Bangladesh (ICDDR, B) has maintained a Health and Demographic Surveillance System (HDSS) in Matlab since 1966. The data collection system has been extensively validated.\textsuperscript{12} The surveillance area is divided into an ICDDR, B service area (that has received extensive health and family planning interventions since 1978) and a Government service area (that receives only Government Health Services). Data on a total population of \approx 200,000 individuals are collected monthly from all registered community members by literate female community health workers who are resident in the area in which they work. Data collected include information on all pregnancy outcomes (live births, still births, spontaneous and induced abortions) gestational age, migrations and deaths. Periodic censuses supplement the demographic data with socio-economic information. Special studies of all deaths in women of reproductive age have been conducted in both areas to ensure completeness of information on pregnancy-related deaths.\textsuperscript{2,13,14} This analysis was approved by the institutional review board of the ICDDR, B.

The ICDDR,B and Government service areas are generally similar in terms of socio-economic environment, but the areas differ markedly in services available to women. In 1987, a safe motherhood programme was piloted in half the ICDDR,B service area.\textsuperscript{15} The programme aimed at increasing coverage of home births with a health professional by posting two trained midwives in each of two health centres, establishing a basic obstetric clinic in Matlab town, and providing transport to the clinic or a referral hospital when necessary. This intervention was extended to two more health centres in 1990, thereby covering the entire ICDDR,B Service area. In 1996, the programme was redesigned for facility-based birth ing.\textsuperscript{16} Between 1987 and 2001, the percentage of births with a skilled attendant increased from 5.0 to 26.7\%\textsuperscript{14} and from 1996 all births with a midwife were health centre based. The caesarean rate has increased steadily from 0.2\% in 1990 to 2.7\% in 2001.\textsuperscript{14} Women in the Government Service area do not have extensive access to trained birth attendants at home or in basic obstetric facilities, but distance to referral care is similar to that in the ICDDR,B service area. The proportion of births with a health professional was extremely low, remaining below 4\% in the late nineties,\textsuperscript{14} and increasing to only 10\% in 2001.\textsuperscript{14} Caesarean section rates on the other hand rose from 0.1 to 1.6\% between 1990 and 2001.\textsuperscript{14}

We examined all person-time in women aged 15–50 living in the HDSS area between 1983 and 2001. Women entered the cohort if (i) they were between 15 and 50 years on January 1, 1983, (ii) they were between 15 and 50 years when they migrated into the area (including women who re-migrated into the area after periods living elsewhere), or (iii) on their 15th birthday. Women exited the cohort and their observations were censored (i) when they moved out of the area, (ii) if they died before or on December 31, 2001, (iii) on their 51st birthday, or (iv) on December 31, 2001.

**Definition of exposure**

We linked records of all pregnancy outcomes (livebirths, stillbirths, spontaneous and induced abortions) during this time period with mortality records, using the unique identification number given to each woman. First, we classified women according to whether they had ever been pregnant in their lifetime. This was possible for most women because reproductive histories are collected after a birth, during the census and when women migrate into the study area and are updated continuously in a relational database (although there is no information on the dates of pregnancy outcomes if these occur whilst living
outside the HDSS area). Then, we searched for all pregnancy outcomes recorded in the HDSS for the women who had ever been pregnant. Only pregnancies for which the date of the outcome was known could be included in the analysis, and person-time for pregnancies that had occurred when living outside the HDSS area was therefore excluded. For example, if a woman gave birth within the HDSS area in 1991 and 1997 (known because the information was recorded in the HDSS) and had another pregnancy outcome whilst living outside the surveillance area in 1994 (known because her reproductive history was updated on re-migration), only person-time for the time spent in the surveillance area between the end of her pregnancy in 1991 and the date of out-migration and then again after the end of her pregnancy in 1997 could be included in this analysis.

For each recorded pregnancy, follow-up time was divided into a ‘pregnant’ period (from the estimated date of conception to the day of the pregnancy outcome) and by ‘time since pregnancy outcome’ (first day after the pregnancy outcome, second day, days 3–7, by week until 3 months post-partum, by month from 3 months to 1 year post-partum and by year thereafter). The ‘pregnant’ category included the full calendar day of the pregnancy termination or birth because the time of the pregnancy outcome was not recorded.

To calculate the person-time ‘pregnant’, data on the duration of pregnancy was obtained from the HDSS records (calculated from the date of the last menstrual period, which is recorded during monthly visits for women who report being amenorrhoic). Where these data were unavailable, this was estimated using nine calendar months for a live birth, seven calendar months for a stillbirth and three calendar months for an abortion. Women who died undelivered were classified as having had a stillbirth if the duration of the pregnancy was 7 months or more or if the gestational age was not known and as having an abortion if the cause of death was reported as due to abortion or if the duration was less than 7 months. All analyses were repeated using different assumptions for the duration of pregnancies ending in stillbirths or abortions to assess whether the assumptions altered the results.

**Statistical analyses**

We summed women-years of observation and deaths within each exposure category, and calculated all-cause mortality rates. We first compared mortality rates between ever and never-pregnant women using Poisson regression, adjusting the rate ratios (RR) and 95% confidence intervals (CI) for maternal age, time period, education, religion, area of residence and marital status. All variables except education and religion were treated as time-varying co-variates and therefore changed as time progressed. In addition, all variables were considered a priori to be important potential confounders and were all included in each adjusted model.

We then restricted the sample to women whose follow-up time could be categorized by time since pregnancy, and compared mortality rates during pregnancy and by time since pregnancy using Poisson regression, adjusting for the variables listed above as well as gravidity and pregnancy outcome (which were also time-varying co-variates). We used days 731–1460 (or the third and fourth post-partum years) as the reference category because we felt that this time period best represented an ‘unexposed’ state (this is the average time at which breastfeeding is ceased in this population) whilst also being large enough to provide stable statistical estimates. We did not use data analysis methods suitable for the analysis of correlated data, despite the fact that some women experienced more than one pregnancy during follow-up, because the outcome of interest (death) could not be clustered by woman.

Finally, we tested for statistical interactions using likelihood ratio tests. We hypothesized that the length of the post-partum risk period may vary with maternal age, gravidity and pregnancy outcome and tested for an interaction between the ‘time since pregnancy’ variable and maternal age (grouped in five-year age groups or as <20, 20–30, >30 years), gravidity (grouped as one, two to six, seven or more) and pregnancy outcome (live birth, still birth, spontaneous and induced abortion). For the latter, we excluded the person time during pregnancy because we were only interested in events that occurred subsequent to each particular pregnancy outcome. All analyses were conducted using Stata version 9.

**Results**

There were 115 557 women aged 15–50 who lived in the surveillance area at some time between 1983 and 2001. After excluding 6197 (5%) women with missing data on any of the covariates mentioned above, the remaining cohort consisted of 109 360 women with 966 362 person-years of follow-up and 1947 deaths. The mean age at entry into the cohort was 22.5 years (9.1 SD) and the mean parity was 1.1 (2.1 SD).

Women who were never pregnant contributed 196 846 person-years and 513 deaths, compared with 769 516 person-years and 1434 deaths among ever-pregnant women (Table 1). Mortality was higher among the never-pregnant compared with the ever pregnant, and the effect was more pronounced after adjustment for co-variates (adjusted RR 3.70, 95% CI: 3.29, 4.15). The main changes occurred on adjustment for age and marital status, suggesting that the higher mortality of the never-pregnant was somewhat masked by the fact that many were younger and early on in their married life. Among the ever-pregnant, there were 53 800 person-years (6% of total follow-up time)
for which time since pregnancy was not known and this person-time was excluded from all subsequent analyses.

During follow-up, there were 177,224 singleton pregnancies, 1,583 twin pregnancies and 21 triplet pregnancies, resulting in 159,225 live births (88% of all pregnancy outcomes, includes twins and triplets), 5,655 stillbirths (3%, includes twins and triplets), 15,435 spontaneous or induced abortions (8%) and 138 women who died before delivery (<1%). The length of gestation was recorded in the HDSS for 93,420 (52%) pregnancies.

The mortality rate during pregnancy and on the day of the pregnancy outcome was 2.61 deaths per 1000 person-years of follow-up (Figure 1 and Table 2). Mortality increased dramatically to 136.69 deaths per 1000 person-years on the first day after the pregnancy outcome. Compared with 731 to 1,460 days after pregnancy, day one mortality was more than 100 times higher (adjusted RR 105.74, 95% CI: 76.08, 146.95). Mortality rates dropped after the first week but remained elevated up to 180 days after pregnancy, with estimates changing little between the crude and adjusted models. Adjusted mortality rates between days 91 and 180 were 1.55 times higher than those in the reference group (95% CI: 1.13, 2.11). There was no evidence of increased mortality between 181 and 365 days after pregnancy, or at any other time after the first year.

Mortality in women after a spontaneous abortion was almost twice as high as after a live birth (Figure 2 and Table 3; adjusted RR 1.74, 95% CI: 1.32, 2.28). Mortality after an induced abortion was three times higher (adjusted RR 3.06, 95% CI: 2.44, 3.84). Mortality rates were highest after a stillbirth, with these women four times as likely to die after birth (adjusted RR 4.12, 95% CI: 3.32, 5.11). There was an interaction between pregnancy outcome and mortality after pregnancy (likelihood ratio test statistic 544.65; P < 0.001). The effect of time since pregnancy on mortality was much stronger for abortions and stillbirths than for live births (Table 4), although the length of time for which mortality remained elevated after pregnancy did not vary by pregnancy outcome. Pregnancies ending in abortions and stillbirths accounted for more than half of deaths in women within the first week after the pregnancy outcome (55%, 62 of 112 deaths) and 50% within the first 6 weeks (108 of 215 deaths). There was no interaction between time since pregnancy and maternal age or gravidity (likelihood ratio test statistics 5.01 and 16.98, P-values 0.89 and 0.08, respectively).

**Discussion**

Our data suggest that pregnancy-related mortality in rural Bangladesh remains high up to 6 months after birth, challenging the commonly held view that post-partum risks extend to 6 weeks only. These effects persisted regardless of the socio-demographic profile of women, but mortality was substantially higher after an abortion or stillbirth than after a live birth. Pregnancies ending in abortions or stillbirths accounted for more than half of the pregnancy-related deaths within the first week of the pregnancy termination and 50% within the first 6 weeks, even though abortions and stillbirths represented only 11% of all reported pregnancies in this population.

Studies in Nepal and Guinea Bissau found increased risks up to 3 months after birth, but neither study was sufficiently powered to look at longer periods. The factors that dictate the length of the post-partum risk period are not well described. The conventional 42-day definition is based on the timing of the involution of the uterus, and has been sanctioned

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**Table 1** Mortality by gravidity in women aged 15–50 in Matlab, 1983–2001

<table>
<thead>
<tr>
<th>Gravidity</th>
<th>Deaths</th>
<th>Person-years</th>
<th>Crude rate</th>
<th>Crude RR</th>
<th>95% CI</th>
<th>Adjusted RR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever-pregnant</td>
<td>1434</td>
<td>769,516c</td>
<td>1.86</td>
<td>1.00</td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Never-pregnant</td>
<td>513</td>
<td>196,846</td>
<td>2.61</td>
<td>1.40</td>
<td>1.26, 1.55</td>
<td>3.70</td>
<td>3.29, 4.15</td>
</tr>
</tbody>
</table>

RR = rate ratio; CI = confidence intervals.

| Gravidity     | | |
|---------------| | |
|              | aPer 1000 person-years of observation.  
|              | bAdjusted for age, time period, education, religion, area of residence and marital status.  
|              | cIncludes 82,177 person-years in women nulligravid at entry before their first study pregnancy and 53,800 person-years in gravid women for which the time since pregnancy was not known.  

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**Figure 1** Crude mortality rates by time since pregnancy in women aged 15–50 in Matlab, Bangladesh, 1983–2001. The asterisk indicates the inclusion of the day of the pregnancy outcome
by widespread religious and traditional beliefs that women need 40 days seclusion following a birth.\(^{19,20}\) Most cardio-vascular and immunological changes associated with pregnancy return to the pre-gravid state soon after a delivery.\(^{21,22}\) However, maternal exposure to other factors that could impact on health, such as fetal cells (microchimerism), breastfeeding and the stresses associated with child rearing or loss may last for much longer.\(^{22–25}\) In addition, as pregnancy and lactation use up energy that would otherwise be available for repair and regeneration of maternal tissues, the duration of excess mortality after pregnancy may be expected to increase with the length of gestation or following a live birth.\(^{26,27}\) However, we found a higher risk of death after pregnancies of a shorter gestation (i.e. following an abortion or stillbirth) and the length of the risk period did not vary by pregnancy outcome.

Despite the reliance on a unique and large cohort,\(^{12}\) our study has some limitations. First, gestational age was not known for almost half of pregnancies and we may have misclassified some pregnant-time. Making different assumptions about the duration of pregnancy by adding or subtracting a month to the person-time pregnant for pregnancies ending in abortion or stillbirth did not change the results shown in Table 2 (data not shown). In addition, our imputed values for the gestational age are not likely to affect the estimates of mortality after pregnancy (Tables 3 and 4) because the date of the pregnancy outcome was always known.

A greater concern is the probable under-reporting of early pregnancies. As many as 50% of early pregnancy losses may be missed in population-based surveys\(^{28}\) and the women in Matlab may have under-reported some abortions, despite the intensive monthly surveillance. Maternal deaths due to abortion are less likely to have been missed because special efforts were made to identify such deaths,\(^{2,13,14}\) and mortality associated with abortions may have been inflated because we may have underestimated abortions amongst women who survived.

The HDSS does not record the time of day at which births and deaths occur. As a result, we cannot reliably report mortality within the first 24 h after birth although we can report deaths on the first and subsequent calendar days after birth. Deaths occurring on the same day as delivery were classified as deaths during pregnancy, thereby inflating mortality during pregnancy and reducing the magnitude of

**Table 2** Mortality by time since pregnancy in women aged 15–50 in Matlab, 1983–2001

<table>
<thead>
<tr>
<th>Time since pregnancy</th>
<th>Deaths</th>
<th>Person-years(^a)</th>
<th>Crude rate(^b)</th>
<th>Crude RR</th>
<th>95% CI</th>
<th>Adjusted RR(^c)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>During pregnancy(^d)</td>
<td>232</td>
<td>88 707</td>
<td>2.61</td>
<td>2.01</td>
<td>1.63, 2.47</td>
<td>2.20</td>
<td>1.77, 2.73</td>
</tr>
<tr>
<td>First day after</td>
<td>49</td>
<td>359</td>
<td>136.69</td>
<td>104.89</td>
<td>75.94, 144.89</td>
<td>105.74</td>
<td>76.08, 146.95</td>
</tr>
<tr>
<td>Second day after</td>
<td>16</td>
<td>358</td>
<td>44.66</td>
<td>34.26</td>
<td>20.46, 57.39</td>
<td>34.60</td>
<td>20.58, 58.18</td>
</tr>
<tr>
<td>Days 8–42</td>
<td>103</td>
<td>12 482</td>
<td>8.25</td>
<td>6.33</td>
<td>4.92, 8.14</td>
<td>6.45</td>
<td>4.98, 8.36</td>
</tr>
<tr>
<td>Days 43–90</td>
<td>50</td>
<td>16 862</td>
<td>2.97</td>
<td>2.28</td>
<td>1.65, 3.13</td>
<td>2.36</td>
<td>1.71, 3.27</td>
</tr>
<tr>
<td>Days 91–180</td>
<td>57</td>
<td>30 521</td>
<td>1.87</td>
<td>1.43</td>
<td>1.05, 1.94</td>
<td>1.55</td>
<td>1.13, 2.11</td>
</tr>
<tr>
<td>Days 181–365</td>
<td>72</td>
<td>59 105</td>
<td>1.22</td>
<td>0.93</td>
<td>0.71, 1.24</td>
<td>1.06</td>
<td>0.80, 1.41</td>
</tr>
<tr>
<td>Days 366–730</td>
<td>124</td>
<td>97 127</td>
<td>1.28</td>
<td>0.98</td>
<td>0.77, 1.24</td>
<td>1.12</td>
<td>0.88, 1.43</td>
</tr>
<tr>
<td>Days 731–1460</td>
<td>148</td>
<td>113 552</td>
<td>1.30</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From day 1461 onwards</td>
<td>433</td>
<td>212 675</td>
<td>2.04</td>
<td>1.56</td>
<td>1.30, 1.88</td>
<td>0.94</td>
<td>0.77, 1.16</td>
</tr>
</tbody>
</table>

**Figure 2** Crude mortality rates by time since pregnancy in women aged 15–50 in Matlab Bangladesh, 1983–2001, stratified by pregnancy outcome

\(\text{RR} = \text{rate ratio; CI} = \text{confidence interval.}\)

\(^a\)Total person-years 633 539; excludes 82 177 person-years in women nulligravid at entry before their first study pregnancy and 53 800 person-years in gravid women for which the time since pregnancy was not known.

\(^b\)Per 1000 person-years of observation.

\(^c\)Adjusted for age, time period, education, religion, area of residence, marital status, gravidity and pregnancy outcome.

\(^d\)Including the day of the pregnancy outcome.
mortality immediately after pregnancy. To estimate the magnitude of mortality on this day, we can assume that women contribute on average half a day of post-partum exposure on the day of the pregnancy outcome, giving a post-partum mortality rate of 524 deaths per 1000 person-years on that day (data not shown), four times higher than what we found a day later.

The magnitude of mortality in the first and second day following birth is staggering, but corroborates findings from other studies. These findings provide a strong impetus in support of a skilled attendance strategy since many of these immediate post-partum deaths can be prevented by better monitoring and early recognition of problems during labour and delivery. In addition, whilst the excess mortality after a spontaneous abortion or stillbirth is likely to be the result of risk factors or illnesses underlying the pregnancy loss rather than a direct effect of the pregnancy loss per se, the huge numbers of maternal deaths immediately after such losses deserve particular attention. Skilled care is generally defined as inclusive of the immediate post-partum period, but women are often discharged <24 h after a birth and there are no specific guidelines as to how long after the outcome a woman should be monitored. While 24 h may be adequate after a live birth, women with complications resulting in abortions or stillbirths should be under close and clinically competent surveillance for at least 48 h, preferably 1 week.

It is perhaps not surprising that we found higher mortality following induced abortions compared with spontaneous abortions. Pregnancy-termination by manual vacuum aspiration or so-called menstrual regulation has been legally available in Bangladesh since the late 1970s, but many abortions are still performed illegally by traditional healers. Abortion-related mortality has declined in the

### Table 4 Mortality after a live birth, spontaneous and induced abortions or stillbirth in women aged 15–50 in Matlab, 1983–2001. Adjusted rate ratios and 95% CI a by time since day of pregnancy outcome

<table>
<thead>
<tr>
<th>Time since day of pregnancy outcome</th>
<th>Live birth</th>
<th>Spontaneous abortion</th>
<th>Induced abortion</th>
<th>Stillbirth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR</td>
<td>95% CI</td>
<td>RR</td>
<td>95% CI</td>
</tr>
<tr>
<td>First day after</td>
<td>80.04</td>
<td>52.30, 122.53</td>
<td>154.99</td>
<td>33.79, 462.60</td>
</tr>
<tr>
<td>Second day after</td>
<td>12.32</td>
<td>4.55, 33.38</td>
<td>83.73</td>
<td>18.05, 388.17</td>
</tr>
<tr>
<td>Days 3–7</td>
<td>12.32</td>
<td>7.66, 19.81</td>
<td>84.07</td>
<td>34.06, 207.51</td>
</tr>
<tr>
<td>Days 8–42</td>
<td>5.01</td>
<td>3.65, 6.89</td>
<td>18.39</td>
<td>8.02, 42.16</td>
</tr>
<tr>
<td>Days 43–90</td>
<td>2.13</td>
<td>1.44, 3.13</td>
<td>4.71</td>
<td>1.57, 14.08</td>
</tr>
<tr>
<td>Days 91–180</td>
<td>1.40</td>
<td>0.98, 2.00</td>
<td>1.09</td>
<td>0.23, 5.04</td>
</tr>
<tr>
<td>Days 181–365</td>
<td>1.09</td>
<td>0.80, 1.48</td>
<td>0.30</td>
<td>0.04, 2.40</td>
</tr>
<tr>
<td>Days 366–730</td>
<td>1.18</td>
<td>0.92, 1.53</td>
<td>0.18</td>
<td>0.02, 1.44</td>
</tr>
<tr>
<td>Days 731–1460</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Day 1461 onwards</td>
<td>1.01</td>
<td>0.81, 1.27</td>
<td>0.30</td>
<td>0.12, 0.77</td>
</tr>
<tr>
<td>RR = rate ratio; CI = confidence intervals.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>aEstimates adjusted for demographic and socio-economic variables (as in Table 2).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Matlab area, partly because of better family planning services but also because of improved access to safe abortion. Continued investments in family planning and safe abortion are clearly important if the reduction in maternal mortality is to be sustained.

Data on the causes of late post-partum deaths could help to shed light on the mechanisms underlying mortality up to 6 months after pregnancy. Unfortunately, these data were not available for this analysis and this is an important area for further study. Current recommendations suggest contact at ‘6 days, 6 weeks and 6 months’ post-partum, but these results suggest that any contact a woman has with health services in the post-partum period (for herself or for her child) should be viewed as an opportunity to interview and thoroughly examine the woman for signs of ill health.

This study also confirms that women in rural Bangladesh who do not become pregnant have higher mortality than those who do. In a population where having children is highly desired, these women may well be too ill to conceive or may have been ostracized because of their inability to have children. These findings also support the ‘healthy pregnant woman’ effect, which has been suggested previously.

We do not recommend changing the definition of maternal mortality. Though we found a clear cut-off for excess mortality at 6 months after pregnancy, studies in other populations, or with even larger sample sizes, may well find somewhat different cut-offs. As the category of late maternal deaths fully captures this potential variability, and as deaths closer to birth are more likely to be attributable to the pregnancy, we encourage the reporting of both conventional (deaths within 42 days after birth) and late maternal mortality (between 43 days and 1 year after birth).

A skilled attendance strategy should extend far beyond the monitoring of labour and delivery and women should be observed for at least 24h, preferably for longer, particularly after a pregnancy loss. Competent care during this period will also protect the newborn at its most vulnerable time. Ensuring such continued and clinically competent care may be difficult to achieve with a home based skilled attendance strategy, suggesting that midwife-led care in facilities may be the preferred option.

**Conflict of interest:** None declared.

### References


