Effect of parent's death on child survival in rural Bangladesh: a cohort study

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Summary

Background The effect of a parent's death on the survival of the children has been assessed in only a few studies. We therefore investigated the effect of the death of the mother or father on the survival of the child up to age 10 years in rural Bangladesh.

Methods We used data from population surveillance during 1982–2005 in Matlab, Bangladesh. We used Kaplan-Meier and Poisson regression analyses to compute the cumulative probabilities of survival and rates of age-specific death up to age 10 years, according to the survival status of the mother or father during that period.

Findings There were 144 861 livebirths, and 14 868 children died by 10 years of age. The cumulative probability of survival to age 10 years was 24% in children whose mothers died (n=1385) before their tenth birthday, compared with 89% in those whose mothers remained alive (n=143 473). The greatest effect was noted in children aged 2–5 months whose mothers had died (rate ratio 25·05, 95% CI 18·57–33·81). The effect of the father's death (n=2691) on cumulative probability of survival of the child up to 10 years of age was negligible. Age-specific death rates did not differ in children whose fathers died compared with children whose fathers were alive.

Interpretation The devastating effects of the mother's death on the survival of the child were most probably due to the abrupt cessation of breastfeeding, but the persistence of the effects up to 10 years of age suggest that the absence of maternal care might be a crucial factor.

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Introduction

The death of a parent, particularly a mother of a young child, is likely to have a major effect on the health and survival of young children, especially in poor settings. The presence of the mother is critical where breastfeeding is the norm, and the absence of a mother will also affect the health and survival of her children, particularly in communities where no other carers step in. The death of the father can also affect the survival of the children, either because the father is directly involved in the care of the children or because he provides the economic support necessary to successfully raise them.[1]

In historical populations in the 15th to 19th centuries,[2–4] and contemporary populations in Haiti,[5] sub-Saharan Africa,[6–9] and Nepal,[10] the death of the mother is a major determinant in the survival of the infant and child. The effect is generally greatest in the neonatal period and during infancy, with much smaller effects noted in childhood.[2,6,8,9] The effect of the death of a mother on child survival after the second year of life, when breastfeeding has stopped, has been investigated in few studies, and findings vary. In a historical population in Canada,[2] the adverse effects of a mother's death persisted in children up to 15 years of age, whereas no effects were noted after 2 years of age in rural Gambia.[8] The role of the father's death on the survival of the child has been investigated in few studies.[1,8] Interest in the effects of the

death of a parent on child survival has had a revival because of the large numbers of orphans in countries with a high prevalence of HIV/AIDS.[6,7,9] However, few studies have been done in Asian populations, in which the distinct biological and care environments might alter the effect of the death of a mother or a father on the child's survival.[10–13] A strong association was noted between the death of the mother and survival of the infant during the first 24 weeks of life in a study in Nepal.[10] In two studies in Bangladesh, adverse effects of the death of a mother on infant survival were noted within 90 days of delivery, but numbers of infants included in the study were small.[11,12] The effect of a mother's death on the survival of her child up to age 10 years was investigated in an unpublished study, in which the family's socioeconomic status was not adequately adjusted for.[13]

The Matlab study area in rural Bangladesh offers a unique opportunity to study the association between the death of a parent and the survival of the child because the prospective surveillance ensures good-quality data for deaths in children, women, and men during a long period.[14,15] We therefore investigated the extent to which the death of a mother or a father affects the survival of the child during its first 10 years of life in rural Bangladesh. To separate the effects of the cessation of breastfeeding in the first 2 years of

life from environmental or behavioural effects later in life, we assessed the detailed patterns according to the age of the child and cause of death. We also investigated whether the effects varied according to the sex of the child.

Methods

The study was done at the International Centre for Diarrhoeal Disease Research, Bangladesh and government service areas in Matlab, Bangladesh, a rural area southeast of the capital Dhaka, with a population of about 220 000.[14,15] We used two sources of data, which were gathered between 1982 and 2005: the routine health and demographic surveillance system (HDSS) and periodic censuses.[14,15] HDSS maintains data for all births, deaths, marriages, and migrations since 1966. Between 1982 and 2005, female community health workers recorded the occurrence of vital events during their scheduled home visits. The schedule of home visits was initially every fortnight and was then changed to once every 2 months. The information about vital events was verified by male supervisors who visited the households once every 2 months. They interviewed a family member or neighbour about the event, and updated forms for records. Before 1987, the cause of death was assigned by the health assistant, but from 1987 onwards all forms were read by physicians who assigned a cause of death.[16] Each individual has a unique identifier, including newborn children, and all data sources can be linked.

Data for all livebirths, and deaths of children and their mothers and fathers between June, 1982, and December, 2005, were extracted from HDSS. Data for asset ownership and maternal education were obtained from the 1996 and 2005 censuses. All women were assigned the socioeconomic status of their husbands at the time of the census. Wealth was assessed by use of an asset index.[17] The assets included durable consumption goods (eg, table, chair, watch, television, bicycle), housing facilities (eg, type of toilet, source of drinking water), housing materials (eg, type of wall), and land ownership. Five wealth quintiles were created.

To assess the effect of a mother's death (from any cause) on the survival of her children up to age 10 years, we identified all livebirths between 1982 and 2005 and followed up children for 120 months or until they died, migrated, or were censored in December, 2005. We also identified all mothers who died during the child's first 10 years of life. For children whose mothers died, the follow-up time was divided into a period during which the mother was alive and a period during which the mother had died. The person time for children who died or migrated before their mother died was defined as a period during which the mother was alive. Mothers who emigrated were censored at the time of migration, and their children were censored on the same date.

Statistical analysis

We used box plots to model the timing of the death of a child relative to the child's age at which its mother died. Boxes represent the median and the IQRs (from 25th to

	Mother died (n=1385)	Mother survived (n=143 473)	All (n=144 858)
Sex of child			
Boy	702 (51%)	72 837 (51%)	73 539 (51%)
Girl	683 (49%)	70 636 (49%)	71 319 (49%)
Pregnancy			
1	235 (17%)	34 495 (24%)	34 730 (24%)
2–3	462 (33%)	53 136 (37%)	53 598 (37%)
4–5	291 (21%)	30 496 (21%)	30 787 (21%)
≥6	385 (28%)	23 822 (17%)	24 207 (17%)
Unknown	12 (1%)	1524 (1%)	1536 (1%)
Mother's age (years)			
≤19	132 (10%)	18 183 (13%)	18 315 (13%)
20–24	396 (29%)	47 727 (33%)	48 123 (33%)
25–29	369 (27%)	38 797 (27%)	39 166 (27%)
30–34	244 (18%)	23 292 (16%)	23 536 (16%)
35–39	157 (11%)	10 630 (7%)	10 787 (7%)
≥40	75 (5%)	3320 (2%)	3395 (2%)
Unknown	12 (1%)	1524 (1%)	1536 (1%)
Asset quintile			
Poorest	272 (20%)	23 445 (16%)	23 717 (16%)
Less poor	270 (19%)	25 971 (18%)	26 241 (18%)
Middle	293 (21%)	26 610 (19%)	26 903 (19%)
Richer	241 (17%)	28 022 (20%)	28 263 (20%)
Richest	235 (17%)	29 724 (21%)	29 959 (21%)
Unknown	74 (5%)	9701 (7%)	9775 (7%)
Mother's formal education (years)			
None	873 (63%)	72 419 (50%)	73 291 (51%)
1–4	142 (10%)	17 064 (12%)	17 206 (12%)
5–7	217 (16%)	27 856 (19%)	28 073 (19%)
≥8	70 (5%)	18 829 (13%)	18 899 (13%)
Unknown	83 (6%)	7305 (5%)	7388 (5%)

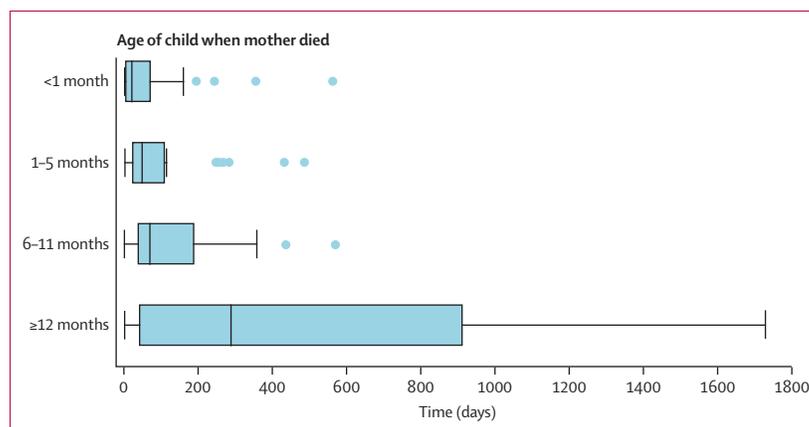*Table 1:* Sociodemographic characteristics of children in the cohort

Figure 1: Time between death of mother and death of her child
Vertical lines represent the medians, boxes represent the IQRs, and whiskers indicate greater than 1·5-fold the IQR below the first quartile and 1·5-fold the IQR above the third quartile.

	Age of child at end of cohort									
	<1 month		5 months		11 months		59 months		119 months	
	Mother died	Mother survived	Mother died	Mother survived	Mother died	Mother survived	Mother died	Mother survived	Mother died	Mother survived
At birth	0·6077 (37)	0·9538 (6681)	0·3531 (87)	0·9336 (9533)	0·2963 (106)	0·9248 (10732)	0·2427 (147)	0·8957 (14203)	0·2386 (158)	0·8897 (14710)
1 month	..	..	0·5809 (50)	0·9789 (2852)	0·4867 (69)	0·9696 (4051)	0·3993 (110)	0·9391 (7522)	0·3926 (121)	0·9328 (8029)
6 months	..	..	..	..	0·8394 (19)	0·9905 (1199)	0·6874 (60)	0·9594 (4670)	0·6759 (71)	0·9530 (5177)
12 months	..	..	..	..	..	..	0·8189 (41)	0·9686 (3471)	0·8052 (52)	0·9621 (3978)
60 months	..	..	..	..	..	..	..	..	0·9833 (11)	0·9933 (507)

Data are Kaplan-Meier cumulative probabilities (number of child deaths). Age at start of the cohort is shown in the first column.

Table 2: Cumulative probability of survival during first 10 years of life according to age at the start versus end of the cohort and survival of mother
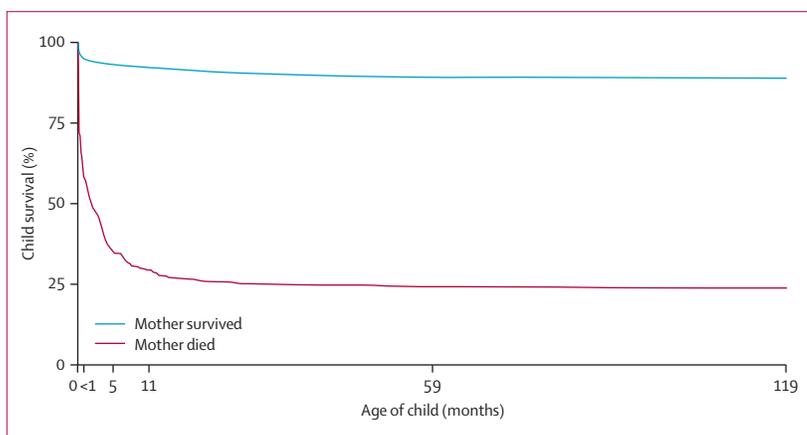
Figure 2: Kaplan-Meier survival curve from birth according to survival status of mother
Numbers at risk for months 0, <1, 5, 11, 59, and 119 were 144 861, 137 156, 128 994, 122 736, 87 427, and 60 381, respectively.

75th percentiles), and any data which were more than 1·5 times the IQR below the first quartile or 1·5 times the IQR above the third quartile were classified as outliers.

Kaplan-Meier survival analysis was used to calculate cumulative survival probabilities during the neonatal period (<1 month), 1–5 months, 6–11 months, 12–59 months, and 60–119 months of life. The log-rank test was used to assess for the difference in survival functions between children whose mothers were alive and those whose mothers had died. Causes of death were analysed from 1987 onwards (because the system became more rigorous from that time), and distributions were compared by use of Fisher's exact test. We also used Poisson regression to compare age-specific death rates in children whose mothers were alive and those whose mothers had died, adjusting for clustering of births in one mother (with robust SEs). In the Poisson regression, children whose mothers died before the child's tenth birthday contributed person time to the exposed group (ie, person time during which the mother had died) and to the unexposed group (ie, person time during which the mother was alive). Children whose mothers remained alive throughout the follow-up only contributed person time to the unexposed group. Crude and adjusted rate ratios (adjusted for year of birth, geographical area, sex of child, gravida, maternal age, maternal education, and husband's socioeconomic quintile) with their 95% CIs were computed. We tested for interaction between the mother's death and the child's age group and sex using the Wald test. We repeated the procedures for the analysis of the effect of the father's death on child survival.

Role of the funding source

The sponsors of the study had no role in study design, data gathering, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all data and had final responsibility for the decision to submit for publication.

Results

Table 1 shows the sociodemographic characteristics of the children. Between June, 1982, and December, 2005, there were 144 861 livebirths, and 14 868 (10%) deaths in children younger than 10 years. Mothers of 1385 (1%) children died during the first 10 years of their child's life; 150 (11%) of these women died within 42 days of the birth of their child. The median age of the mothers at the time of death was 29 years (range 19–44). Information about the father was missing for 14 854 (10%) births, largely because the father did not live in the surveillance area. These fathers were wealthier than those residing in the area (eg, 4232 [28%] of 14 854 children with fathers for whom information was missing belonged to the wealthiest quintile compared with 25 729 [20%] of 130 007 residing in the area; p<0·0001). Births for which the information about the fathers was missing were excluded from the analysis of the effect of the father's death on child survival. Fathers of 2691 (2%) children died during the first 10 years of their child's life. The median age of these fathers was 41 years (23–72) at the time of death. A dummy variable was added for children with missing information about maternal education (7388 [5%] of 144 861) and household assets (9775 [7%] of 144 861) so that they could be included in the analysis.

Many very young children died soon after the death of their mothers (figure 1)—eg, neonates (n=37) died a median of 20 days (IQR 3–69) after their mother's death.

	Age of child at end of cohort									
	<1 month		5 months		11 months		59 months		119 months	
	Father died	Father survived	Father died	Father survived	Father died	Father survived	Father died	Father survived	Father died	Father survived
At birth	1·0000 (0)	0·9527 (6134)	0·9729 (2)	0·9318 (8799)	0·9577 (5)	0·9225 (9933)	0·9048 (33)	0·8922 (13166)	0·8935 (50)	0·8862 (13615)
1 month	..	..	0·9729 (2)	0·9780 (2665)	0·9577 (5)	0·9682 (3799)	0·9048 (33)	0·9365 (7032)	0·8935 (50)	0·9301 (7481)
6 months	..	..	..	..	0·9843 (3)	0·9900 (1134)	0·9300 (31)	0·9576 (4367)	0·9184 (48)	0·9511 (4816)
12 months	..	..	..	..	..	..	0·9448 (28)	0·9672 (3233)	0·9330 (45)	0·9607 (3682)
60 months	..	..	..	..	..	..	..	..	0·9875 (17)	0·9932 (449)

Data are Kaplan-Meier cumulative probabilities (number of child deaths). Age at start of the cohort is shown in the first column.

Table 3: Cumulative probability of survival in the first 10 years of life according to age at start versus end of the cohort and survival of the father

Children aged 1–5 months (n=50) and 6–11 months (n=19) died within 2·0 months (51 days, 26–112) and 2·5 months (71 days, 41–189), respectively, of their mother's death. By contrast, when the mother died after her child's first birthday (n=52), the time between her death and the death of the child was much longer (287 days, 41–909).

Table 2 and figure 2 show that the effect of the mother's death on the cumulative probability of survival of the child up to age 10 years was substantial. The cumulative probability of survival from birth to 10 years of age was 24% in children whose mothers died before the child's tenth birthday versus 89% in those whose mothers remained alive (log-rank test p<0·0001; figure 2 and table 2). Similarly, in children who survived the neonatal period, cumulative survival up to 10 years of age was 39% if the mother died compared with 93% if the mother survived (log-rank test p<0·0001; table 2). The adverse effects of a mother's death remained substantial after the first 6 months and the first year of a child's life (table 2). In children who survived the first year of life, cumulative probability of survival up to age 10 years was 80% if the mother died compared with 96% if she survived (log-rank test p<0·0001)

The effect of the father's death on the cumulative probability of survival in children up to 10 years of age was small (table 3, and figure 3). None of the children whose fathers died during the first month of their lives died, but the cumulative probability of survival up to 10 years of age in children who survived the neonatal period was lower if the father died than if he survived (log-rank test p<0·0001).

The interaction between the mother's death and the child's age was significant (p<0·0001). Children whose mothers died in the neonatal period were nearly nine times more likely to die than were children whose mothers were alive (table 4). After the first month but before the sixth month of life, the death of the mother increased child mortality by 25 times (table 4). Effects remained significant for children up to age ten years (table 4). Adjustment for confounders did not substantially alter the findings.

Generally, the age-specific death rates were slightly higher in children whose fathers had died than in those
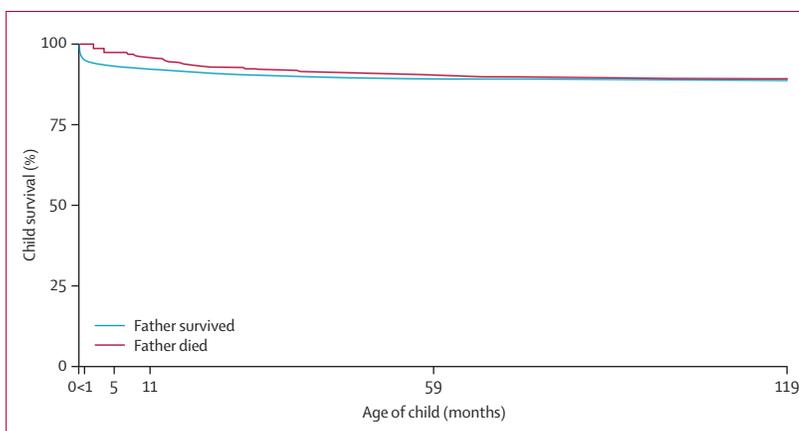
Figure 3: Kaplan-Meier survival curve from birth according to survival status of father
Numbers at risk for months 0, <1, 5, 11, 59, and 119 were 130 007, 122 974, 115 722, 110 025, 77 837, and 53 210, respectively.

whose fathers had survived (table 5), but most 95% CIs included 1. Adjustment for confounders reduced the effect estimates, and none of the adjusted rate ratios were significant.

Table 6 shows that infants whose mothers died were more likely to die from diarrhoeal diseases and nutritional deficiency than were those whose mothers survived (p<0·0001). Malnutrition was much more common in children aged 12–119 months whose mothers had died than in those whose mothers were alive (p<0·0001).

Neonatal mortality rate was lower in girls than in boys (rate ratio 0·86, 95% CI 0·82–0·91), but girls had higher rates of postneonatal (1–11 months) and child (12–59 months) mortalities (1·07, 1·01–1·14, and 1·43, 1·34–1·54, respectively). However, table 7 shows that there was no interaction between a mother's death and the sex of the child. Similarly, table 8 shows that there was no interaction between the father's death and the sex of the child.

Discussion

The cumulative probability of survival up to 10 years of age was 24% in children whose mothers died before the child's tenth birthday, compared with 89% for children whose

mothers stayed alive. The death of a father had no effect on the survival of the children. The magnitude of effect of the mother's death on child survival in the rural population of Bangladesh is much greater than that seen in African populations[6–9]—eg, the ratio of infant mortality in children whose mothers died compared with those whose mothers survived did not generally exceed five or six,[2–9] which was much lower than the differences noted in our study.

The increased risk of death in neonates and infants after the death of the mothers is largely attributable to the interruption of breastfeeding, which is a major determinant of infant survival.[18] In rural Bangladesh, breastfeeding is generally prolonged,[19] and 92% of infants in Matlab were still breastfed at 12 months of age.[20] When the mother dies before the child's first birthday, breastfeeding is abruptly stopped. Wet nursing is not

	Deaths per 100 000 child days (number of child deaths)		Crude rate ratio (95% CI)*	Adjusted rate ratio (95% CI)*†
	Mother died	Mother survived		
0	1504·1 (37)	171·5 (6681)	8·77 (6·22–12·38)	8·35 (5·73–12·18)
1–5 months	350·6 (50)	14·0 (2852)	25·05 (18·57–33·81)	27·61 (20·27–37·61)
6–11 months	92·3 (19)	5·2 (1199)	17·80 (11·09–28·59)	18·74 (11·70–30·01)
12–23 months	34·9 (21)	4·3 (1845)	8·04 (5·20–12·43)	8·20 (5·34–12·61)
24–35 months	7·0 (7)	2·3 (898)	3·02 (1·43–6·38)	2·85 (1·35–6·02)
36–47 months	3·6 (5)	1·3 (458)	2·79 (1·16–6·71)	2·53 (1·05–6·13)
48–59 months	4·5 (8)	0·8 (270)	5·43 (2·69–10·97)	5·09 (2·52–10·28)
60–119 months	0·9 (11)	0·4 (507)	2·22 (1·16–4·25)	2·13 (1·11–4·07)

*Adjusted for clustering of births in one mother. †Adjusted for year of birth, geographical area, sex of child, gravida, maternal age, maternal education, and husband's socioeconomic quintile.

Table 4: Age-specific death rates in children according to survival status of the mother

	Deaths per 100 000 child days (number of child deaths)		Crude rate ratio (95% CI)*	Adjusted rate ratio (95% CI)*†
	Father died	Father survived		
0	0 (0)	175·54 (6134)	..	..
1–5 months	16·6 (2)	14·6 (2665)	1·14 (0·28–4·54)	0·52 (0·07–3·69)
6–11 months	8·7 (3)	5·5 (1134)	1·60 (0·51–4·95)	1·40 (0·45–4·37)
12–23 months	8·7 (11)	4·5 (1719)	1·92 (1·06–3·48)	1·62 (0·89–2·94)
24–35 months	2·0 (4)	2·4 (846)	0·82 (0·31–2·20)	0·66 (0·25–1·77)
36–47 months	2·9 (8)	1·3 (421)	2·19 (1·09–4·41)	1·75 (0·86–3·54)
48–59 months	1·4 (5)	0·8 (247)	1·71 (0·71–4·13)	1·44 (0·59–3·49)
60–119 months	0·6 (17)	0·4 (449)	1·58 (0·97–2·57)	1·51 (0·92–2·47)

*Adjusted for clustering of births in one father. †Adjusted for year of birth, geographical area, sex of child, gravida, maternal age, maternal education, and husband's socioeconomic quintile.

Table 5: Age-specific death rates in children according to survival status of the father

	Age group								
	0–11 months			12–119 months			0–119 months		
	Mother died (n=73)	Mother survived (n=7357)	p value	Mother died (n=31)	Mother survived (n=2240)	p value	Mother died (n=104)	Mother survived (n=9597)	p value
Disorders arising in perinatal period*	12 (16%)	2972 (40%)	<0·0001	0	9 (<1%)	1·000	12 (12%)	2981 (31%)	<0·0001
Diarrhoeal diseases	19 (26%)	480 (7%)	<0·0001	2 (6%)	215 (10%)	0·763	21 (20%)	695 (7%)	<0·0001
Respiratory infections	18 (25%)	1611 (22%)	0·570	3 (10%)	247 (11%)	1·000	21 (20%)	1858 (19%)	0·804
Other infectious diseases	2 (3%)	430 (6%)	0·444	2 (6%)	168 (8%)	1·000	4 (4%)	598 (6%)	0·414
Nutritional deficiencies	12 (16%)	525 (7%)	0·006	14 (45%)	436 (19%)	1·000	26 (25%)	961 (10%)	<0·0001
Injuries	0	97 (1%)	1·000	4 (13%)	819 (37%)	0·001	4 (4%)	916 (10%)	0·044
Other causes	0	116 (2%)	0·631	1 (3%)	154 (7%)	0·719	1 (1%)	270 (3%)	0·373
Unknown	10 (14%)	1126 (15%)	0·870	5 (16%)	192 (9%)	0·184	15 (14%)	1318 (14%)	0·776

Data are number (%). *Includes premature, small for date, birth trauma, and birth asphyxia.

Table 6: Causes of death in children according to age group and survival status of the mother during 1987–2005

	Deaths per 100 000 child days (number of child deaths)		Crude rate ratio (95% CI)*	p value for interaction
	Mother died	Mother survived		
<1 month				0·598
Male	1479·0 (18)	183·8 (3625)	8·04 (4·97–13·00)	..
Female	1531·0 (19)	158·9 (3056)	9·63 (5·96–15·58)	..
1–11 months				0·920
Male	194·1 (35)	9·0 (1983)	21·58 (14·66–31·78)	..
Female	202·2 (34)	9·6 (2068)	20·99 (14·24–30·94)	..
12–59 months				0·718
Male	7·5 (19)	1·9 (1455)	3·95 (2·46–6·34)	..
Female	9·7 (22)	2·7 (2016)	3·53 (2·30–5·41)	..
60–119 months				0·466
Male	1·0 (7)	0·4 (266)	2·64 (1·24–5·61)	..
Female	0·6 (4)	0·4 (241)	1·74 (0·65–4·66)	..

*Adjusted for clustering of births in one mother.

Table 7: Age-specific death rates in children according to sex of child and survival status of the mother

commonly practised, and the available complementary feeding options are insufficient to ensure adequate growth and survival.[20] The inadequacy of alternative feeding options when breastfeeding is stopped also accounts for the short time between the death of a mother and her infant.

The effect of the mother's death on child survival is greatest in the first 6 months of life, but detrimental effects persist thereafter. Deaths of children in rural Bangladesh are mostly due to respiratory infections, diarrhoeal diseases, malnutrition, and injuries.[21,22] Adequate feeding, early recognition of illness, and timely care seeking are essential for the prevention of such causes. Nearly half of all deaths in children whose mothers had died were associated with malnutrition, suggesting that the mother's main role as a source of nutrition was not compensated for. Unlike rural African women,[8] rural Bangladeshi women do not work outside the home to farm the fields, and their duties at home allow them to continue to be the child's main carer for a long time after the period of weaning. Data from Africa suggest that the presence of other women in the household—such as older sisters or the maternal grandmother—is important when mothers are doing subsistence or domestic work.[8] The death of adults other than the parents did not affect child survival in a previous study in Matlab,[13] suggesting that raising the child is the sole responsibility of the mother. Little is known about how care is organised when children are orphaned. Bangladeshi men tend to remarry soon after the death of their wives, but how this affects the child's care is not known. There is a Bengali saying that when a child's mother dies the father becomes the father-in-law of the child's brother or sister—ie, when the mother dies the father behaves like someone else's father and becomes a distant relative. This proverb aptly sums up the neglect of a motherless child.

An unexpected finding was that the father's death did not have an effect on child survival; however, evidence from other parts of the world suggests that the presence of fathers benefits children and mothers.[1,23] The father's death had no effect on child survival in rural Gambia.[8] Fathers in rural Bangladesh do not actively take part in the care of their children, but they are thought to be important because of the economic support they provide.[24] This economic provision might be more than the mere supply of funds, and might be related to the father's status and connections to the community.[1] Households in rural Bangladesh are made up of married brothers and their parents, wives, and children, and financial support from the extended family might compensate for the loss of the father. Widows also remarry, and young children accompany their mother to her new husband's house, ensuring a social safety net.

	Deaths per 100 000 child days (number of child deaths)		Crude rate ratio (95% CI)*	p value for interaction
	Father died	Father survived		
<1 month				..
Male	0 (0)	187·8 (3321)	..	..
Female	0 (0)	162·9 (2813)	..	..
1–11 months				0·647
Male	8·3 (2)	9·4 (1863)	0·88 (0·22–3·51)	..
Female	13·4 (3)	10·0 (1936)	1·33 (0·43–4·10)	..
12–59 months				0·759
Male	2·3 (11)	2·0 (1347)	1·14 (0·60–2·16)	..
Female	3·7 (17)	2·9 (1886)	1·29 (0·80–2·08)	..
60–119 months				0·328
Male	0·5 (7)	0·4 (237)	1·22 (0·57–2·59)	..
Female	0·7 (10)	0·4 (212)	1·99 (1·06–3·76)	..

*Adjusted for clustering of births in one father.

Table 8: Age-specific death rates in children according to sex of child and survival status of the father

The effect of a mother's death on child mortality did not vary with the child's sex. The higher mortality rate in girls than in boys during infancy and childhood in rural Bangladesh is well known.[25] Mortality rate in girls has declined at a much faster pace than in boys in Bangladesh,[26] and differences in the mortality rates between girls and boys in Matlab and elsewhere in Bangladesh have now disappeared.[27] The greater effect of the death of mothers on girls than on boys in previous studies in Matlab indicate the discrimination against girls at that time.[13] Educational achievements in girls have increased greatly,[28] though the preference for boys has not necessarily changed.[29]

The data and analytical approach used in this study merit careful scrutiny. First, the longitudinal nature of the data allows for a careful follow-up of all births and deaths in the population. Births outside of marriage are uncommon in Bangladesh, and both the father and mother are generally known. The survival status was not known for 10% of fathers, either because the father had left the household before the child was born or because he did not live in the surveillance area. The missing fathers were from wealthier households, but their exclusion is unlikely to have altered the findings in any important way. Second, the factors that increase mortality in the parents might also increase mortality in their children, calling into question the causality of the association between parental and child deaths. For example, poor households might be more prone to losing a parent or a child than are wealthy households, and the effects might be due to underlying poverty rather than to the direct effect of the death of a parent on child survival. Although we adjusted our analyses for geographical area, mother's education, and the socioeconomic asset score of the family, some residual confounding might have persisted. Third, we took account of the correlation in mortality risks of siblings by adjusting the analysis for clustering of births for one parent. Last, Bangladesh has a low prevalence of HIV/AIDS,[30] and findings might differ from those in populations affected by the HIV/AIDS epidemic.[6,7,9]

In our analysis, we focused on survival, ignoring other dimensions of parenting that might affect the child's cognitive development, school achievement, and emotional wellbeing.[1] In other parts of the world, the children benefit from the presence of their fathers in terms of school performance, reduced aggressive behaviours in boys, and increased self-esteem in girls.[1] Fathers in rural Bangladesh do not have much direct contact with their young children, and whether they influence the child's emotional or social competence, or their school success, is not known.

Although the death of a mother is a rare event, it does not go unnoticed and the consequences are devastating for the child. Little is known about the rates and causes of mortality in women of reproductive age in Bangladesh, most of whom are mothers. In Matlab, infectious diseases were identified as the main cause of death in women of reproductive age, and most women did not seek professional care before death.[31] Much more work is needed to understand what happens to a young mother when she is ill, and to the child when the mother is ill or dies. Formative research is needed to understand the behavioural factors that increase the mother and child's risks of dying, and to describe the family and community's responses to illness or the death of a mother. Research so far has successfully informed interventions to prevent drowning of children of Bangladesh.[32] An in-depth investigation of the perceptions and practices of families and communities will guide the design of locally acceptable and feasible interventions to support families in coping with the loss of a young mother.

The death of a mother not only affects the survival of her child in the immediate maternal period, as embodied in the Millennium Development Goal 5, but also throughout the life cycle of the child and into the next generation. The future for children will not be safe without sustained investments to ensure that a mother is healthy throughout the life of her child.

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