Child Mortality and Fertility Regulation Behaviour in Bangladesh:

Implications for Family Planning Programmes

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ABSTRACT

The impact of child mortality on the dynamics of contraceptive use was examined using the longitudinal data from Matlab, Bangladesh collected during 1982-1987. A strong and negative impact of child death on subsequent contraceptive acceptance was observed regardless of the number of surviving children. A child death negatively affected subsequent contraceptive continuation among the parents with four or fewer surviving children but not among the parents with more than four surviving children indicating that parents wanted to replace a dead child by postponing contraceptive use. The study concludes that contraceptives may be acceptable for both limiting and spacing purposes even if a child dies in a relatively large family, and contraceptives may be acceptable for spacing after a child dies in a small family. The family planning programmes can substantially reduce fertility and also maternal and child health risks by counselling, motivating, and supplying contraceptives to those parents whose young child had died. Mothers are exposed to a high risk of conception immediately following a child death due to the abrupt truncation of breast feeding and, thus, deserve special attention from family planning workers for counselling and supply of contraceptives.

INTRODUCTION

A high level of childhood mortality almost certainly keeps fertility at a high level through both biological and behavioural mechanisms. Although the biological effect of child mortality on fertility (whereby the infertile period following a birth is shorter because of truncated breast feeding after the death of the child) is quite well established, the behavioural positive effect has not been clearly shown in developing countries. This paper, therefore, examines the patterns of contraceptive acceptance and discontinuation, as measures of fertility regulation behaviour, associated with child death in Matlab, a rural area of Bangladesh.

We conducted this research in the so-called "treatment" area of Matlab, which has remained socioeconomically poor and has relatively high mortality. Contraceptive prevalence there has, however, risen to over 60 per cent due to various public health interventions (1). We used very high-quality longitudinal data on reproductive behaviour and childhood mortality gathered over a five-year period between 1982 and 1987. The data set provides a unique opportunity to systematically assess the need for contraception among the parents who experience child deaths as well as excess fertility. The findings will help the national family planning programmes develop strategies to reduce excess fertility and improve child and maternal reproductive health.

THEORETICAL FRAMEWORK

The impact of child mortality on contraceptive use dynamics is an important area of research which has been of longstanding interest to demographers. The 1970s witnessed a large number of studies on the effect of mortality on fertility (2-4). Most of the studies attempted to measure both biological and behavioural effects of child mortality on fertility. The biological effect occurs when an early child death exposes a mother to a high risk of subsequent conception due to abrupt truncation of breast feeding. Due to this effect, in a population where voluntary control of fertility is absent, child mortality results in excess fertility (5). With regard to the behavioural effect, contraceptive use is the key proximate determinant which is likely to be negatively affected by child mortality and keep fertility at a high level.

In developing hypotheses, demographers have identified a so-called "replacement effect" and an "insurance effect" to explain the behavioural effect of child mortality on fertility. The "replacement effect" hypothesis proposes that fertility control would be low among parents whose child dies, simply because they would continue child bearing (and, thus, would not use contraception) to replace the dead child. Fig.1 (left panel) displays a hypothetical scenario to show a pure replacement effect.

The upper curve of the left panel represents a typical parity-fertility-control relationship; contraceptive use increases with the number of surviving children and plateaus when the number of children is large. The lower curve (index child died) follows a similar progression but maintains a constant distance. Contraceptive use for parents with X surviving children, whose last child died, equals that of (X-1) surviving children of the group whose index child survived. Death of the last child with X children will leave parents with X-1 surviving children. Therefore, these parents will follow the pattern of contraceptive use of those parents whose child survived with X-1 surviving children.

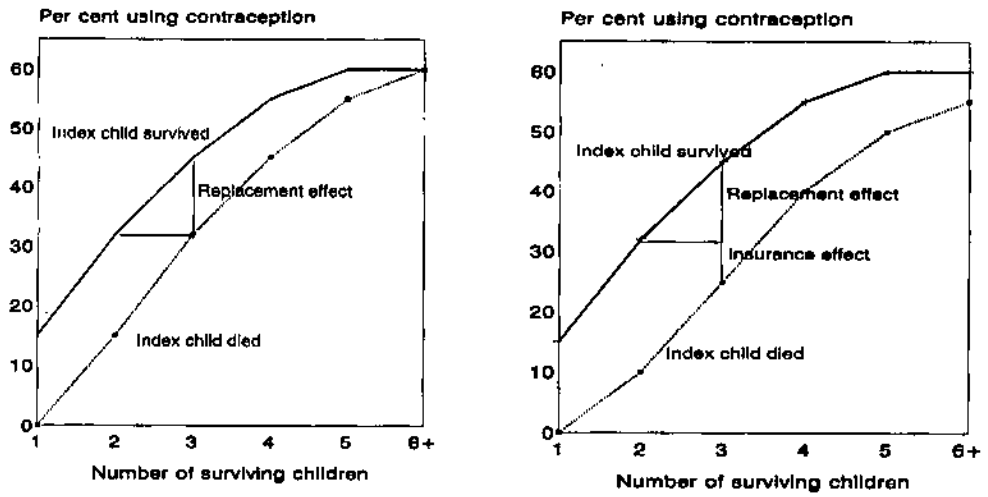

Fig. 1. Child survival and contraceptive use: hypothetical pattern

The right panel of Fig. 1 is similar to that of the left panel except that there is a larger gap between the two curves. The larger gap represents both replacement and insurance effects. The insurance hypothesis proposes that, in an environment of high infant and child mortality, parents attempt to have more births than the number of surviving children they want to have to compensate for the likelihood that some of their children will die. In this case, contraceptive use for parents whose last child has died with X surviving children is much lower than for the parents whose last child has survived with (X-1) surviving children due to both replacement and insurance effects.

A few studies undertaken in Bangladesh observed no or negligible behavioural effect of child mortality on fertility. For example, two studies did not find any significant effects of mortality of a previous child on the duration of the subsequent birth interval (5-6). One probable reason may be that contraceptive use was very low (5 per cent or below) during the period of study in the late 1960s and early 1970s. A recent descriptive study in the

Matlab treatment area, when contraceptive prevalence was between 20 and 35 per cent during 1977-1979, found no significant impact on acceptance but significant impact on discontinuation of contraception (7). This study did not adjust for the effects of: (i) the death of the index child, and (ii) conception that had taken place while waiting to accept contraception during the follow-up period, and therefore, had biases in the results.

TESTING OF HYPOTHESES

We examined the impact of child mortality on contraceptive use by testing these hypotheses which will help assess which of those parents whose child dies are more likely to use contraception. To do this, we need another piece of information -- desired family size, the desired number of surviving children. This is mainly because parents would like to replace a dead child only if the death leaves parents with a number of surviving children that is lower than the desired number of surviving children. In other words, if the number of surviving children after the death of the last child is still equal to or higher than the desired number of surviving children, parents would not try replacing the dead child. We do not, however, have information on the desired family size at the individual level in our data set.

In the Matlab treatment area, the desired family size was 4.4 in 1975, and 3.1 in 1990 (1). We will assume that surviving children of order five or more represent an "excess" of children beyond what is desired by parents. Research on demand for contraceptives indicates that a substantial proportion of parents in Bangladesh experience excess fertility due to poor or lack of access to appropriate contraceptive supplies.

We can test our hypotheses among the group of parents who have five or more surviving children. If only the replacement effect exists in the population, we expect to find no differences in contraceptive use between the parents whose last child died and those parents whose last child survived in large families (five or more). If the former still have lower use than the latter, this may be an indication of the insurance effect.

We also have a variable, "number of previous child deaths" (Table 1), which may help in testing the insurance hypothesis. This variable is likely to capture some effect of insurance strategy of fertility behaviour. If a mother has already experienced a child death, she may perceive that more of her children may die and, thus, she should have a number of children that

is larger than her desired number of surviving children. This is because she might perceive that after the death of some children she would be left, at least, with the desired number of children. We expect that contraceptive acceptance will be negatively associated with the number of previous child deaths, and contraceptive discontinuation will be positively associated with the number of previous child deaths.

Table 1. Averages of the explanatory variables by contraceptive acceptance and discontinuation

Explanatory variable	Non-acceptors	Acceptors		
		All	Continuers*	Discontinuers
Index child died	0.22	0.07	0.04	0.08
Number of children ever born	3.43	3.64	4.71	3.18
Number of previous child deaths	0.86	0.53	0.48	0.76
No surviving son	0.31	0.17	0.05	0.23
No surviving daughter	0.29	0.22	0.13	0.27
Number of surviving sons	1.26	1.62	2.21	1.37
Maternal age	25.6	25.8	28.8	25.5
Maternal education (years of schooling)	1.36	1.90	2.02	1.93
Household head's education (years of schooling)	2.32	2.86	3.25	2.80
Hindu	0.17	0.19	0.21	0.17
Number of observations	1,531	1,616	335	1,180

* through the end of a five-year period.

The analysis was carried out separately for the two groups -- families with four or fewer and families with five or more children. According to the replacement hypothesis, death of the index child will have negative impact on contraceptive acceptance or continuation among the parents with four or fewer children. The index child death will not affect the contraceptive behaviour of parents who have five or more surviving children. According to the insurance hypothesis, contraceptive acceptance and continuation will be negatively related to the number of previous child deaths regardless of the number of surviving children.

POPULATION, DATA, AND METHODS

Area

Matlab is a rural, riverain subdistrict located about 35 miles south of Dhaka, the capital of Bangladesh. The area is isolated and largely inaccessible except by river transportation. Subsistence rice agriculture and fishing dominate the economy. Literacy is still low, particularly among women, and social institutions are predominantly traditional despite a steadily increasing modernizing influence of access to radios and personal commercial contact with urban areas.

The Matlab treatment area has received a series of carefully designed and closely supervised health and family planning interventions (8-11). Briefly, family planning services have been provided on an intensive basis since 1977 through house-to-house delivery of contraceptives and information by the trained village women, known as Community Health Workers (CHW). The service programme has been given credit for a marked increase in the use of contraception and correspondingly pronounced decline in fertility (11). The contraceptive prevalence rate rose from about 5 per cent in 1977 to about 45 per cent in 1985, and has since increased further to around 65 per cent in 1995. The total fertility rate (TFR) has declined from 6.8 children per woman in the late 1970s to 2.9 in 1993. In the neighbouring comparison area, where family planning services are provided by the government programme, the contraceptive prevalence rate was 16 per cent in 1984 and 27 per cent in 1990 (1,12). TFR in the comparison area was 3.8 in 1993.

Infant and child mortality has declined over the last decade in Matlab (Appendix A), but it is still high in the comparison area and moderate in the treatment area. Neonatal mortality remained high; 43 and 65 per 1,000, respectively, in the treatment and comparison areas. The Bangladesh Demographic and Health Survey in 1993-1994 documents that, in the rural

areas of the country, probabilities of dying by one month, one year, and five years, were 65, 103, and 153 per 1,000 respectively (13). These estimates reflect an average mortality level during 10 years prior to the survey.

Data

Information on the vital events was taken from the "Demographic Surveillance System" (DSS) which has been registering births, deaths, and migrations since 1966 and marital events since 1974 in Matlab. Information on the dynamics of contraceptive use was taken from the "Record Keeping System" (RKS), a service statistics system which has been maintaining reproductive histories of the married women aged 15-49 years since late 1977. The dates of contraceptive acceptance, discontinuation, and method switching are available from RKS in the treatment area only. This information was linked to the DSS data on births, deaths, and migrations. Data on socioeconomic conditions, household environment, and other background characteristics are compiled in cross-sectional, house-to-house censuses in the DSS area. The last such census for which data were available at the time of this study was undertaken in mid-1982. Each individual in the DSS area has a unique and permanent identification number, permitting cross-referencing and linking of information over time.

For this study, the data were linked to provide a cohort of 3,435 women who had singleton live-births (hereafter referred to as the index births or children) in the Matlab treatment area during the 1982 calendar year. A longitudinal record was created for each mother to include the RKS and DSS information for five years after the index birth. Background information on maternal education, household socioeconomic status, and preceding births and child deaths to the mother in the five years before the index birth was included in the data.

Of the 3,435 mothers who had singleton live-births in 1982 in the treatment area, 3,305 had information on contraceptive use. Of those, 3,158

were matched with requisite demographic and household data. Further consistency and linkage checks identified 11 records without requisite data on background socioeconomic characteristics, leaving a sample of 3,147 treatment area women in the study sample. Therefore, about 8 per cent of the women with births in 1982 were excluded from the study because of missing data. Although selection bias could conceivably arise from sample loss, this is unlikely: The characteristics of the unmatched individuals were not significantly different from those individuals who were included in the analysis with regard to birth spacing and childhood mortality (tabulation not shown).

ANALYSIS

Dependent Variables

Two components of the dynamics of contraceptive use were used as the dependent variables in the analysis: (i) contraceptive acceptance as measured by the waiting time to accept after the index birth, and (ii) contraceptive discontinuation by the duration of use. Use of any type of contraceptive methods -- whether modern or traditional -- was considered as the event of acceptance. Among the episodes of contraceptive use, more than 41 per cent were of injectables, about 30 per cent were of IUDs, 12 per cent were of oral pills, 6 per cent were of tubectomies, 0.1 per cent were of vasectomies, 4 per cent were of condoms, and 7 per cent of other traditional methods.

Contraceptive acceptance and discontinuation were defined according to the conventional definitions accepted internationally in demographic research. Acceptance refers to the timing of the first episode of contraceptive practice in the post-delivery period. The definition of continuation complies with the standard definition widely used in studying the "all-method continuation rate" of contraceptive use (14). If an acceptor discontinued and then reaccepted contraception after a gap in use, the second episode of use was not considered in the duration of contraceptive use. If method switching without discontinuation occurred, the total duration of use of all methods was considered.

Discontinuation refers to the termination of the use of a method, whether it was voluntary or due to contraceptive failure. We can not distinguish between purposeful discontinuation and method failure. Pills, condoms, and traditional methods, which comprise 23 per cent of the methods used, are prone to use-failure. Bairagi and Rahman (15) found in the Matlab treatment area, during the early 1980s, that the 12-month use-failure of these methods is quite high (about 15 per cent). If a conception

occurred during the use of a method, the case was treated as a discontinuation. The date of discontinuation was estimated by subtracting one month from the date of conception. Contraceptive failure may be associated with certain behavioural characteristics: For example, a pill or condom user whose child died may be less careful in using the method to avoid subsequent pregnancy than a user whose last child survived. The probability of contraceptive failure is expected to be higher for the former than for the latter. Our inability to distinguish the failure cases from the discontinuers is not likely to bias the result since the relationships between discontinuation and contraceptive failure and the death of the index child are expected to be in the same direction.

The event histories used here were censored by out-migration of the woman and by conception before the acceptance of contraception. The date of conception is estimated by subtracting 9 months from the date of birth of the subsequent birth. We concentrated only on intervals between live-births, and disregarded conceptions leading to non-live-births. A record was censored after the subsequent birth, and therefore, any births or use of contraception after the first subsequent birth in the five-year follow-up period were not considered in this analysis.

Bivariate Analysis

Proportions accepting and discontinuing contraception were compared with the parents whose index child survived and those parents whose index child died. Migrants were excluded from such calculations, but contraceptive use was almost equal for the non-migrants and out-migrants (Table 2). The maximum likelihood estimates of the waiting time to accept contraception, birth-to-conception interval, and duration of use were calculated, using the Kaplan-Meier method (16-17). The time unit in calculating the Kaplan-Meier estimates was the completed month after the birth of the index child in case of acceptance and the completed month after acceptance in case of discontinuation. The censored cases were kept in the analysis until just before the month of the censoring event.

Multivariate Analysis

A number of variables shown in Table 1 are correlated with both child mortality and contraceptive use. A multivariate analysis is necessary, because the bivariate relationship between child mortality and contraceptive use is highly likely to be confounded by the demographic and socioeconomic variables shown in Table 1. We conducted the analysis in hazards models where these variables were included. A generalized hazards model was used for analyzing the acceptance data, because maternal age was found to have a non-proportional (i.e. time-dependent) effect on contraceptive acceptance. The effects of all the explanatory variables on contraceptive discontinuation were found to be proportional, and, therefore, Cox's (18) proportional hazards model was used for studying contraceptive discontinuation. A discrete time hazards model was used for estimating the hazards regression coefficients in the acceptance analysis (19). A three-monthly interval was used for acceptance to simplify computing.

Variable Specifications

The survival status of the index child was entered in the hazards model as a time-varying covariate. At each monthly time interval, the variable "index child died" took the value of 0 if the index child was still alive and the value of 1 if he or she had died before contraceptive acceptance. In the discontinuation analysis, a similar coding scheme was applied for the "index child died" variable, but the reference period began with the time of acceptance.

For the variable "number of previous child deaths," all child deaths prior to the birth of the index child were included in the mother's acceptance analysis. In the contraceptive discontinuation analysis, all child deaths prior to contraceptive acceptance were considered. There may be death(s) of the elder siblings of the index child during the study period. We did not have a record of such deaths. Since the median previous birth interval was

greater than four years, most elder siblings who had survived till the birth of the index child, had passed the highest mortality risk by the time the index child was born, it is highly likely that this variable captures the real number of previous child deaths.

To control for the effect of gender preference on contraceptive use, three variables were included: (i) a dummy variable "no surviving son", which took the value of 1 if the parents did not have a surviving son and the value of 0 otherwise, (ii) the number of surviving sons, and (iii) a dummy variable "no surviving daughter," which took the value of 1 if there was no surviving daughter in the family, and the value of 0 otherwise.

Maternal and household head's education, and household space, a proxy for income, were included as the socioeconomic variables. The variable "Hindu," which captures religious affiliation, was coded as 1 for Hindus and 0 for Muslims.

Descriptive statistics for the explanatory variables are shown separately for the contraceptive acceptors and non-acceptors in Table 1. The proportion of couples with index child dying was lower among the acceptors than among the non-acceptors. The average of the number of previous child deaths was also lower among the acceptors than among the non-acceptors. These differences suggest that contraceptive use in this population is influenced by child deaths. However, various subgroups, in terms of contraceptive acceptance and discontinuation, also differ with respect to demographic and socioeconomic characteristics. Therefore, we need to control for the effects of these variables in a multivariate analysis.

BIVARIATE RESULTS

Contraceptive Acceptance

Table 2 shows the distribution of parents by the survival status of their index child and status of contraceptive acceptance in a five-year follow-up period between 1982 and 1987 in the Matlab treatment area. Of the 3,147 sample mothers, about 16 per cent (n=485) lost their index children due to death within five years of birth. This implies a probability of death of 159 per 1,000 by age five (Table 3). Overall, 1,616 parents (51.4 per cent) accepted contraceptives within five years after the birth of the index child and before the birth of the subsequent child (if any). Among the parents whose index child died, 57 accepted contraceptives after the death of the index child, 85 children died after contraceptive acceptance, and 343 parents did not accept any contraception. The number of acceptors whose contraceptive decision was likely to be influenced by child death was 57, and therefore, the contraceptive acceptance rate among the parents whose index child died was {57/(485-85)} or 14.2 per cent. In contrast, the contraceptive acceptance rate among parents whose child survived was {(85+1,334)/(85+1,334+1,048)} or 57.5 per cent. Contraceptive acceptance by the parents whose index child died was only one quarter (14.2/57.5) than that of those whose index child survived.

The parents whose index child died not only had a lower level of contraceptive acceptance than the parents whose index child survived, but they also tended to accept the short-term and temporary contraceptive methods. Table 4 shows that, of the 57 parents who accepted contraceptives after the death of the index child, none accepted a permanent method. In contrast, of those parents who accepted before the child died, nine per cent adopted the permanent methods. Similarly, the proportion of IUD acceptors was almost half as great among the group whose index child died compared

to those mothers whose index child survived. Proportions of injection and pill use were almost 1.5 to 2.0 times greater among the mothers whose index child died than among the mothers whose index child survived.

Table 2. Distribution of parents by the survival status of the index child and contraceptive acceptance during the five-year period of observation

Survival status of the index child and contraceptive acceptance	No. of patients (n=3,147)
Parents whose index child died	**485**
Child died before acceptance	57
Child died after acceptance	85
Child died and mother did not accept contraception	343
Parents whose index child survived	**2,382**
Child survived and mother accepted contraception	1,334
Child survived and mother did not accept contraception	1,048
Mothers who migrated out of the study	**280**
Mother migrated out after contraceptive acceptance	140
Mother migrated out but did not accept contraception before migration	140

Table 3. Distribution and probability of childhood death by age

Age at death (month)	No. of deaths	Cumulative per cent	Cumulative probability of dying
0	162	33	52
1-5	84	50	78
6-11	37	58	90
12-17	45	67	105
18-23	64	80	126
24-35	56	92	145
36-47	29	98	155
48-59	8	100	159

Table 4. Per cent distribution of acceptors by contraceptive methods and survival status of the index child

Survival status	Pill	Injectable	IUD	Permanent methods	Other methods	Total %	Total (n)
Accepted after child's death	23	60	14	0	3	100	(57)
Accepted before child's death	9	34	29	9	19	100	(85)
Child survived for at least 5 years	13	43	28	7	9	100	(1334)

Figure 2 shows contraceptive acceptance by the survival status of the index child and the number of surviving children. Contraceptive acceptance varied from 50 per cent to 60 percent for those parents whose index child survived to 20 per cent or below for those parents whose index child died. Very large differences in contraceptive acceptance between the two groups were observed almost equally for all surviving children indicating that child death negatively and strongly affects contraceptive acceptance. These results, however, do not support our hypothesis regarding the pattern of "replacement effect." According to our hypothesis, the difference of contraceptive use between groups "index child survived" and "index child died" would be nearly equal for couples who already had a larger than desired family size (i.e. five or more surviving children). Also, differences in contraceptive acceptance would be smaller. It seems that parents postpone the decision to adopt any method of contraception when the index child dies irrespective of the number of surviving children they have.

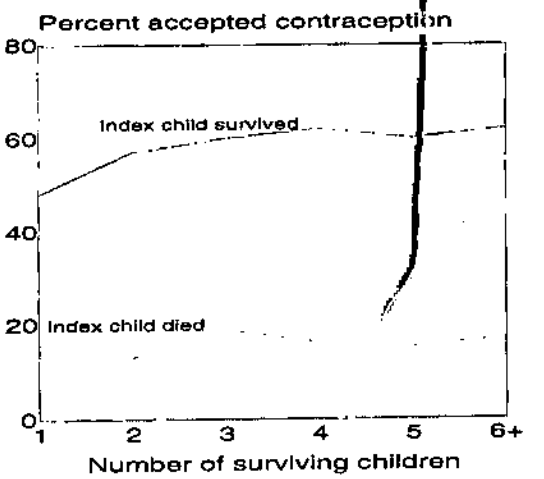

Fig. 2. Contraceptive acceptance by survival status of the index child

These results raise a number of questions related to inconsistencies between the actual behaviour of parents related to contraceptive use, parents' (usually questions are asked of mothers) statement about their desired family size, and changes in the supply of children due to death. One important question may be: Do parents in rural Bangladesh have a definite goal of the number of surviving children?

Contraceptive Discontinuation

A total of 142 (57+85; Table 2) parents were exposed to the risk of discontinuation due to the death of the index child. (We excluded from the discontinuation analysis those couples who have adopted the permanent methods.) Table 5 shows the proportion of parents who had discontinued contraception by the end of the study period or before having a subsequent conception within the five-year period. It should be noted that, in Matlab, the temporary contraceptive methods are often used for spacing rather than limiting of births (12,20). Therefore, it is not unexpected that, as we observe in Table 5, parents will discontinue contraceptive use when the last index child is at certain age, say, five years or over.

Table 5. Distribution of temporary methods that were discontinued at the end of five-year study period by survival status of the index child

Survival status	Number	Discontinue	Per cent
Index child died before acceptance	57	50	88
Index child died after acceptance	77	72	94
Index child survived	1,247	979	79

Chi-square (2 df)=12.4;$p<0.01$

Contraceptive discontinuation was significantly higher ($p<0.01$) among the parents whose index child died than among those parents whose index child survived. Contraceptive discontinuation was lower among the parents whose index child died before acceptance than among those parents whose child died after acceptance. One probable reason is that the parents who accepted a method after the death of the index child already had a number of surviving children which was larger than their desired number of

children even after the death of the index child. In contrast, parents whose index child died after contraceptive acceptance found themselves in changed circumstances and were more likely to want to replace the lost child. Thus, they discontinued contraception. Those parents who accepted contraception after the death of the index child might have done so for limiting rather than spacing and, thus, were highly motivated to continue contraceptive use.

Table 6 shows that the proportion of contraceptive discontinuation was not only lower among the parents whose index child survived compared to those parents whose index child died but also the median duration of use of methods was longer by one year or more.

Table 6. Duration (month) of use of temporary methods by survival status of the index child

Survival status	Number	First quartile	Median	Third quartile
Index child died before acceptance	57	11	20	36
Index child died after acceptance	77	16	21	36
Index child survived	1,247	23	33	52

The percentages of discontinuing contraception by the number of surviving children are compared for the two child survival groups in **Fig. 3**. The results are very interesting and strongly support our hypothesis regarding the replacement effect. Contraceptive discontinuation among the parents with only one surviving child, as expected, was very high for both groups. However, 93 per cent of the parity-one parents whose child survived discontinued, compared to 100 per cent of the parents whose child died. Among the parents whose index child survived, discontinuation rapidly declines with the number of surviving children, and stabilizes at around 60 per cent for those parents who had five or more surviving children. Among the parents whose index child (most recent child) died, discontinuation remained at 100 per cent for up to two surviving children and then steadily declined for three and four surviving children. After this number of surviving children, discontinuation becomes almost equal for the two groups of parents with regard to child survival. This result indicates that if parents have five or more surviving children and one of them dies (the last one, in this case), the parents continue contraceptive use and do not attempt to replace the child who died, because they have achieved their desired family size or more. In contrast, before the achievement of desired size, or if the death of the index child leads to a supply which is lower than demand, mothers discontinue contraceptive use to replace the dead child.

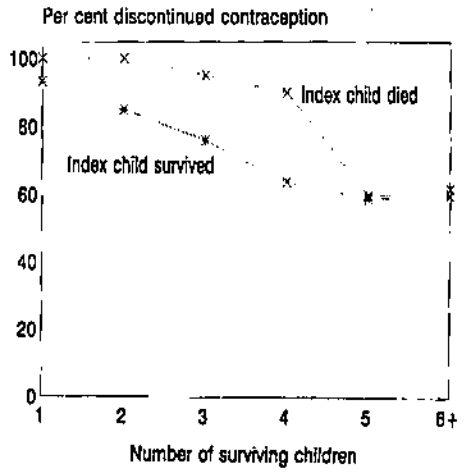

Fig. 3. Contraceptive discontinuation by survival status of the index child

DISCRETE-TIME HAZARDS MODEL RESULTS

Contraceptive Acceptance

The hazards model estimates of the predictors of contraceptive acceptance are shown in Table 7. The variable "index child died" has a very large negative, but highly significant, effect on contraceptive acceptance even after controlling for the effects of other variables. The likelihood that the parents whose index child died will accept contraception was only 0.15 times {relative risk (RR)=exp(-1.93)} that of those parents whose index child survived. Note that we find a stronger effect in the hazards regression analysis than in the bivariate analysis. Contraceptive acceptance was 14.2 and 57.5 per cent among those parents whose index child died and those mothers whose index child survived respectively. RR is 0.25 (14.2÷57.5). To see if the effect of the index child's death on contraceptive acceptance decreased with the number of surviving children, hazards models were estimated for each number of surviving children (results not shown here). We observed that the magnitude of the effect of child death on contraceptive acceptance was similar for all numbers of surviving children. These results confirm that, even after controlling for the effects of other variables, for all number of surviving children contraceptive acceptance was lower for parents whose index child has died than for those parents whose index child has survived. However, the contraceptive acceptance behavior is not consistent with the hypothesized "replacement effect." According to replacement hypothesis, we expected that child death would not reduce contraceptive acceptance among parents who have a large number of children, say five or more.

Table 7. Hazards model estimates of the effects of child death and other variables on contraceptive acceptance

Covariate	Surviving children		
	All (n=3,147)	4 or less (n=2,521)	5 or more (n=626)
Index child died	-1.928***	-1.937***	-1.734***
Children ever born	0.063*	0.204***	0.185
Number of previous child deaths	-0.153***	-0.333***	-0.085
No surviving son in the family	-0.387***	-0.222*	-2.448*
No surviving daughter in the family	-0.324***	-0.180*	-0.227
Number of surviving sons	0.123**	0.116*	0.101*
Maternal age	-0.103**	-0.191***	-0.119
Maternal age squared	0.001+	0.003**	0.001
Maternal age x time	-0.012*	-0.004	-0.031***
Maternal education (years of schooling)	0.061***	0.063***	0.039
Household head's education (years of schooling)	0.003	0.008	-0.004
Log of household space (sq. ft.)	0.048	0.062	-0.056
Hindu	0.207**	0.178*	0.420
Three-monthly postpartum duration	0.151***	0.182***	0.178***
Duration squared	-0.017***	-0.023***	-0.010
Constant	-1.197*	-0.494	-0.223
-2(Log-likelihood)	5,505	4,268	1,206

+p<0.10, *p<0.05, **p<0.01, and ***p<0.001

Contraceptive Discontinuation

Table 8 shows the hazards model estimates separately for parents with four or fewer and those with five or more children. The coefficient for the variable "index child died" is positive, large, and highly significant for parents with four or fewer children. The coefficient indicates that the parents whose index child died had a 2.4-time {RR=exp(0.889)} higher risk of discontinuing contraception than those parents whose index child survived. The coefficient in the large family model (five or more children), though positive, is small and insignificant. Thus for the large families, the risk was only 1.12 times higher {RR=exp(0.113)} and non-significant. These results confirm that the parents' decisions about contraceptive continuation were consistent with the replacement effect hypothesis.

Previous Child Deaths and Contraceptive Use

The hazards models presented in Table 7 and 8 include another child mortality variable -- "number of previous child deaths." This number refers to the time period prior to the birth of the index child. This variable can capture the replacement as well as insurance effects of childhood mortality on contraceptive use. Parents who have had one or more children who die prior to the index birth are particularly likely to adopt the insurance strategy of child bearing. Parents with a moderate to small number of surviving children (four or fewer) who have not yet achieved their desired family size because of child deaths are likely to defer using contraception or else use it for a shorter period, because they need more children to replace the ones who died. Contraceptive use may also be lower among the parents who have experienced child deaths, because they may anticipate more deaths, and, therefore, may attempt to continue child bearing to achieve an excess of births, thus ensuring their desired family size or sex composition. We can not separate out these two effects in the present analysis. However, under the assumption that parents with five or more surviving children have achieved an excess of their desired family size, if the variable "number of previous child deaths" negatively affects contraceptive use, one may hypothesize that parents might have adopted an insurance strategy to compensate for anticipated future child deaths.

Table 8. Hazards model estimates of the effects of child death and other variables on contraceptive discontinuation

Covariate	Surviving children		
	All (n=1,515)	4 or less (n=1,213)	5 or more (n=302)
Index child died	0.653***	0.889***	0.113
Children ever born	0.027	0.010	0.115
Number of previous child deaths	-0.075	-0.064	-0.187*
No surviving son in the family	0.420***	0.417***	1.231
No surviving daughter in the family	0.513***	0.481***	0.173
Number of surviving sons	-0.195***	-0.177*	-0.167*
Maternal age	-0.025*	-0.027*	-0.003
Age of last child at acceptance (in log)	0.228***	0.284***	0.344**
Maternal education:			
primary	-0.194*	-0.159	-0.385
above primary	-0.110	-0.095	-0.204
Household head's education:			
primary	-0.116	-0.109	-0.148
above primary	-0.059	-0.054	0.004
Log of household space	-0.026	-0.008	-0.179+
Hindu	-0.256**	-0.237**	-0.319
Three-monthly postpartum duration	0.083***	0.108***	-0.051
Duration squared	-0.005**	-0.005**	-0.002
Constant	-2.041***	-2.178***	-2.202**
-2(Log-likelihood)	3,674	2,999	660

+p<0.10, *p<0.05, **p<0.01, and ***p<0.001

In the acceptance analysis, the coefficient of the variable "number of previous child deaths" is negative, large, and highly significant for overall and relatively smaller families (four or fewer children). This result can be interpreted as follows. Parents of small families, regardless of the fate of the index child, who have experienced some child deaths in the past wanted to replace them by not accepting or at least deferring the acceptance of contraception.

In families with five or more children, the variable "number of previous child deaths" did not have any impact, probably because parents have achieved a desired family size even with the experience of previous child deaths. One may reject the "insurance hypothesis," because it seems that parents with previous child deaths did not continue child bearing by postponing contraceptive use with an anticipation that some additional children may die which will lead to a deficit in the desired number of surviving children.

The variable "number of previous child deaths" did not have a strong impact on contraceptive discontinuation (Table 8). This is not surprising since those parents who were at risk of discontinuing were current users, some of whom were a selected and motivated group who made a decision to accept contraception despite experience with previous child deaths. Therefore, we would expect this variable to have more effect on acceptance than on discontinuation.

Effects of Other Variables

We find from Table 7 that contraceptive acceptance increased with the number of children ever born. Contraceptive acceptance was high among the parents who had children of both sexes or several sons. It increased with maternal education or it was higher among Muslims than Hindus. Table 8 shows that contraceptive discontinuation also had differentials similar to acceptance.

In two previous studies, we reported the effects of the variables shown in Table 7 and 8 on contraceptive use (21) and on birth spacing (22). The results were discussed in greater detail for some of the variables, and therefore, are not discussed here. It may be noted that some of the statistics may differ slightly from those reported earlier, mostly because of differences in the specifications of either variables, sample groups, or minor correction in the data set at a later stage.

WHY WAS A "REPLACEMENT EFFECT" NOT OBSERVED IN THE ACCEPTANCE MODEL?

We expected, following the replacement hypothesis, that child death would have negative impact on contraceptive acceptance and continuation among the parents who have four or fewer children. In contrast, child death would not reduce contraceptive acceptance and continuation among the parents who have five or more children. We find that child death had negative impact on contraceptive acceptance of all parents regardless of the number of surviving children. However, we find, according to our expectation, that child death had negative impact on contraceptive continuation among the parents with four or fewer children but not among the parents who have five or more children. The apparently inconsistent behaviour of contraceptive adoption associated with the "replacement effect" may perhaps be explained by relating it to the patterns of lactation and postpartum contraceptive use.

Fertility in Bangladesh is substantially lower than it could be because of universal and remarkably prolonged breast feeding in the population. The average duration of breast feeding in Bangladesh is the longest in the world; in Matlab, the median duration of breast feeding and postpartum amenorrhoea were about 30 and 16 months respectively (23). However, a relatively recent study indicates that the duration of postpartum amenorrhoea in Matlab has a declining trend (24). Truncation of breast feeding due to the death of the index child in neonatal, infancy, and early childhood period exposes the mother to a high risk of subsequent pregnancy in the absence of contraceptive use. In Fig. 4 and Table 9, we compare the cumulative probabilities of subsequent conception of two groups of non-acceptors of contraception according to postpartum duration. The two groups are: those non-acceptors whose index child died before subsequent conception or within the five-year follow-up period and those non-acceptors whose index child survived until subsequent conception or within a five-year follow-up period. Conception of women whose index child died occurred much earlier than

those women whose index child survived. For example, one-quarter and one-half of the non-acceptors whose index child died conceived by eight and 14 months respectively. In contrast, the same proportion of non-acceptors whose index child survived conceived by 18 and 25 months respectively. The delay in conception of non-acceptors whose child survived is associated with the anovulatory protection provided by continued breast feeding. In contrast, the non-acceptors whose index child died did not have such protection fairly soon after the child died.

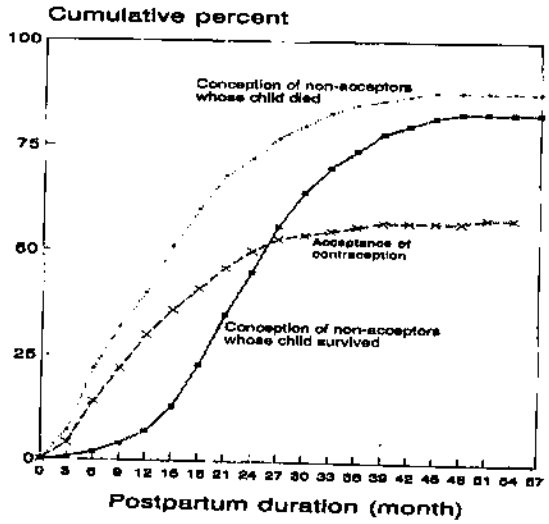

Fig. 4. Cumulative per cent of (i) conception of contraceptive non-acceptors by child survival status and (ii) accepting contraception, by postpartum duration

Table 9. Birth-to-conception interval (month) of those mothers who did not accept contraception by the survival status of the index child and waiting time to contraceptive acceptance after the index birth

Survival status	Number	First quartile	Median	Third quartile
Birth-to-conception interval of non-acceptors whose:				
Index child died	343	8	14	26
Index child survived	883	18	25	36
Birth-to-contraception acceptance interval for those:				
Who accepted contraception	1,616	10	24	a

[a] less than 75 per cent of couples accepted contraception

Fig. 4 and Table 9 also show that the pattern of postpartum waiting time to start using contraceptives matches quite well with that of the conception of mothers who did not accept contraception and whose index child survived. On the average, adoption of contraceptives occurred earlier than conception of those mothers whose index child survived. This timing of adoption of contraception appeared to be optimal timing for adoption with the least wastage of resources because of minimal overlap between postpartum amenorrhoea and contraceptive use for those mothers whose index (last) child survived. But the timing of adoption was not appropriate for those parents whose index child died. The parents whose last child died should have adopted contraception much earlier than those parents whose last child survived, because the former were at the risk of conception immediately after the death of the index child.

CHWs, who provide information to mothers, and counsel about contraceptive use and supply methods at the doorstep, probably use a strategy to recommend a time after birth when a couple should begin using contraception. This time is probably immediately after the start of menstruation or immediately after the cessation of breast feeding, whichever is earlier. This strategy seemed to work very well for the parents whose index child has survived but not for those parents whose index child has died. This is mainly because the mothers whose index child has died conceive, on an average, ten months earlier than the mothers whose index child has survived. Death of the index child exposes the mother to high risk of conception due to abrupt truncation of breast feeding. It seems that the Matlab women or CHWs failed to recognize that the mothers whose child has died are at high risk of conception and should immediately, after the death of the last child, start using contraception if they wish to postpone or avoid another birth.

One plausible reason why the mothers of the large families whose last child died did not accept contraception is due to the "bereavement effect." Parents were not willing to accept contraception until they recovered from the shock of the child's death. By the time the mothers were ready to accept contraception, they often found themselves already pregnant. It is also possible that CHWs were reluctant to approach the bereaved mothers for motivating them for or providing contraceptives immediately after the child death.

Another, though less plausible, reason may be that Matlab women may presume that the long average duration of postpartum amenorrhea in the population applies to all women and may not recognize the linkage between the cessation of breast feeding and the return of fecundity following a death.

IMPLICATIONS FOR FAMILY PLANING PROGRAMMES

This study, which uses longitudinal data to systematically examine the impact of child mortality on contraceptive use, shows the importance of reducing childhood mortality for family planning success in Bangladesh. The results justify the approach of integrating a maternal and child health (MCH) programme with family planning to ensure the success of family planning both in Bangladesh and elsewhere.

We observe that contraceptive acceptance was substantially lower among the parents whose last child died than among the parents whose last child survived. This was true regardless of the number of surviving children. Further, we find that the long-term and permanent methods of contraception were less likely to be used by parents whose last child died. Contraceptive continuation and the duration of use were also lower among the parents whose last child died than among the parents whose last child survived, but only in families with a relatively small number of surviving children ($<=4$). Among the families with five or more surviving children, contraceptive discontinuation was not affected by the death of the last child. This suggests that, in large families, the last child might have been in "excess" of the desired number of children. In such cases, parents did not attempt to replace the child who died.

Infant and child mortality is still high in Bangladesh, and this has a substantially negative impact on contraceptive prevalence. Mothers whose last child died are at higher risk of conceiving (sooner) due to truncation of breast feeding and earlier return of menstruation.

The discontinuation results indicate that many parents continue to use contraceptives especially if they are likely to have more than their desired number of children, even if the last child died. But the same is not true with regard to accepting contraception. Our findings do not support the hypothesis that child mortality should have no adverse effect on

contraceptive acceptance among the parents whose last child died but who still have more than the mean desired family size. This information should guide the family planning workers in targeting these couples for special family planning information, motivation, and supply of contraceptives. They may be motivated to use contraception for limiting purposes, and thus, may need help in adopting the long-term and permanent methods.

From the viewpoint of demand for children, targeting parents who have not yet achieved their desired family size and who have lost their last child is probably not an optimal strategy. If parents want to replace the dead child, they probably will not want to contracept. But these parents should be screened any way as contraception may improve the reproductive health of the mother and benefit the health of the next child. We observed that subsequent conception occurs very early after the death of the last child in absence of contraception. Such an early conception exposes both the mother and subsequent child to the "maternal depletion syndrome." Maternal depletion syndrome refers to a pattern of repeated and closely spaced pregnancies that does not allow adequate time for the mother to recover fully from the adverse physiological and nutritional demands associated with pregnancy, parturition, and extended breast feeding. Under such conditions, an inhospitable intrauterine environment exists for the subsequent pregnancy, increasing the likelihood of poor reproductive outcomes, such as intrauterine growth retardation, low-birth weight, and reduced length of gestation. All these outcomes carry intrinsically higher mortality risks during the early stages of life. Short previous and subsequent birth intervals had adverse effect on neonatal and childhood survival in Matlab, Bangladesh (25). The family planning workers, by providing information, should motivate and encourage the parents who want to replace a child who has died to adopt the contraceptive methods for longer spacing of the subsequent birth. They may recommend the short term temporary methods. The argument that longer spaces between children can improve the survival chance of the next child may be especially appealing to parents who have recently experienced the trauma of a child death.

A complementary strategy is to prevent deaths through a carefully designed appropriate health-care delivery system. A discussion on these issues is beyond the scope of this paper. However, a family planning programme can definitely help this high-risk group to improve maternal and child health.

The findings of this study provide a clear message for family planning programmes. A substantial proportion of parents whose last child died in early childhood constitute a high-risk group. They need information, motivation, and contraception both for spacing and limiting of births. A well-organized contraceptive-delivery approach should target parents whose last child died to combat excess fertility and infant mortality as well as to improve maternal reproductive health in Bangladesh and similar developing societies with a high burden of mortality.

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Appendix-A

Some fertility and child mortality indicators in Matlab, 1982-1993.

	Treatment Area			Comparison Area		
Indicator	1982	1987	1993	1982	1987	1993
Total Fertility Rate	5.0	4.2	2.9	6.3	5.4	3.8
Probability of death per 1000 live births:						
Under 1 month	58.1	43.8	42.8	68.1	54.9	64.5
Under 1 year	105.6	78.4	63.1	118.3	94.3	99.3
Under 3 years	a	103.9	80.4	a	134.3	121.6
Under 5 years	169.4	113.1	86.1	207.2	145.2	135.1

[a] Data not available

Sources: International Centre for Diarrhoeal Disease Research, Bangladesh (26-28).