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THE EFFECTS OF INFANT AND CHILD MORTALITY ON FERTILITY IN BANGLADESH

BY

ABU JAFAR MOHAMMAD SUFIAN

A DISSERTATION

SUBMITTED TO

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ABSTRACT

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Available evidence suggests that the acceptance rates of family planning services in Bangladesh are very low despite intensive effort put into the National Family Planning Program. The present study explored one possible impediment to the acceptance of such services in Bangladesh -- high infant and child mortality.

The data for this research were obtained from the Bangladesh Fertility Survey, 1975-76 that was conducted as part of the World Fertility Survey. Two dimensions of reproductive behavior -- fertility subsequent to the death of a young child (under age five years) and ever-use of contraception -- were investigated in four propositions. In this analysis, the occurrence of a birth 10-24 months after the death of an older sibling was considered as relatively fast and this rapidity was assumed to reflect a conscious desire to replace the dying child. Also, if the "child replacement hypothesis" operates, then women with child death experience will be less likely to have ever-used contraception.

A logit regression analysis showed that when the birth order of a dying male child was five or less or when he left behind fewer than two brothers, his death was much more likely to be followed by another birth 10-24 months later than the death of a female child. A woman was less likely ever to have used any contraception if she had ever lost a son through death and if the number of her living children was five or fewer. Mothers (irrespective of child loss) having five or fewer surviving children who at the same time had fewer than two surviving sons were much more likely never to have used contraception.

Thus, it appears that high infant and child mortality discourages the use of contraception. The findings suggest that norms about the optimal number and gender of offspring guide reproductive behavior in Bangladesh.

بسم الله الرحمن الرحيم

In the name of Allah the most merciful and the most beneficient

TO

My mother and father whose prayers

and sacrifice lighted my way.

Sufian

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PROLOGUE

In a note to his cousin John in France, dated 19 May 1786, Paul Revere wrote: "Since my last letter to you, I have lost one of the finest Boys (sic) that was ever born, two years and three-months-old, named John, whom I named for you.

"I now begin to think I shall have no more children."

But a year later, Revere's wife, Rachel, gave birth to another son, who was named John.

CHAPTER I

INTRODUCTION

Bangladesh: Socioeconomic Context

Bangladesh is a predominantly agricultural country located in South Asia. Having an area of 144,000 square kilometers and an estimated (mid-1983) population of 96.5 millions (1983, World Population Data Sheet), Bangladesh is the eighth most populous country in the world. Bangladesh is overwhelmingly rural. It has, in absolute size, the fourth largest agricultural population in the world, next to China, India and the Soviet Union. It derives about 60 percent of its GNP from agriculture, and about 80 percent of its labor force is engaged in agriculture (Islam, 1978: 2). However, farm holdings are small and fragmented with a growing proportion (now perhaps more than one third) of rural households landless. The problem of land scarcity affects most of the population directly as 90 percent of the people reside in rural areas. Perhaps as a result of land scarcity, the country has not been self-sufficient in food for over two decades, and nutritional levels are probably inadequate for half the population (Arthur and McNicoll, 1978: 24). Indeed, the country presents the spectre of a nation struggling to survive.

Evidence suggests that the situation has gotten worse over time. Per capita incomes are among the lowest in the world; less than 15 percent of the adult population has had five or more years of schooling. During the last few years, the country has been characterized by famine and quasi-famine situations (Alamgir, et al., 1981: 1).

Population Problem in Bangladesh and National Family Planning Program

A severe problem is the population growth rate of 3.1 percent (World Population Data Sheet, 1983) annually, which will double the population size in the next 22 years. This rapid population growth puts ever increasing pressure on a restricted and uncertain environment, makes the swift adoption of new food technologies critical, places additional demands on an already inadequate food supply, and contributes to further fragmentation of farm holdings. Most of this rapid growth rate is attributed to an extremely high total fertility rate of 6.2 live births per average woman by menopause (World Population Data Sheet, 1983).

For this reason, the Pakistan Government (then including Bangladesh as East Pakistan) initiated a family planning program in 1960 and in large scale in 1965. To reduce the birth rate from 50 to 40 births per 1000 population by 1970 through protecting 25 percent of

the fertile couples from pregnancy was the main objective of the Pakistan National Family Planning Program. The basic strategy was to make family planning information, services, and contraceptive supplies readily available to the population through developing an intensive infrastructure of family planning personnel and facilities. It was estimated in 1969 that the total staff in the national program consisted of about 1000 doctors certified for IUD and Vasectomy operations, about 200 fulltime women family planning visitors, about 250 women home visitors, about 17,000 part time dais (village midwives), about 20,000 part time agents (selling condoms and conventionals), 1,700 assistants, and about 600 officers and 56 executives. Over 800 hospitals, clinics and centers were providing family planning services and there were over 40 mobile teams (Sirageldin et al., 1975). Furthermore, the new Bangladesh Government formed after the 1971 War of Independence, at a January, 1976, meeting of the National Population Council, declared rapid population growth as the number-one national problem (cited in 12/Intercom, April, 1979) and adopted an official policy of reducing the population growth rate through continued support for the national family planning program. As in many other developing countries that recently initiated family planning programs, the key assumption was that there was a latent demand for family planning, a large part of which could be met by providing the necessary information and services.

Unfortunately, however, the Bangladesh Fertility Survey of 1975/76 (conducted as part of the World Fertility Survey) revealed that only

eight percent of married women aged 15-49 were using contraception (Mamlouk, 1982: 30). Moreover, an important experiment undertaken in 1975 at Matlab Thana (administrative unit) of Comilla district estimated the limits of contraceptive demand by a saturation distribution scheme. The results indicated a ceiling of around 17 to 18 percent of married women in reproductive ages using proffered supplies, tailing off after two years to less than 10 percent despite continued intensive effort put into the supply system (cited in Arthur and McNicoll, 1978: 56). Matlab Thana was selected by the International Center for Diarrheal Disease Research more than two decades ago as the field station for extensive demographic research; and a number of local and international experts have been working in that area for quite a long time. In spite of these external influences, the adoption of modern contraception, as the above figure indicated, is negligible. Needless to say, other rural areas of Bangladesh would probably provide much lower adoption rates.

Associated with the high fertility rate are high rates of infant and child mortality. For example, the number of infants dying for every 1,000 live births is 85 for the world as a whole but at least 136 for Bangladesh (Haub, 1982). The number of children dying at ages 1-4 for every 1,000 children in this age bracket is 12 for the world as a whole but 19 for Bangladesh (Haub, 1982). Infant and child survivorship could not have been much different in Bangladesh in the early 1960s than it is today (see Kabir, 1982: 50).

For these reasons, contraceptive services began in 1960 in East Pakistan (Bangladesh) under an umbrella program of maternal and child

health (MCH) (Rogers, 1973). It was thought that a health program which improved the survivorship chances of children would at the same time generate a demand by their mothers for contraception. Also, the expansion of the MCH program to include contraceptive services would allegedly reduce the psychic and actual costs of accepting them. The psychic cost would be reduced because the mother could hide her contraceptive reasons for visiting an MCH clinic from a disapproving husband or mother-in-law by taking along her children for medical care. The actual cost would be reduced since one trip to the MCH clinic could serve the health-care needs of not only the children but also their mother.

Why, then, has such a small proportion of married couples come to practice modern contraception in Bangladesh? The major hypothesis of this research is that the severe poverty of Bangladesh discourages most couples from the use of modern birth control because of the widescale threat to the survivorship of children to adulthood. The purpose of this dissertation is, thus, to test the "child survival hypothesis" with data recently gathered in Bangladesh.

The Effect of Child Survivorship on Fertility

The relationship between infant and child mortality and fertility has occupied a central position in demographic research. This relationship was one of the most prominent issues in the early

literature on the decline of fertility in European countries. The issue gained salience after the formulation of the demographic transition model that focuses attention on the timing of declines in fertility and child mortality and has naturally invited speculation concerning possible causal links between them.

A number of possible links between them have long been recognized; and this relationship is one of the most significant areas of population research. The adverse consequences of excessively high fertility on child health and mortality seldom need to be established. Wray (1971) accumulated a good deal of evidence, both direct and indirect, on how large family size is associated with low per capita expenditure on food, treatment and maternal care, which in turn leads to high infant mortality. The disadvantages of a newborn in a poor, unsanitary and unhealthy environment in which its family is unable to afford minimally required nutrition and medical assistance, are obvious. However, the pattern of the reverse relationship -- the consequences of mortality for fertility is yet to be settled.

There are two main ways the child mortality experience might affect fertility. The first, labelled the biological effect, suggests that lactation inhibits conception by suppressing ovulation and by delaying resumption of the menstrual cycle (Van Ginneken, 1978: 180). The death of an infant interrupts lactation prematurely, thereby allowing ovulation to be resumed sooner and therefore, in the absence of contraception, results in an earlier subsequent pregnancy. For example, in a sample survey that collected direct information on

amenorrhea in the Punjab, Potter et al. (1965) showed that the median amenorrheic period was two months if the child died in the first month and eleven months if the child survived the first year. This difference was attributed to the longer breastfeeding of the surviving child, given that breastfeeding is common in the Punjab.

The second way in which infant and child mortality might boost fertility is through nonbiological (behavioral or volitional) means. For example, Alam (1973) used data from Cebu, Philippines to calculate life-table estimates of how the probability of not having another birth varied by the number of months that had elapsed since the previous birth. This strategy was used in order to separate biological from nonbiological effects since the effects of lactation and of post-birth recovery on inhibiting the resumption of ovulation would be strongest in the early months after the (previous) birth. He found that among non-lactating women, the mean length of the interval to the next birth was two to five months shorter, depending on parity, when the preceding child died in infancy (i.e., at ages under 12 months) than when the child survived. This difference in birth-interval lengths according to the fate of the previous child is not attributable to the biological effect of lactation on ovulation, since these women had never lactated. In other words, these findings left open the interpretation that the faster pace of the next birth when the preceding birth did not survive may have been due to a conscious attempt to replace the dying child.

The research cited for the Punjab (Potter et al., 1965) and for Cebu, Philippines (Alam, 1973) invite opposite conclusions about how

high child mortality might provide conscious, deliberate motivations for high fertility. However, one reason for this disparity may be that sons have a higher degree of subjective economic value than daughters do in the Punjab because parents look to sons for support in old age. Because infant mortality rates are higher among girls than boys in India and because parents may not care to replace dying girls, studies such as that by Potter et al. (1965) which do not control the sex of the dying child may be unable to detect attempts to replace children of only one sex. On the other hand, this limitation would not apply to the research of Alam in the Philippines, where sons and daughters have comparable economic value for their parents, who thus should be motivated to replace dead children without respect to gender (see Williamson, 1978: 11).

The question of whether high infant/child mortality provides motivations for high fertility in Bangladesh and explains the low adoption rates of contraception there is an urgent one. If the answer to this question is "yes," then stronger support for child-health programs would be indicated as a way to curb population growth. As such, this dissertation will examine whether the death of a child before age five is related to the subsequent births of siblings in Bangladesh and, whether the gender of the dying child conditions this relationship.

CHAPTER II

REVIEW OF LITERATURE

Child Survival Hypothesis

A pivotal assumption guiding development planners has been that a high probability of death among infants and young children motivates a deliberately high fertility level and an avoidance of contraception (Rogers, 1973: 86). This assumption has been termed the "child survival hypothesis". In other words, experience with or fear of child mortality might make married couples have "extra" births to replace young children who have already died; this alleged effect of child mortality on fertility has been called the "replacement strategy" (Preston, 1978: 10). Another possilleged effect of child mortality on fertility has been called the "replacement strategy" (Preston, 1978: 10). Another possilleged effect of child mortality on fertility has been called the "replacement strategy" (Preston, 1978: 10). Another possihat couples might adopt modern contraception only when they are confident their fertility goal will be reached and not eroded by child mortality or when the costs of falling short of their fertility goal become less than the costs of exceeding.

Aggregate-Level Studies

Most aggregate-level studies have obtained results supportive of

the child survival hypothesis. For example, Heer (1966) used data of 41 nations from official publications of the United Nations to test the hypothesis that a low level of infant and child mortality is a necessary condition for low fertility. The measure of fertility that was used as the dependent variable was the general fertility rate for males (i.e. the number of births divided by the male population aged 15-54 years) for the year 1953. This unconventional male measure was preferred to a female measure of fertility because some of the nations of the study, in particular the U.S.S.R., had a very large excess of women over men in the reproductive ages. The mortality of infants under one year of age was taken as the operational measure of infant and child mortality and was one of the independent variables in both the additive and multiplicative models. The partial correlation between fertility and infant mortality under the additive model was .369 and that under the multiplicative model was .424 which would achieve statistical significance under the assumption of a random sample from a multivariate normal distribution. Thus, there was reason to believe that the association between infant mortality and fertility was not spurious. The author concluded that a substantial part of the association was due to the effect of infant mortality on fertility. In other words, the levels of infant and child mortality may be determinative of fertility levels. The findings tended to indicate that the vigorous support of public health programs would be strong aid in achieving a rapid reduction in fertility.

Friedlander and Silver (1967), using a cross-country approach, performed separate regressions for countries at different levels of

development (developed, intermediate and underdeveloped) and for countries at all levels of development in the 1950's and early 1960's. The regressions of fertility on the probability of death before age 14 produced significant coefficients for the latter variable. These results supported the interpretation that the lower the probability of death before age 14, the lower the rate of fertility. However, since this study was based on aggregate level data, the findings might not hold for individual married couples. An inappropriate application of aggregate-level results to a lower level of analysis has been called the "ecological fallacy" (Robinson, 1950).

Taylor, Newman and Kelly (1976) analyzed the association between the infant mortality rates and the crude birth rates in 53 countries of Asia, Africa and Latin America for each five-year period since 1945. In all countries except one (the Dominican Republic), the greater the mean postwar rate of fall in infant mortality, the shorter the interval between the infant mortality decline and the onset of fertility decline. For the 53 countries as a whole, the median interval following 1945-49 or the subsequent onset of mortality decline to the onset of fertility decline was only 11.4 years. This appears to support the hypothesis that the more rapid the fall in infant mortality, the sooner this will be followed by fertility decline. Yet the possibility that the declines in both infant mortality and fertility were caused by other factors and that infant mortality responded earlier than fertility, cannot be ignored.

A problem plaguing the above three studies, as with most aggregate-level tests of the child replacement strategy, was an

inability to control the effects of lactation on fertility. The death of a nursing infant will generally stop the lactation of its mother and thereby hasten the return of ovulation and the possibility of another pregnancy. Thus, a strong correlation between measures of infant mortality and fertility reflect to some extent the biological effects of lactation on ovulation. Since these biological effects might be nonvolitional, it is necessary to hold them constant so that net relationships between infant mortality and fertility can be attributable to human intent. This control is usually impossible in ecological studies due to a lack of breastfeeding data for population aggregates.

An important exception, however, was an analysis of nineteenth-century German districts identifiable by whether or not breastfeeding was common (Knodel and van de Walle, 1967). Among the 13 Bavarian districts where 80 percent or more of the mothers reported not to have breastfed their children at all, the correlation between infant mortality and marital fertility was .87. This was at a time when fertility was still very high and had not yet begun to decline. This correlation was the same among the 22 districts in which 70 percent or more of the mothers reported not to have breastfed. Thus the influence of mortality on fertility through the interruption of lactation was virtually absent. These findings suggested that infant mortality had a direct volitional influence on fertility. However, these results were based on data relating to areas rather than to individuals and as a result, the threat of an "ecological fallacy" was present.

This criticism does not apply to Knodel (1968), who based his study on individual family histories assembled from parish registers of marriages, births and deaths occurring in three Bavarian parishes in the latter half of the nineteenth century, a period when fertility and mortality were still very high. In two of these parishes breastfeeding was rare while in the third parish, breastfeeding was extensively practiced. A comparison of the average interval between successive births by the length of life of the child born at the beginning of the interval reveals that infant deaths had a different effect on the following birth interval in the presence and absence of breastfeeding. In the area of common breastfeeding, birth intervals following infant survivals were substantially longer than those following infant deaths. No such clear trend was evident in the other two parishes, although in one of these parishes birth intervals were distinctly longer if the child born at the onset survived the first year of life than if the child died as an infant. Thus, although the lactational effect on the length of birth intervals was confirmed, an independent volitional effect of infant mortality on birth intervals was not so evident.

To estimate the effect of infant mortality on the birth interval independent of any effects of breastfeeding, the author observed the relationship between the fate of the first child and the interval between the second and third births, holding constant the fate of the second child. The results indicated that in all three parishes, the interval between the second and third birth was longest if the first two infants survived and shortest if the first two infants died.

However, since the statistical difference in question and the numbers of cases in most categories were small, the results did not conclusively support the hypothesis that infant mortality shortens the subsequent birth-interval length independently of the effects of lactation.

Knodel (1968) tested the hypothesis that couples with low child mortality experience in the three parishes practiced family limitation more than couples experiencing high child mortality. If the hypothesis were true, then the total number of children ever born should be positively related to the number surviving to age 10. This relationship was found for two of the Bavarian provinces (Moemmlingen and Schoenberg) but not for Anhausen. These results did not uniformly support this hypothesis.

Finally, Knodel examined the notion that if women sought additional births to replace dying children then the average age at which mothers bore their final child would be higher if several of their children had died at early ages. Yet the maternal age at last birth was not substantially higher in the case of death of the first several children than if they survived. It is noteworthy that when this Bavarian data set was analyzed at the individual-level of analysis (Knodel, 1968), it offered little evidence for the child survival hypothesis; but when the same data set was analyzed at the district level, it supported the hypothesis (Knodel and van de Walle, 1967). This contradiction illustrates the ecological fallacy of inferring individual-level behaviors from aggregate-level associations.

Furthermore, it calls for future tests of the child survival hypothesis to be conducted with data on individual women and children.

Individual-Level Studies

Tests of the child survival hypothesis at the aggregate level of analysis have produced less equivocal conclusions than those at the individual level. As evidenced by the Knodel (1968) investigation cited above, the latter studies usually confront a wider choice of dependent variables. For example, one can examine whether or how rapidly another birth follows the death of a particular child and whether the child's death causes its mother to abandon birth control. Evidence of child replacement strategies would be a new birth after a certain child's death or a short interval between the death date and the next birth date or a cessation of contraception. Studies of individual women have often investigated more than one of these indicators and have typically found support for the child survival hypothesis on some indicators but not on others.

For example, Rizk et al. (1980) analyzed the relationship between the experience with child mortality at parities 1 to (i-1) and the length of the (i+1)st birth interval for a sample of rural Egyptian women. They found no significant variation in mean interval lengths between parities i and (i+1) by previous child-death experience. However, they found that women who had lost one or more children

desired an average of almost one half child more than did women without such experience; and 13 percent of women with child death experience had ever-used contraception compared to 26 percent among women who had not lost any children. These latter two pieces of evidence supported the idea that some women in rural Egypt did want to replace dying children and were attempting pregnancy by an avoidance of contraception. The negative evidence from the comparisons of the (i+1)st birth interval may have arisen from the stringency of the test itself. That is, it would seem the attempt to replace a dying infant would be strongest at the next higher birth order, a possibility that Rizk et al. (1980) did not examine since the (i+1)st birth interval was computed only when children of order i had survived.

Another study that used the birth interval as a measure of fertility but in a developed country -- France -- was by Vallin and Lery (1978). The data were a 1962 French survey of family structure conducted under the auspices of the 1962 population census. Out of a sample of 240,000 ever-married women under 70 years of age, 92,000 were classified as having achieved completed families (that is, were women first married before age 45 and continuously married at least until this age). For such women, the average lengths of closed interbirth intervals between the nth birth and (n+1)st birth calculated according to the survivorship status of the nth child and the final number of children were six-to-twelve months shorter in families with infant deaths than in families where an infant did not die, regardless of the birth order or final size of the family. However, this study did not

attempt to control for the biological effect on ovulation that could arise had the infants who died, been breastfed.

This study also used another dimension of reproductive behavior -- the parity progression ratio - to examine the extent of replacement of dead children. In this measure, proportions of women with completed families, who having borne at least n children, subsequently proceeded to have another child, were determined. If the nth child had died, these proportions were distinctly higher than if it was still alive at the date of the survey (74 percent versus 61 percent). This effect of infant death on subsequent fertility was maintained at about constant strength even after controlling for social class. However, the problem of the confounding biological effect of breastfeeding on ovulation was not controlled. But if it can be assumed that the extent of breastfeeding in France is low, given that breastfeeding is less common in developed countries, then this study clearly indicates that the replacement effect is operating in the French society.

Ben-Porath (1978) used retrospective data from the special fertility section of a labor force survey held in 1971 in Israel, that collected information from Jewish women up to age 64, who were married once and whose husbands were alive. The results of tabular and regression analyses indicated that for a given birth order, the stopping probability (the complement of parity progression ratio) -- the probability that a given birth is a last birth is lower where one of the preceding births ended in death -- and that this child mortality experience reduces the length of intervals between births. This study,

thus, supports the idea "that replacement is a significant phenomenon and that it occurs fairly quickly" (Ben-Porath, 1978: 178).

Unlike the French and Israeli studies, the data used by Rutstein and Medica (1978) to test the child survival hypothesis were from contemporary developing countries. The data used in this study were collected under a program called PECFAL-Rural from the rural and semi-urban areas of four Latin American countries -- Colombia, Costa Rica, Mexico, and Peru. These four KAP-type fertility surveys each interviewed approximately 3000 women of all marital statuses and of ages 15 to 49 inclusive. For each country, this strategy yielded between 1400 and 2100 mothers for further analysis. Using the parity progression ratio as the dependent variable and the number of deaths to children under age 14 years occurring before the conception that gave rise to the increase in parity as the independent variable, they calculated, ratios according to the direct personal experience of child mortality for different attained parity levels. Time exposure to the risk of a subsequent birth, woman's education, quality of housing, husband's occupation, sector (rural or semiurban), and perception of changes in child mortality were control variables. The overall <u>increases</u> in parity progression ratios of the women having child death experience over those without such experience were .26 in Costa Rica and .15 in Peru; whereas for Mexico and Colombia, overall <u>decreases</u> of .26 and .23, respectively, were observed. But the increases in Costa Rica and Peru did not occur at all parity levels; they reached local peaks around the numbers which more than half the women in both country areas stated to be most convenient -- parities three to five.

Rutstein's (1971) analysis of Taiwanese data illustrates how the child mortality experience was associated with a delay in the initiation of contraception. Fourteen percent of non-contracepting women having parity level three and without child loss had begun contraception whereas only 6.1 percent of those who had lost one or two children had begun contraception. At parity four these figures were 25.7, 13.1 and 8.0; and at parity five they were 28.3, 19.3 and 21.2. These figures indicate that Taiwanese women delay the beginning of contraception until there are three-to-five surviving children.

The above review of the available evidence suggested to Preston (1975: 191-92) that populations at the lowest and highest levels of socioeconomic development should exhibit the strongest effects of infant and child mortality on fertility. Breastfeeding is usually common in the poorer populations; and, hence, the effect that is observed in these populations should be a biological one that operates through breastfeeding. As the society modernizes, breastfeeding decreases and so does the strength of the biological mechanism. Preston advanced six obstacles that might make the behavioral response to replace dead children incomplete and argues that these obstacles are greatest among populations of lowest socioeconomic development (Preston, 1978: 13-14). Probably the two most important of these obstacles are that family size goals are not framed in terms of surviving numbers of children or that the target number is so high that it could not be achieved even if all children survived. Preston maintained: "only when family size goals become sufficiently low that

contraception is generally required to avoid overshooting them, can a substantial volitional response be expected" (Preston, 1975: 193). In other words, despite the developing country status of Colombia, Peru, and Taiwan, women may try to replace dying children to achieve the cultural ideal of three-to-five living offspring.

If Preston's generalization is correct, then one would not expect to find a deliberate attempt to replace child deaths in Sierra Leone, which is at a very low level of economic development. Snyder (1974) investigated this question with data from personal interviews on demographic and economic characteristics of 717 households during the 1966-68 Western Area Household Survey. The dependent variable was the number of live births fathered by the household head. As a measure of child mortality, the reciprocal of the child survival rate 1/(1-M), where M is the household's combined infant-child mortality rate, was included in the regression model. The results indicated that child mortality had a strong positive relationship with number of births. Couples showed a tendency to replace or overreplace a lost child at their early stages of family formation, although in later years child deaths were slightly underreplaced.

Perhaps a reason for child replacement strategies in Sierra Leone is the influence of Islam. About 60 percent of the population are of this faith (Bureau of Public Affairs, 1984). Since Islam attributes greater moral, physical, and intellectual powers to males than to females, it creates a cultural pressure for the production of sons.

If this reasoning be correct, then one would expect to witness child replacement strategies in Turkey, where 98 percent of the people

are Muslim (Bureau of Public Affairs, 1983). Indeed, child replacement strategies were reported by Adlakha (1973), who surveyed 803 married women in Ankara in 1966. The analysis of these data showed that the inter-pregnancy interval between second and third parity births was 18.7 months if both the first and the second child had died; 23.0 months if only the second had died; 26.2 months if only the first had died; and 36.4 months if neither had died. The lactational influence cannot account for the ten-month difference between the last two figures because the intervening child had survived and was presumably being breastfed. Intervals between third and fourth births and between fourth and fifth births displayed a similar pattern. Virtually identical results remained even after adjusting for age and socioeconomic status.

The author also attempted to test the hypothesis that infant mortality has a negative influence on the use of contraceptives and a positive effect on the number of live births. A lesser percentage of women having at least one infant death was found to use some method of birth control than those who never had an infant death. However, after controlling for socioeconomic variables, mixed results were obtained. In all categories of community origin (both village, mixed and both urban) the percentage of users of contraception was higher among women with no infant deaths than those with some experience of infant mortality. When income and education were controlled, differentials in the use of contraception still remained in the low and middle income and educated categories, but for high income groups differentials were either very small or nonexistent.

Analysis of data on Turkish couples revealed that infant mortality has a strong positive relationship with fertility. Among women aged 45 and over, those with infant mortality experience had 2.6 more live births than those with no such experience. Also, women with infant mortality experience expected a larger number of additional children. These relationships still existed even after controlling for education, income, media exposure, community of birth, or duration of marriage. In sum, Adlakha's study supported the contention that Muslim women with infant mortality experience try to make up for the lost children by shortening birth intervals, avoiding contraception and consequently having more births.

One would also expect to find attempts to replace dying children in Bangladesh, for at least two reasons. One is that a majority of the population (85 percent) is Muslim (Ministry of Health and Population Control, 1978). Another reason is that the target number of living children is four or five per woman, far below the biological maximum. (This point is elaborated below.) Accordingly, the Bangladesh Fertility Survey showed that the percent of married, fecund women using contraception rose from about five percent of those with only one living child to about 15 percent of those with seven living children (Mamlouk, 1982: 19). Moreover, Schultz and Davanzo's (1970) study of 4,200 women in Central Bangladesh found that a drop in child mortality (at ages 0-14) at lower parities was attended by a smaller drop in the probability of births of higher parity children. Thus, even though Bangladesh is almost universally a breastfeeding society and is at a

very low level of socioeconomic development, the above results are congruent with the notion that enhanced child survivorship in Bangladesh would motivate the adoption of birth control and would hasten the drop in birth rates.

The study by Chowdhury and his associates contradict this conclusion. Chowdhury et al., (1976), used data on women from Matlab Thana, Bangladesh to compute the median length of intervals between parities (i) and (i+1) where parity (i) was a child surviving. They compared this median birth interval length by whether deaths had occurred among siblings of parities less than (i). It was argued that variation in the median length of the (i+1)st birth interval was not attributable to curtailment of breastfeeding for the ith child, since the latter had survived. Rather, shorter (i+1)st birth intervals for births where some deaths had occurred at parities 1 to (i-1) might represent a desire of the parents to replace these earlier child losses. However, the (i+1)st birth intervals did not vary significantly by whether the children of parities 1 to (i-1) had lived or died. Chowdhury et al. concluded that rapid childbearing at higher parities in cases where the next lower parity did not survive represented mainly the disappearance of lactational amenorrhea and not necessarily the conscious desire of parents to replace dying children.

However, there are two noteworthy shortcomings in the study done by Chowdhury, Khan, and Chen (1976) that might have concealed the child replacement effect in the Muslim majority society of Bangladesh. The first of these might have arisen from the fact that in their study,

Chowdhury et al. (1976) compared the median length of intervals between parities i and i+1 where parity i was a child surviving in all cases and where child deaths had occurred only before the birth of child i. But it may well happen, as Chowdhury et al. recognized, that the couples would have the strongest motivation to replace a dead child with the next birth following the death. The methodology used by Chowdhury et al. may have been too conservative to distinguish this motivation because the median birth interval length they calculated was not opened by the death of one child and closed by the birth of another. This same criticism applies to Rizk et al. (1980).

The second shortcoming that besets the study by Chowdhury and his colleagues is that it did not take into account that strong son preference exists in Bangladesh and that the gender of the dying child may well be related to the motivation to replace him/her. As a corollary, the sex composition of the surviving children in a family might also induce differential motivation to replace dead children -- a possibility that has also been ignored by both the studies cited above. This may explain, at least partly, their failure to detect any behavioral response to child death in Bangladesh -- although studies in other Muslim societies have shown the existence of such effects.

Sex Preference

The sex of the deceased child in Bangladesh should influence significantly the parents' tendency to replace him/her. The absence of

formal and informal external sources of social and economic security, the high labor intensity of production, a rigid gender division of labor, and frequent natural disasters link the fortunes of a couple to the gender of their offspring. Sons (not daughters) provide parents with significant net economic returns. Cain (1977) showed that in rural Bangladesh by age 12, the average male child has become a net producer; by age 15, he has compensated for his cumulative consumption; and by age 22, he has repaid the investment in himself and one sister. Moreover, women find sons the highest form of security against the privations of widowhood. He also notes that a family faces a period of extreme vulnerability through loss of assets due to the lack of male labor or through social predation if the husband dies or is incapacitated before his eldest son is old enough to assume control of family property. Therefore, not only to have sons but also to have them as early as possible becomes important for future security. And sons are the only form of economic support in old age.

Not surprisingly, Khuda's (1977) study found that almost all women in his study village believed that sons are really important to a woman when her husband is no longer alive. In contrast, although a daughter helps her mother in some activities, such as food preparation and child care, a girl cannot generate as much income for the family as a boy does because of the seclusion of females from about the age of 12 onward. In fact, a daughter may represent a net lifetime drain on family resources since her marriage, which will typically occur at about age 15 (Ministry of Health and Population Control, 1978: 107)

requires a dowry. After marriage, a daughter moves to her husband's family and is solely obligated to that family. In other words, she has little to contribute to her parents' family after her marriage. These relationships are consistent with the fact that 91 percent of the respondents in Khuda's (1977) study state that their daughters are a burden to them.

The greater economic utility of sons may explain why they are less likely than their sisters to suffer from malnutrition and stunting and more likely to be taken for free medical treatment at the International Center for Diarrheal Disease Research in Matlab Thana (Chen et al., 1981). Analysis of Bangladesh Fertility Survey data also revealed a strong son preference among currently married fecund non-pregnant women (Ministry of Health and Population Control, 1978: 88). Mothers of family sizes of 1-4 children, are more likely to want no more children if they have sons only than if they have daughters only. Women who wanted another child stated their son preference even more strongly. For example, of the women who wanted another child, 62.5 percent of those having no living children wanted a son compared to 1 percent who wanted a daughter, and 84.1 percent of those having one living daughter only wanted a son compared to .8 percent who wanted a daughter. These figures are well indicative of very strong son preference in Bangladesh.

Ahmed (1981) using data on 673 only once married women from Matlab Thana, Bangladesh attempted to examine fertility preferences in detail and to investigate the correlates of such preferences. Sex composition

was measured in two ways: by a single valued statement of desired sex composition and by employing the IS scale measure. In this IS scale, which measures the preferences for sex of children, respondents are placed on a psychological continuum ranging from 1 to 7. An IS of 1 corresponds to an extreme girl preference while an IS of 7 represents extreme boy preference. Preference for a balanced sex in a family composition is indicated by an IS of 4. The use of this scale enables a preference for sons to be measured independently of a preference for large families. Results of Ahmed's study indicated that son preference in Matlab Thana, Bangladesh is very strong and that most of the variation in sex preferences lies between strong and very strong son preference. Almost 93 percent have a son preference while only 5 percent prefer a balanced sex composition.

The central hypothesis of Repetto's (1972) study of the consequence of son preference on total fertility of couples, was that the desire for a minimum number of sons directly affects fertility behavior. If the hypothesis is true, then the underlying expectation should be that couples who have produced this minimum number of sons will have a greater tendency to limit their further reproduction. Consequently this leads to the expectation of a negative correlation between total fertility and the ratio of sons to total number of living children.

To this end, he looked at the correlation between the total fertility and the sex ratio of children across couples. He used the data of 2500 rural and urban couples collected for the "Demographic

Survey of East Pakistan" carried out in 1961 and 1962 by the Dhaka University Statistical Survey Research Unit. Ordinary least-squares regression was used for analysis with total parity as the dependent variable. Both the percentage of living male children among total living children and the percentage of living male children among total children ever born alive were used as measures of sex composition. Separate regressions were computed for the three age groups 25-29, 30-34 and 35-39. In each regression, the ratio of living males to total living children, contrary to expectation, was found to be significantly positively associated with total fertility. However, it is possible that the unexpected positive correlation reflected a response bias: respondents might have underreported female births. Also only two factors that might affect fertility (the other is the number of effective years of marriage) were included in the regression model, which explained a small percentage of the total variance (.19, .11 and .04 for the three age groups, respectively). The omission of maternal education, for example, may have resulted in a spurious positive association between sex composition and total fertility.

The lower the level of maternal education, the higher is the total number of children. Also, the lowly educated women tend to depend more on children than highly educated women; and, therefore, given that one has to bank more on sons rather than on daughters for this dependence, it is likely that a woman of lower educational level will, intentionally continue producing children until a larger number of sons have been born. This might have resulted in the unexpected positive

association found by Repetto between the percentage of living male children among total living children and the total fertility.

Ben-Porath et al. (1976) used the same survey data for Bangladesh that Repetto used, to estimate effects of the sex composition of surviving children on the length of subsequent birth intervals. Fairly clear effects of sex composition emerged: the higher the proportion of surviving boys in the family, the longer are the subsequent birth intervals. The authors also tried to reproduce Repetto's results but without success. They noted: "It seems on the surface that Repetto's estimates are seriously biased by including women who have had no live births while setting the 'sons-children' variable to zero" (Ben-Porath et al., 1976: 294, footnote 15). The authors also calculated the logit estimates for the probability that a child born alive will die before the fifth birthday. It was found that although for boys born alive the survival chance to age five appears to be independent of the sex composition of the families, this is not so for girls. Girls born into a family having either a majority of girls or equal numbers of boys and girls are significantly more likely to die before age five than girls born into a family with more boys than girls. The implication of this result is that the survival chance of a girl is conditioned by the presence of boys in the family. The amount of care of whatever form given to a baby girl does not reach that given to a baby boy until the family composition is heavily biased towards boys. Overall, this signifies the value of a male child over a female child in Bangladesh.

Heer and Wu (1978) found in Taiwan that the adjusted subsequent fertility of women who had three surviving sons was significantly

smaller than that of women who had three surviving daughters. When the first two live births were sons, adjusted subsequent fertility was significantly greater with the loss of one son than without child loss. In contrast, if the first two live births were daughters, adjusted subsequent fertility was not significantly higher after the loss of one daughter than without such loss. Furthermore, where one son and one daughter had been born, 49.9 percent of the loss was made up if the son had died compared to 29.6 percent if the daughter had died. In the Chinese culture of Taiwan, son preference is deeply rooted. It is a misfortune for a baby to be a girl rather than a boy. A daughter cannot pass along the family name to future generations. Also, her marriage requires a dowry, which is viewed as a wastage of her family's money. Married Chinese daughters do not contribute any longer to their parents' support; rather, their labor benefits their husband's family (Wu, 1977). Consequently, data from rural Taiwan support the notion that in cultures where sons are highly valued, the death of sons can lead to higher subsequent fertility. Since Bangladesh is such a culture, it is reasonable to expect that a male child's death will be perceived as a much greater loss for the family than that of a female child and will be more likely to be replaced.

Although sons are more highly valued than are daughters in Bangladesh, unlimited numbers of sons (or of children in general) are not seen as an unmixed blessing (Ministry of Health and Population Control, 1978). Among married, fecund, non-pregnant women having children all of the same sex, 69.2 percent of those with two living

sons desired no more children as compared to only 52.3 percent of those with one living son. In contrast, 50.1 percent of these women who had two living daughters (and no sons) wanted to have another baby. The data on all ever-married women showed that those who had fewer than four living children wanted more, and those who had more than five living children wanted fewer. Bangladeshi women who had four or five living children desired the number they had. Therefore, the Bangladesh Fertility Survey suggested that the culturally prescribed ideal is four-to-five living children, about two of whom are sons. The reason for preferring two sons to one son may probably be to insure that at least one survives to adulthood to help the parents. Given that it takes around four live births to get two living sons, Bangladeshi women may have come to idealize four to five living children as the optimal number.

Achievement of this ideal number of living children or living sons (whichever occurs first) should create pressures for the initiation of contraception. Maintenance of these ideals, once achieved, should require additional births if some of the living sons die. For example, we would expect that the motivation to replace a dying son would be stronger if he were survived by only one brother and two sisters than if he were survived by two brothers and two sisters. This expectation is congruent with research on the Aymara Indians of Peru (Collins, 1983), whose ideal is to have five living children. Women who seek contraception at the health post of the Peruvian village almost always have at least five living children. When a child dies in infancy, an

Aymara woman will try to become pregnant again unless she has at least five remaining offspring (Collins, 1983). The death of either a son or a daughter can trigger child-replacement behavior, since gender preferences are not nearly so salient in Aymara society as in Bangladesh.

Propositions

The foregoing literature review leads to the following two propositions. The first proposition emphasizes the effect of sex preferences on the tendency to replace dying children with new births, while the second proposition stresses the influence of the sex composition of surviving siblings.

Proposition 1:

a. The likelihood of a live birth following a child's death will be larger when the dying child is a male than when a female in a society where sons are more highly valued than daughters.

b. The likelihood that a woman has ever-used contraception will be lower if she has had a son to die than if she has had only daughters to die in a society where sons are more highly valued than daughters.

However, if a couple has three living sons, then the death of one of them might not induce the same motivational force to replace, as

would have been the case had the couple been left with fewer than two surviving sons.

Proposition 2:

a. The likelihood of a live birth following a son's death will be greater when he had fewer than two surviving brothers in a society where sons are more highly valued than daughters.

b. The likelihood of a woman's ever-using contraception will be directly related to the number of her surviving sons in a society where sons are more highly valued than daughters.

CHAPTER III

METHODOLOGY

Sample Design and Quality of Data

Data for this research were obtained from the Bangladesh Fertility Survey (BFS) which was conducted during 1975-76, as part of the World Fertility Survey (WFS). The basic objective of the survey was to provide data for the nation and for various socioeconomic subgroups on factors affecting fertility, nuptiality and contraception. These data were seen as useful information with which to evaluate, improve, and modify the existing family planning program of the country. The Population Control and Family Planning Division of the Bangladesh Ministry of Health and Population Control was in charge of all activities, including planning, supervision, coordination and execution of the field work. A household, defined as "a group of persons usually living and eating together in a structure or dwelling" (Ministry of Health and Population Control, 1978: 20), was the ultimate sampling unit and was preferred to an individual woman for the sake of sampling operation. Ever-married women aged below 50 years who slept in the household the night preceding the household interview were eligible for interview. Thus the survey was based on de facto criteria; it was expected that the number of absent household members would approximate the number of visitors.

Within each of the two strata -- rural and urban -- a three-stage sample was drawn. The first two stages were area selections and the ultimate stage was a household selection.

At the time of the 1974 census, the country was divided into 4949 census circles (4241 in the rural stratum and 708 in the urban stratum). These census circles constituted the primary sampling units (PSU's). Usually the boundaries of these census circles coincided with those of 4350 administrative divisions -- called unions. Separate lists for rural and urban census circles along with the number of households and population size within each were obtained from the census office. The number of households in an area determined its size which was used in the probability selection.

From rural stratum 160 PSU's and from urban stratum 80 PSU's were selected with probability proportional to size. These numbers were chosen to attain a high degree of spread of the sample in the country. A few contiguous villages made a PSU in rural area while in the urban area each PSU consisted of a few census blocks. The census office was the supplier of the list of villages and urban census blocks of the selected PSU's along with their number of households. If a village or a census block had less than fifty households, it was added with the neighboring village or block to make all the units of size above fifty households. These units were called the intermediate sampling units (ISU). From each PSU, one ISU was selected with probability proportional to size.

The Bangladesh Fertility Survey staff collected within each selected ISU, a complete list of households, names of the heads of households and the number of household members. For a proportionate representation of the households of all sizes, the households were

stratified into four categories according to the number of household members. Selection of households (i.e. ultimate sampling units) was done with probability inversely proportional to the measure of size that was used in the selection of the respective PSU and ISU. The number of households selected from an ISU ranged from 15 to 45 in rural areas and from 5 to 29 in urban areas. This scheme made the sample self-weighting within each stratum.

Two questionnaires were administered in the field in Bengali -- the native language -- to obtain data from the households and individual interviews. The household questionnaire was used to obtain information on certain characteristics such as age, marital status, sex, and education of the members of the households. The individual questionnaire was more detailed in nature and was used to obtain information on the marriage history, reproductive history, experience with fertility regulation, economic characteristics and abortion attitudes from ever-married women under age 50. The WFS core questionnaire was the basis of BFS, although it was modified to adapt to conditions prevailing in Bangladesh. The principal modification was to change the suggestion of the WFS core questionnaire to record the pregnancy history on two separate tables: one for live births and the other for still births, miscarriages and abortions. Instead, a single integrated pregnancy history table was developed to avoid errors that could arise from the need to recall two sequences of events.

One source of error in the Bangladesh Fertility Survey was the lack of contact with all the households that were selected for

interview. Out of 4626 selected rural households, 4437 were successfully interviewed with a response rate of .959 (=4437/4626). The corresponding rate for the urban households was .934 (=1418/1519). The principal reason for failure to achieve 100 percent response in the household survey in both rural and urban areas was that the dwelling was vacant when the interviewer called (Ministry of Health and Population Control, 1978: 28). It may be noted that the main field work started on 18 December 1975 and was completed on 31 March 1976. This period is the cropping season of one of the most important varieties of rice (Boro) -- the staple food in Bangladesh (Chen et al., 1975: 205). Many men in the rural areas were probably engaged in activities related to rice production in the rice fields during the day in this cropping season. Women also remain busy in caring for all post harvest activities (Wennergren, 1983: 217). They prepare the threshing floor and are responsible for proper drying, winnowing, and storage of the rice. Boiling and husking are also done by women. Sometimes these activities can cause the women to stay out of the dwelling for a considerable period of time. Probably this is why the interviewers failed, on some occasions, to contact the residents of some households. In urban areas, the seasonal effect may not be operating but a greater percentage of women work outside their home. Moreover, urban people are probably more mobile because of transportation facilities. This increases the likelihood of finding some dwellings vacant.

A second source of error in the Bangladesh Fertility Survey was due to failure to interview all eligible respondents (ever-married

women under age 50 who had slept in the household the night preceding the household interview). Out of 5123 eligible rural respondents, 5024 were successfully interviewed with a response rate of .981 (=5024/5123). The corresponding rate for the urbanites was .976 (=1489/1525). The principal reason for individual nonresponse in both rural and urban areas was the nonavailability of the respondents (Ministry of Health and Population Control, 1978: 30). For the nonavailability of respondents, the same cause as in the case of household nonresponses (dwelling vacant) may apply. This may have biased the data against including small-sized households in which everybody works away from home during the day, leaving the household completely or partially vacant. But such a bias is unlikely to be serious, since most Bangladeshi households are not small-sized.

A second reason for nonresponse of individuals eligible for the survey was refusal to cooperate (Ministry of Health and Population Control, 1978: 30). Most of the potential interviewees were illiterate while most interviewers were university graduates. This created a considerable social distance between the eligible women and the interviewers that might have made some of the former hesitant to disclose their private matters. Moreover, the interviewers were mostly single women in their early twenties and therefore of the age of daughters of some of the potential interviewees. The big age difference might have also inhibited some from participating in the survey. Among the interviewers, the rural areas were under-represented while the city of Dhaka was over-represented. The majority of the

interviewers had rarely ventured outside Dhaka city. Their lack of familiarity with rural life, lack of experience at survey field work, and unfamiliarity with regional dialects may have contributed to the refusal rates.

However, the overall completion rate of the survey was extremely high. We calculated the overall completion rate of rural and urban areas separately. The rural household response rate was .959 and the rural individual response rate was .981. The overall rural completion (response) rate was thus .959 x .981=.941. Similarly, the overall urban completion rate was .934 x .976=.912. Both of these completion rates compared highly favorably with the 64.1 percent completion rate of the 1970 United States National Fertility Study (Johnson, 1977: 34) and the total completion rate of 93.6 percent of the Indonesian Fertility Survey (Nasikun, 1982: 41).

A number of steps were taken to minimize nonresponse which may explain the high overall completion rate. The BFS objectives and plan of action were widely published in the national newspapers. An earnest appeal was made to the public through public radio to cooperate with the field staff. This is likely to have created among listeners a sense that the survey was of national concern. Those receiving the radio messages were not surprised by the arrival of the interviewers, and, hence, any reluctance to discuss private matters with interviewers may have been somewhat reduced.

Given that the central questions in the questionnaire were extremely personal, the likelihood was great that many of the female

respondents would be unwilling to respond to these questions posed by male interviewers. This source of nonresponse was avoided by appointing female interviewers.

A third strategy to minimize nonresponse was the special training provided to interviewers and their supervisors. There were eleven interviewing teams (including one reserve team), each of which consisted of one male supervisor, one female supervisor, five interviewers and a cook. These supervisors and interviewers were provided training to increase their skill in building rapport with the respondents. Moreover, a pretest of the questionnaire was done in August, 1975, when 160 rural women and 120 urban women were interviewed. The pretest was meant to pinpoint problems in the survey instrument, but it also provided a rehearsal for the interviewing teams.

The pretest showed that a number of modifications were needed on the questionnaire. Firstly, some questions had to be resequenced. For example, marriage history questions were moved to precede pregnancy history questions to avoid embarrassing separated women, for example, by asking them: "Are you now pregnant?" Also to insure that sensitive questions were not asked toward the start of the interview, abortion questions were moved to a new section at the end of the questionnaire.

Other alterations in the questionnaire were the rewording of questions. For instance, the questionnaire was translated into the colloquial language as far as possible. This was designed to increase the understandability of the questions and thereby the quality of the responses in general.

The birth history data from developing countries are usually fraught with the problem of accuracy of reporting. Older women have the tendency to omit births and deaths that occurred in the past. This is probably because of the effect of the longer intervals of time and a larger number of events on memory. These omissions can lead to false conclusion not only about the level of fertility and mortality, but also about trends, since the omitted births have typically occurred in the more remote past.

Because of the indication from the results of the pretest that high illiteracy and innumeracy would lead to considerable recall error, the pregnancy history section of the questionnaire was simplified. There was a series of questions in the questionnaire that was designed to ascertain the number of sons and daughters either living at home or away from home. These questions were eliminated and more attention was paid in obtaining a single integrated history of all pregnancies.

Because of these precautions the quality of the pregnancy history data appears high. As a test of omission of vital events, it could be assumed that the omission of births would be sex selective, given the differential status males and females face in Bangladesh. The overall sex ratio of births derived from the BFS birth histories for the period 1945-1974 is 1.06 which appears to be normal (Kabir, 1982: 48). There is no evidence that the reporting of births is more complete for one sex than the other. The total number of children ever born to respondents was 25,836 of whom 3916 were reported to have died in infancy. This yields an implied infant mortality rate of 152 infant

deaths per 1000 live births, a rate typical of several other countries in middle South Asia (e.g., Nepal and Bhutan; see Haub, 1982). The implied infant mortality rate is higher for males than for females which is common in most societies. Thirdly, in BFS data, considerably higher mortality was reported in the neonatal period (days 0-27 from birth) than in the postneonatal period (days 28-364 from birth), a pattern also found in most nations of the world (Kabir, 1982: 41). All these and the fact that the fixation of the upper age limit of the respondents at fifty years excluded women likely to show the most extreme recall bias, suggest that the failure to report births which later died in the BFS data, is unlikely to seriously distort the analysis.

A final point that is worth mentioning is that only 9 percent of the Bangladesh population are urbanites (Ministry of Health and Population Control, 1978: 9). But the percentage of the urban respondents in the BFS data is 23 (=1489 x 100 / 6513). This clearly indicates over-sampling in the urban area. This over-sampling was done to obtain a larger sample of urbanites to facilitate the statistical control of a number of social factors related to urban fertility. However, to ensure that the results of the present study are not biased by an over-representation of urbanites, residence of the respondents (rural/urban) will be treated as a control variable in this research.

In conclusion, the 1975-76 Bangladesh Fertility Survey data, for the study of the effect of infant and child mortality on fertility in Bangladesh do appear to be reasonably sound. The rate of response is

highly satisfactory, in comparison to what is typical for fertility surveys in general and the amount of bias that might have crept in does not appear to have seriously distorted the data.

Measures

Dependent and Test Variables

The unit of analysis in Proposition 1a is an infant or child death. Infant or child mortality will be defined in the present study as death between birth and exact age five years. An infant or child death will be deemed as "replaced" by another live birth if the latter occurs within 10-24 months of the death date of the former. A live birth following a child's death date by 9 or fewer months could not have been conceived after the older child died and, hence, could not have been conceived for the purpose of replacement. Therefore, a birth occurring 10-24 months after the death of an older sibling will be deemed to have happened relatively fast. We reason that this rapidity could reflect a conscious desire to replace the dying child. The dependent variable of Proposition 1a shall be scored dichotomously: (0) child death not followed by live birth 10-24 months later; (1) child death followed by live birth 10-24 months later.

To avoid censorship bias, all live births after December, 1969, will be excluded from the study. This will be done since some children

born between 1970-75 may have been alive at the time of the survey but may have died later on before reaching the fifth birthday. Thus, the inclusion of births within five years prior to the survey date would prevent the observation of all deaths to these children before the fifth birthday and this would downwardly bias the measurement of child mortality. In other words, the survey artificially censors or truncates the observation of child mortality for children currently under age five; hence the name -- censorship bias. Similarly, since child replacement is defined as a new birth 10-24 months following the death of a child under age five, the inclusion of deaths to children born after 1969 would preclude observation of some attempts by mothers to replace the deceased. Both these biases are likely to distort the true relationship between child mortality and subsequent fertility and might lead us to reject Propositions 1a and 2a when they are, in fact, true.

Also, all women who did not yet experience the birth of the first child, will be excluded from this study. These women cannot contribute to the study of the effect of infant/child mortality on fertility. Another category of women that will not be included in this study are those whose first birth happened within five years prior to the survey date. As has been discussed in the case of children, the inclusion of these women will import truncation bias in the analysis. Also if a woman has missing information on any variable of interest for a particular proposition, she will be excluded for the analysis of that proposition. This may result in differential number of cases for different propositions.

Proposition 1a hypothesized that the tendency of a dying child to be followed by a live birth 10-24 months after the death will be greater if the deceased is a male than if a female. The test variable for this proposition is the gender of the dying child: (1) male; (2) female.

Proposition 1b hypothesized that the likelihood of a woman's ever-using contraception will be lower if she has had a son to die than if she has had only daughters to die. The dependent variable for this proposition is a woman's ever-use of contraception and will be measured by scoring "1" if she has ever-used any method of contraception and "0" if she has not. These methods of contraception were the pill, IUD, other female scientific method (such as foam tablets, jelly, or cream), condom, rhythm, abstinence, withdrawal, douche, female sterilization, male sterilization or any other method. Clearly, the length of use and the timing of adoption or abandonment of contraception in connection with infant and child deaths are more sensitive indicators of attempts to replace dying offspring. But due to the lack of appropriate data, these indicators could not be used in the present study.

The test variable is the sex of the dead child and will be dichotomized by scoring "1" if at least one boy died and "2" if only girls died. For example, if she has had both a son and a daughter to die, her score on the test variable would be "1". Obviously, the unit of analysis for Proposition 1b is a mother who has faced one or more deaths of children under age 5.

Proposition 2a asserted that after the death of a son, the likelihood of a live birth 10-24 months later will be greater when he had fewer than two surviving brothers. The dependent variable is the same as for Proposition 1a. The test variable is the number of surviving sons (or brothers of the dead son) at the death of the reference son. This variable will be dichotomized: (1) zero or one surviving son; and (2) two or more surviving sons.

The final hypothesis (Proposition 2b) was that a woman's likelihood of ever-using contraception will be directly related to the number of her surviving sons. The unit of analysis is all mothers, whether or not they have faced child loss. The dependent variable is the same as for Proposition 1b, and the independent variable is the same as for Proposition 2a.

Control Variables

The relationship between infant/child mortality and subsequent fertility can be affected by a multitude of additional influences. This poses difficulty in the isolation of the direct influence of our test variables. For example, some factor (e.g., female education) may systematically affect both her fertility and the mortality of her children and engender a spurious relationship between the latter two variables. Therefore, it is necessary to control those factors other than the test variable which are suspected to be related to a dependent variable of interest.

As mentioned previously, the unit of analysis for Propositions 1a and 2a is a child death; and the unit of analysis for Propositions 1b

and 2b is a mother. Hence, two control variables will be specific to Propositions 1a and 2a. Two control variables will be unique to Propositions 1b and 2b. And three control variables will be shared in common by all four propositions. Therefore, the number of control variables for a given proposition will be five, the maximum number allowed by the BMDP (Biomedical Computer Programs) computer software. The control variables will be discussed in that order.

Control Variables for Propositions 1a and 2a.

One of the factors for child spacing for societies, like Bangladesh, where contraception is rare, is breastfeeding. Breastfeeding prolongs post-partum amenorrhea, but the death of a nursing child can hasten the return of ovulation and the probability of a new birth. A proper test of Propositions 1a and 2a requires that potentially nonvoluntary effects on child spacing be controlled so that deliberate attempts to replace dying children with new births can be recognized. The very nature of these two propositions automatically allows for the biological effect. For example, in Proposition 1a we are interested in comparing the frequencies with which the women give birth to babies within a period of 10-24 months inclusive after the death of a male child versus a female child. The biological factor should be operating equally in both cases. As a result, whatever differences exist between the two frequencies, should be attributed to behavioral response to the death of a child of selective sex. Similarly, in Proposition 2a, we will be comparing how the tendency of

another birth to occur 10-24 months inclusive after the death of a son depends on the number of his surviving brothers. As before, the breastfeeding pattern should not vary so that any variation in tendency should be attributable to differences in number of surviving brothers. Therefore, breastfeeding will not be a control variable.

Mortality perhaps affects fertility but fertility itself probably also affects mortality. Probabilities of survival are poorer for births of higher order (Puffer and Serrano, 1975). Scrimshaw (1978) argued that higher-order births are less likely to be wanted, and, hence, receive less solicitous care than do their lower-order siblings. Children of high birth orders come from large sibship (by definition), a factor associated with protein-calorie malnourishment in some studies (see Wray and Aguirre, 1969). In Bangladesh, the target number of living children is 4-5, about 2 of whom should be sons. Thus, deaths to births of order five or lower should be more likely to induce replacement than those of births of order six or higher. The introduction of birth order (scored [1] = ≤ 5; [2] = 6+) as a control variable will estimate the differential effect of child mortality on fertility while holding constant the reciprocal effect of fertility on child mortality.

In case of multiple births, the birth order will be determined as follows: if a woman produces twins at her first delivery, for example, a singleton at the second delivery, and again twins at the third delivery then the first twins will have birth orders 1 and 2 and this ordering will be the same as the order in which they have been

mentioned to the interviewer and accordingly recorded; the single birth at the second delivery will be assigned the birth order 3 and the twins of the third delivery will have birth orders 4 and 5, again in the order in which they were reported. In other words, the birth orders will match the ordering in which they have been mentioned to the interviewer and, therefore, reported.

The other control variable specific to only these two propositions will be the age of mother at the death of the child. This age might affect her physical ability to replace the child with another birth. This variable will be measured: (1) less than 20 years old; (2) 20-29 years; and (3) 30 or more.

Control Variables for Propositions 1b and 2b.

The number of living children of a woman might affect whether she has ever used contraception. As mentioned before, the culturally prescribed target number of living children in Bangladesh is 4-5. As a result, a woman with more than five living children is more likely to use contraception than a woman with less than five living children, other things being equal. This control variable will be measured by assigning a value of (1) if a woman has five or fewer living children and a value of (2) if she has more than five living children.

The relationship between ever-use of contraception and mother's current age has been found to follow an inverted "U" distribution (Ministry of Health and Population Control, 1978: 79). That is, the mothers of youngest and oldest age groups are less likely to ever-use

contraception compared to mothers of the middle age range. This may be because, as has been discussed before in Chapter II, in the social structure of Bangladesh, adult sons are the highest form of security against the privations of widowhood and as a result women attempt not only to have sons but to have them as early as possible in their marital life cycle. Then, understandably, ever-use of birth control is low among the youngest married women. The reason why the oldest women are less likely to ever-use contraception may reside in the fact that they are more traditional in their views and are, therefore, less prone to ever-use contraception. The mothers of the middle age groups may not be as traditional as the older ones and at the same time, are more likely already to have the desired number of children. This results in their higher ever-use of contraception. Combination of these three groups and their relationship with ever-use just discussed, will give rise to an inverted "U" distribution. This control variable -- mother's current age -- will be coded: (1) less than 20 years; (2) 20-29 years old; and (3) aged 30 years or more.

Common Control Variables

Place of residence has been found to be related with infant/child mortality, fertility and use of contraception. Infant mortality rates are higher in rural areas than in urban areas (Kabir, 1982: 44). Most of the rural people belong to the lower socioeconomic group with highly limited access to nutritional foods and health services. Regarding contraceptive use, 28.1 percent of the urban women have ever-used at

least one contraceptive method compared to 12.3 percent of the rural women (Ministry of Health and Population Control, 1978: 80). Although in general, the fertility of rural women is higher than that of their urban counterparts, in the BFS data, only a small difference was observed between the mean number of children ever born to urban and rural women (3.9 and 4.0 live births, respectively; see Ministry of Health and Population Control, 1978: 68). But interesting differences emerged after controlling for education. Although uneducated women display no urban/rural difference, contrary to the usual pattern, the urban women with primary or more education have higher fertility than rural women. The number of children ever born to urban women with primary education is 4.0, while it is 3.4 to rural women having same educaion; the figures are 2.6 and 2.3, respectively, for the higher education group (Ministry of Health and Population Control, 1978: 68). The recent phenomenon of higher use of contraception in urban areas has not yet altered this fertility differential. Place of residence will be measured as: (1) rural; (2) urban.

The rate of infant deaths to mothers with no schooling has been found to be substantially higher than that to mothers having five or more years of schooling (Kabir, 1982: 43). Wife's education has a strong positive association with knowledge and use of contraception (Ministry of Health and Population Control, 1978: 80). As a result, the average number of Bangladeshi children ever born to a woman with no schooling is 4.2; to a woman with primary education, 3.46; and to a woman with more education 2.4 (Ministry of Health and Population

Control, 1978: 68). Moreover, Chaudhury (1977), using data on 1130 fecund women in the reproductive ages (15-49) living with their husbands, in Dhaka, Bangladesh, showed that, at every age level, wife's education had a stronger depressant effect on fertility than did husband's education. In view of this, wife's education rather than the husband's education will be a control variable and will be scored (1) primary or less education; (2) more than primary education.

Religion may have a direct effect on the number of children ever born. After age standardization, the mean number of children ever born to Bangladeshi women is 4.0 for Muslims and 3.8 for non-Muslims (Ministry of Health and Population Control, 1978: 69). Many factors might account for the higher fertility of Muslim women. The age at marriage for Muslim women is lower than that for non-Muslim women, although the difference is not considerable (13.0 and 13.3 years, respectively; Ministry of Health and Population Control, 1978: 53). In the Muslim concept of marriage, dissolution is possible in case of serious maladjustment while a Hindu marriage cannot be terminated. Thus, while the first marriage dissolution rate among Muslims is almost twice as much as among non-Muslims, the incidence of remarriage after this dissolution is almost three times as much. This causes a greater proportion of non-Muslim women to remain outside marriage than Muslim women, thereby contributing to higher fertility of the latter. For the present analysis, religion will be measured by scoring (1) Muslim woman; (2) non-Muslim woman.

Statistical Procedures

No research of the type undertaken here has been done on child replacement in Bangladesh. It was hence unwise to assume equiprobability that a birth would or would not occur 10-24 months after the death of an older sibling under age five years (see dependent variable of Propostions 1a and 2a). Likewise, it was known that the percent of women in Bangladesh ever trying contraception was far below 50 (see dependent variable in Propositions 1b and 2b). When the distribution of responses into categories of a dichotomous dependent variable depart much from a 50-50 split, it becomes unlikely that each explanatory variable will follow a normal distribution with equal covariance matrices at both levels of the dependent variable (Johnson and Nelson, 1984). Since this assumption of ordinary-least-squares (OLS) regression might not hold, it was decided to employ a logit regression to test the four propositions.

In a logit regression model, an expected odds is the basic form of the variation to be explained. An expected odds is the ratio between the expected frequency of being in one category of the dependent variable and that of not being in that category. The expected cell frequencies are estimated by the maximum likelihood estimation technique. The natural logarithm of the expected odds of being in the first category of the dependent variable can be expressed as a linear function of the effect of being in the first categories of all the explanatory variables. Consequently, a logit regression is the categorical-variable analog to OLS regression (Fienberg, 1981).

To fit the logit models, a step-up procedure will be used. This means that, first a general log-linear model involving only the main effects of the dependent variable, test variable, and control variables will be fitted. As a simple example, let us assume that A is the dependent variable, B is the test variable, and C is the control variable. The log-linear model is

$$\log m_{ijk} = \mu + A_i + B_j + C_k \quad \ldots\ldots (1)$$

where m_{ijk} is the expected frequency of the cell corresponding to the ith category of the variable A, jth category of B and kth category of C. After fitting this model, we will have the likelihood ratio chi-square statistic (Knoke et al., 1980: 30) given by

$$G_1 = 2 \Sigma f_{ijk} \log m_{ijk}$$

where f_{ijk} is the observed frequency in the (ijk)th cell. G^2 has the chi-square distribution with degrees of freedom equal to the number of parameters that were set to have no effects on expected cell frequencies. A large value of G^2 indicates a poor fit of the model to the data.

The next model to be fitted would include all the main effects that were included in the first model and in addition, all first order interactions involving the dependent variable. Our interest lies in the relationship between the dependent variable and the test variable after the influences of control variables have been accounted for. These latter relationships are represented by two-way interactions between the dependent variable and the rest; in our example above, they would be AB and AC. The new model would be

$$\log m_{ijk} = \mu + A_i + B_j + C_k + (AB)_{ij} + (AC)_{ik} \quad \ldots\ldots (2)$$

The log-linear model will compute a likelihood ratio chi-square statistic G_2^2 and the degrees of freedom corresponding to the fit of the model (2). A statistically significant relationship between the dependent variable and the set of test and control variables will be indicated if the difference $G_1^2 - G_2^2$ is statistically significant. If the inclusion of the interaction terms in step 2 does produce a statistically significant reduction in G^2, the model resulting from this inclusion of the interactions in step 2, will be preferred. In the same manner, a third model having all of the second-order interactions involving A, B, and a control variable (and their lower-order relatives) can also be fitted. These second-order interactions would show whether B might be conditionally related to A. It is to be noted that the preferred model might have a statistically significant G^2. However, our purpose is not to find the "best fitting model". Rather, to achieve a nonsignificant G^2 might require the inclusion of interaction terms of only the control variables, which terms are not germane to a test of the propositions. The omission of the higher-order terms involving only the control variables allows us to construct a parsimonious general log-linear model. Also, to attain a statistically nonsignificant G^2 might have required the inclusion of higher order interaction terms involving A and B and some combinations of two or more control variables. For simplicity, such terms were not considered.

Maximum likelihood estimation will provide estimates of a set of parameters for this final general log-linear model. From these

estimates, an estimated logit regression model will be generated. Let us assume that our final general log-linear model is represented by equation 2. The logit regression model is

$$\log\left(\frac{m_{1jk}}{m_{2jk}}\right) = 2\lambda + 2\Sigma\lambda_{t} + 2\Sigma\lambda_{tu} \quad \ldots\ldots (3)$$

where m_{1jk} is the expected frequency in the (ijk)th cell when i=1 and m_{2jk} is the expected frequency in the (ijk)th cell when i=2; the first term on the right is the logit regression intercept, the second term on the right consists of the unstandardized logit regression slopes representing the effects of test and control variables and the third term on the right is composed of unstandardized logit regression slopes representing the interactions between the dependent variable and the other variables.

For testing the significance of the test variable, a simple t-test could be employed. The ratio of 2 to its standard error is distributed as a t- statistic under the null hypothsis of no effect, with appropriate degrees of freedom. This distribution tends to a normal distribution as n, the sample size, approaches infinity. Given the size of our sample, our statistic λ/S.e.(λ) will be distributed as N(0,1). Consequently if λ/S.e.(λ) gives a value greater than 1.96, we can reject the null hypothesis at the 5 percent level of significance and can conclude with a 95 percent probability of being correct that the observed effect did not arise out of chance.

CHAPTER IV

PRESENTATION OF FINDINGS

Description of the Units of Analysis

The basic theme of this research relates to one of the most controversial areas of demography -- whether, and if so, how, infant and child mortality may affect subsequent fertility. Specifically, this research examined whether the gender of a dead child and the sex composition of its living siblings affects its mother's subsequent fertility as well as her future use of contraception. To this end, two units of analysis were employed: a child death -- defined as a death between birth and exact age five years -- for Propositions 1a and 2a; and a mother for Propositions 1b and 2b.

In the BFS data, the total number of births that occurred before 1970 and ended in death before exact age five years was 4837 (Table 1). Table 1 shows that most of the dying children had been born to rural Muslim women with no more than a primary school education. Thirty-seven percent of their mothers were teenagers, a fact which may explain why most (75.6 percent) of the dying children had fewer than two surviving brothers. Child mortality had impaired mothers' ability to achieve the cultural ideal, a household of 4-5 living children and two living sons, because more than half of the dying children were males (52.4 percent) or were fifth or lower-order births (84.2 percent). (The latter figure should not be understood to indicate that death

TABLE 1. Descriptive Statistics for Child Deaths.

Variable	N	Percent
Sex of Child		
Male	2536	52.4
Female	2296	47.5
out of range	5	.1
Total	4837	100.0
Birth order of child		
≤5	4074	84.2
>5	763	15.8
Total	4837	100.0
Surviving brothers at death		
0 or 1	3655	75.6
≥2	1182	24.4
Total	4837	100.0
Mother's education		
≤Primary	4707	97.3
>Primary	107	2.2
Out of range	23	.5
Total	4837	100.0
Place of residence		
Rural	3921	81.1
Urban	916	18.9
Total	4837	100.0
Religion		
Muslim	4010	82.9
Other	825	17.1
Out of range	2	.0
Total	4837	100.0
Child replaced by new birth		
No	2400	49.6
Yes	2437	50.4
Total	4837	100.0
Mother's age at death of child		
<20	1789	37.0
20-29	2168	44.8
≥30	880	18.2
Total	4837	100.0

rates are higher at lower birth orders; rather, that lower-order births are relatively more common.) This impairment may have created pressures on the bereaved mothers to have more children, for 50.4 percent of the deaths were followed by a new birth 10-24 months later.

The other unit of analysis was women whose first birth had occurred before 1970 (N = 4133 women; Table 2). All such women were considered regardless of their experience with child loss. Thus, the mothers of the dead children of Table 1 are a subset of all these mothers. Like this subset, the set of all mothers was composed mainly of rural Muslim women with primary-school education or less. Unlike the mothers of the dead children, the majority (60.6 percent) of this more inclusive set of mothers was aged 30 or over. Only 19 percent of all these mothers had ever tried any method of contraception. A reason for such low usage might be the high child mortality rates, for 60.8 percent of these mothers had lost at least one child under age five. A minority of the women had at least six living children (2.3 percent) or at least two living sons (45.1 percent). Thus, high child mortality had seriously deterred mothers from attaining the cultural ideal of 4-5 living children and two living sons.

TABLE 2. Descriptive Statistics for All Mothers.

Variable	N	Percent
Number of surviving sons		
0 or 1	2269	54.9
≥2	1864	45.1
Total	4133	100.0
Mother's education		
≤Primary	3922	94.9
>Primary	192	4.6
Out of range	19	.5
Total	4133	100.0
Number of living children		
≤5	4039	97.7
>5	94	2.3
Total	4133	100.0
Place of residence		
Rural	3219	77.9
Urban	914	22.1
Total	4133	100.0
Religion		
Muslim	3423	82.8
Other	709	17.2
Out of range	1	.0
Total	4133	100.0
Ever used contraception		
No	3349	81.0
Yes	784	19.0
Total	4133	100.0
Mother's current age		
<20	26	.6
20-29	1603	38.8
≥30	2504	60.6
Total	4133	100.0
Sex of dying children		
No children died	1621	39.2
At least one boy	1694	41.0
Girls only	818	19.8
Total	4133	100.0

Proposition 1a

Proposition 1a asserted that the likelihood for a live birth to occur 10-24 months after the death of a child will be greater if the dead child is a male rather than a female. Apart from the sex of the dead child, other variables that were suspected to be related to the dependent variable (mother's education, birth order of the dead child, mother's age at the death of the child, residence and religion) were introduced as control factors. For the sake of convenience of presentation, let us label these control variables as C, D, E, F, and G, respectively. We label the dependent variable (the occurrence of a birth 10-24 months after the death of a child) as A and the test variable (the sex of the dying child) as B.

Due to the lack of any past evidence, it was apprehended that the assumption of equiprobability that a birth would or would not occur 10-24 months after the death of an older sibling under five years of age might not be a valid one. As a result, logit regression rather than OLS regression was employed. However, as mentioned before, the simple frequency table showed that 50.4 percent of the new births occurred 10-24 months after the deaths of children. Nevertheless, for the other propositions, logit regression would be needed. Therefore, to maintain comparability, logit regression was used to test Proposition 1a.

The first task was to fit a general log-linear model. A step-up procedure was followed to find whether the main effects and two-way interactions of all study variables improved the fit of the general log-linear model. The first model was the simplest possible: only a mean. If the first model were the best possible, it would signify that the observations were distributed across the seven-way table in totally random fashion. The second model is the first model to which have been added the seven main effects. The reduction in the value of likelihood ratio chi-square is 12982.56 with a corresponding reduction of 8 degrees of freedom (Table 3). This highly significant reduction in the value of G^2 implies that the inclusion of the main effects has considerably improved the fit of the general log-linear model. That is, observations are more likely to appear in some cells than in others.

The model 3 involves the mean, the seven main effects and the first order interactions involving only the dependent variable A. The question of interest to be addressed here is: "Is the dependent variable related to any of the six other variables? In other words, does the knowledge of scores on one or more of the explanatory variables help predict scores on the dependent variable?" The inclusion of the first order interaction terms reduced the likelihood ratio chi-square by 116.32 with corresponding reduction of 7 degrees of freedom. This is also highly significant and, therefore, considerable improvement in the model has been achieved by inclusion of these first

TABLE 3. Likelihood-ratio Chi-square, Degrees of Freedom, and Probabilities of General Log-linear Models of the Occurrence of Births 10-24 months after Deaths of Children on the Test and Control Variables.

General Log-Linear Models	Liklihood-ratio chi-square (G^2)	Degrees of Freedom	Probability <
1. [Mean]	14562.36	191	.00001
2. [A] [B] [C] [D] [E] [F] [G]	1579.80	183	.00001
3. [AB] [AC] [AD] [AE] [AF] [AG]	1463.48	176	.00001

order interaction terms. This implies that the dependent variable is significantly related to one or more of the explanatory variables. Thus, Model 3 became the log-linear model on which the test of Proposition 1a was based.

Model 3 was written to express the natural logarithm of the expected cell frequencies as an additive function of being in the first categories of all the variables. Then the equation was rewritten to express the natural logarithm of the expected cell frequencies as an additive function of being in the second category of the dependent variable but the first category of the test and control variables. When the second equation was subtracted from the first, the remainder was a logit regression equation: the natural logarithm of the odds of being in the first category of the dependent variable (no new birth in 10-24 months after a child death) equated to an additive function of being in the first category of all the control and test variables. A logit regression coefficient (2λ, see column 1 of Table 4) not significantly different from zero meant that a test or control variable did not affect the log odds that a new birth would not follow a child death in 10-24 months. Alternatively, we can take the antilogarithm of both sides of the logit regression equation to express these interrelationships in multiplicative form ($e^{2\lambda}$). If the multiplicative form of a logit regression coefficient is not significantly different from unity, it means that the variable has no effect (column 3, Table 4).

Table 4 shows that the age of a mother at the death of a child was significantly related to whether or not a new birth followed in 10-24

TABLE 4. Logit Regression of Child Replacement (0=No; 1=Yes) on Sex of Dying Child and Control Variables.

Independent Variables	2λ	$\frac{\lambda}{S.e.(\lambda)} = t$	$e^{2\lambda}$
Intercept	2.132		8.432
B = Sex of child (male; female)	-.032	-1.113	.969
C = Mother's education (≤primary; >primary)	.020	.208	1.0202
D = Birth order of dead child (≤5; >5)	-.070	-1.746	.932
E = Mother's age at death of child			
Under 20	-.384	-9.105	.681
20-29	-.114	-2.830	.892
F = Residence (rural; urban)	.036	.980	1.037
G = Religion (Muslim; other)	.016	.397	1.016

N = 4807

months. A child's death was less likely not to be followed by another birth in this period if its mother was a teenager (2λ=-0.384) or aged 20-29 (2λ=-0.114). This may reflect the greater fecundity of women under age 30.

Of chief interest to the test of Proposition 1a was the effect of the sex of the dying child on the log odds of no new birth 10-24 months later. Table 4 shows that the death of a male child was slightly less likely not to be followed by a new birth in this time frame (2λ =-0.032), but this effect was not significantly different from zero. In other words, the deaths of sons were no more likely than the deaths of daughters to be superseded quickly by a new birth (in 10-24 months). These results rejected Proposition 1a.

Proposition 1b

Nonuse of contraception could stem from a wish for more children. In Chapter II, researches were cited that found lower use of contraception among women who had experienced child loss. Therefore, nonuse of contraception could be a child-replacement strategy. Because sons are highly valued in Bangladesh, we proposed that mothers who had lost at least one son would be less likely to use contraception than mothers who had lost daughters only (Proposition 1b).

To explore this question, we first sought a parsimonious log-linear model relating the following variables. We labelled the dependent variable (ever-use of contraception) as A; the test variable (sex of the child that died) as B; and the control variables (mother's education, mother's current age, number of living children, residence and religion) as C, D, E, F, and G, respectively. Four log-linear models were fitted using only those study women who had lost at least one child under age five (N=2499).

Table 5 shows that the general log-linear model with the five two-way interactions of A and a control variable, together with their lower-order relatives, generated a G^2 of 156.24, which was not significant at 176 degrees of freedom. Thus, Model 3 was a good fit. But addition of the five three-way interactions involving A, B, and a control variable reduced this G^2 by 51.75 and the degrees of freedom by 12, reductions which were highly significant. Therefore, Model 4 was chosen as the log-linear model from which to produce the logit regression for Proposition 1b (Table 6).

Table 6 shows that mothers who had had at least one son to die before age five were <u>less</u> likely <u>not</u> to have contracepted than were mothers who had had only daughters to die ($2\lambda = -.844$). This is in contradiction with our hypothesis. But the death of male children is associated with significantly lesser use of contraception <u>provided</u> the number of living children is five or less ($2\lambda = .188$). Thus our hypothesis is conditionally supported. If the number of living

TABLE 5. Likelihood-ratio Chi-square, Degrees of Freedom and Probabilities of General Log-Linear Models of the ever-use of Contraception on the Test and Control Variables.

Log-Linear Model	Likelihood-Ratio Chi-square (G^2)	Degree of Freedom	Probability <
1. [Mean]	12255.86	191	.00001
2. [A] [B] [C] [D] [E] [F] [G]	438.18	183	.00001
3. [AB] [AC] [AD] [AE] [AF] [AG]	156.24	176	.8554
4. [ABC] [ABD] [ABE] [ABF] [ABG]	104.49	164	.9997

TABLE 6. Logit Regression of Ever-Use of Contraception (0=No; 1=Yes) on Sex of Dying Child and Control Variables.

Independent Variables	2λ	$\frac{\lambda}{S.e.(\lambda)} = t$	$e^{2\lambda}$
Intercept	-.130		.878
B = Sex of child (male, female)	-.844	-3.419	.430
C = Mother's education (≤primary; >primary)	.000	.004	1.000
D = Mother's current age			
Under 20	.082	.204	1.085
20-29	.230	1.073	1.259
E = Number of living children (≤5; >5)	-.552	-6.865	.576
F = Residence (rural, urban)	.006	.098	1.006
G = Religion (Muslim; other)	-.090	-1.322	.914
BC	.222	1.739	1.249
BD			
Under 20	-1.346	-3.338	.260
20-29	.754	3.533	2.125
BE	.188	2.340	1.207
BF	.210	3.233	1.234
BG	.012	.181	1.012

N = 2499

children is less than or equal to the culturally prescribed number (five), the death of male children may threaten her attainment or maintenance of that number.

Ruralites were significantly more likely than urbanites never to have used contraception when they had lost at least one son than when daughters only had died young (2λ=.21). This may reflect the fact that a much greater proportion of urbanites are employed in jobs that provide guarantee of old age security in the form of a pension. This type of employment in rural areas is virtually absent. Since rural sons begin to help their parents early in life and support the parents in old age, sons are much more economically valuable than daughters, especially in rural areas. This may explain why women who had lost boys were much less likely to have ever contracepted than women who had lost only girls, when those women resided in rural areas.

Teenaged mothers were significantly less likely to have never used contraception when they had lost at least one son (2λ =-1.346). (The reason for phrasing as "less likely to have never used" is that the first category of the dependent variable in the logit regression model is "never use" of contraception and hence a negative logit regression coefficient implies a combination of two "negatives".) This may reflect the fact that younger women are less traditional with respect to contraceptive use than older women.

Proposition 2a

Proposition 2a hypothesized that if the death of a son leaves fewer than two surviving brothers, then the woman's likelihood of having a live birth in 10-24 months following this death would be greater than if two or more surviving brothers were left. The dependent variable is the same as for Proposition 1a except that it is restricted to male child deaths. We label this variable as A. The test variable is the number of surviving brothers of the dead son at the time of its death and is labelled as B. The control variables: mother's education, birth order, mother's age at death of the child, residence and religion are labelled C, D, E, F and G, respectively. As before, a step-up procedure was followed.

Table 7 shows the log-linear models used, and the corresponding likelihood ratio chi-square, degrees of freedom and the probability levels. As before, the first is the model of no effect; the second model involves the main effects with corresponding reduction in the likelihood ratio chi-square and degrees of freedom by 7684.65 and 8, respectively. This highly significant reduction in G^2 implies significant improvement in the model fitting. The inclusion of the first order interactions reduced G^2 by 74.85 and the degrees of freedom by 7. This also indicates further improvement in the model. At this stage, to see whether the joint effect of the dependent and test variables is conditioned by a third variable or not, model 3 with

TABLE 7. Likelihood-ratio Chi-square, Degrees of Freedom, and Probabilities of General Log-Linear Models of the Occurrence of Births after the Deaths of Sons on the Test and Control Variables.

Log-Linear Model	Likelihood-ratio Chi-square (G^2)	Degrees of Freedom	Probability <
1. [Mean]	9354.16	191	.00001
2. [A] [B] [C] [D] [E] [F] [G]	1669.51	183	.00001
3. [AB] [AC] [AD] [AE] [AF] [AG]	1594.66	176	.00001
4. [ABC] [ABD] [ABE] [ABF] [ABG]	534.66	164	.00001

second order interactions involving AB was fitted. The reduction in G^2 is 1060.00 and that in degrees of freedom is 12, a significant change. Therefore, Model 4 is the best of the four models.

Table 8 provides the independent components of the log odds of the replacement of a dead son, due to the effects of the intercept, the test variable and the control variables, under the model 4.

None of the variables was measured on less than 2468 cases and hence test of significance may be based on N(0,1) table; i.e., if a t-value in the third column is greater than 1.96, we may reject the null hypothesis of no effect at the 5 percent level of significance. Table 8 shows that when the death of a son who is a fifth or lower-order birth leaves fewer than two surviving brothers, then the odds of another birth in 10-24 months will be greater than if he leaves two or more surviving brothers or than if his birth order is greater than five (2λ=-0.134). In other words, these results cannot reject Proposition 2a, provided that the dying son's birth order is fifth or lower.

Proposition 2b

This proposition hypothesizes that the greater the number of surviving sons of a woman, the greater is the likelihood that she will use contraception. As before, we label the dependent variable -- (ever-use of contraception) as A; the test variable (number of surviving sons) as B; and the control variables -- (mother's education,

TABLE 8. Logit Regression of Replacement of Dead Son (0=No; 1=Yes) on the Number of Surviving Brothers and Control Variables.

Independent Variables	2λ	$\frac{\lambda}{S.e.(\lambda)} = t$	$e^{2\lambda}$
Intercept	-.258		.773
B = Number of surviving brothers of the dead son (0, 1; ≥2)	-.078	- .406	.925
C = Mother's education (≤Primary; >Primary)	-.034	- .207	.967
D = Birth order of the dead son (≤5; >5)	-.052	- .847	.949
E = Mother's age at death of the son			
Under 20	-.336	-2.193	.715
20-29	-.172	-1.842	.842
F = Residence (rural; urban)	.006	.107	1.006
G = Religion (Muslim; other)	-.012	- .193	.988
BC	.114	.683	1.121
BD	-.134	-2.177	.875
BE			
Under 20	-.126	- .825	.882
20-29	.014	.148	1.014
BF	.016	.266	1.016
BG	.084	1.350	1.088

N = 2521

mother's current age, number of living children, residence and religion) as C, D, E, F, and G, respectively. Four log-linear models were fitted. The first had no main-effect terms, while the second, third, and fourth added the main effects, the first-order interactions involving A, and the second-order interactions involving AB (respectively) to their lower order relatives (Table 9). We selected model 4 from which to create the logit regression for Proposition 2b because that model had the smallest G^2 and degrees of freedom.

Turning to Table 10, we observe that teenaged women with fewer than two surviving sons were significantly more likely not to have used contraception. Also the women having five or fewer surviving children and at the same time fewer than two surviving sons were significantly more likely not to have used contraception ($2\lambda = .26$). These findings could not reject Proposition 2b.

TABLE 9. Likelihood-ratio Chi-square, Degrees of Freedom and Probabilities of General Log-Linear Models of the ever-use of Contraception on the Test and the Control Variables.

Logit Regression Model	Likelihood-ratio Chi-square (G^2)	Degrees of Freedom	Probability <
1. [Mean]	18960.10	191	.00001
2. [A] [B] [C] [D] [E] [F] [G]	1709.23	183	.00001
3. [AB] [AC] [AD] [AE] [AF] [AG]	1042.12	176	.00001
4. [ABC] [ABD] [ABE] [ABF] [ABG]	208.35	164	.01090

TABLE 10. Logit Regression of Ever-Use of Contraception (0=No; 1=Yes) on the Number of Surviving Sons and Control Variables.

Independent Variables	2λ	$\frac{\lambda}{S.e.(\lambda)} = t$	$e^{2\lambda}$
Intercept	.948		2.581
B = Number of Surviving sons (0,1; ≥2)	.774	3.593	2.168
C = Mother's education (≤Primary; >Primary)	.218	2.812	1.244
D = Mother's current age			
Under 20	.070	.178	1.073
20-29	.050	.250	1.051
E = Number of living children (≤5; >5)	- .294	-5.271	.745
F = Residence (rural; urban)	.158	3.601	1.171
G = Religion (Muslim; other)	- .156	-3.064	.856
BC	-.056	- .736	.946
BD			
Under 20	1.336	3.402	3.804
20-29	- .980	-4,825	.375
BE	.260	4.643	1.297
BF	- .082	-1.882	.921
BG	- .184	-3.616	.832

N = 4113

CHAPTER V

SUMMARY AND CONCLUSIONS

Bangladesh has one of the lowest per capita incomes in the world, a low level of literacy, an extremely high population growth rate, and a very high level of infant and child mortality. The rapid population growth has been singled out by the Government as the severest problem of the country. With an area about one-third of the state of California and a population of about one hundred million, Bangladesh may be described as a nation struggling to survive. Under these circumstances, population control has been aptly top-prioritized and a huge amount of resources have been and are being poured into the National Family Planning Program. The establishment of this National Family Planning Program, together with subsequent augmentations of its budget, essentially was based on the assumption that there is a latent demand for contraceptive services among the married couples. Once this latent demand was met, it was thought that the fertility rate would fall "naturally."

The validity of this assumption is suspect. Ten years after the formal establishment of the National Family Planning Program, the Bangladesh Fertility Survey revealed that only eight percent of the married women aged 15-49 were using contraception. Research needs to pinpoint the impediments to the acceptance of the family planning services. To this end, the present study explored one such plausible impediment -- high infant and child mortality.

The levels of fertility and mortality of the European populations fell dramatically within only about two generations, in the late nineteenth and early twentieth centuries. This "vital revolution" led researchers to the persisting speculation of a causal link between the two variables. The standard conjecture is that there is a bidirectional relation between fertility and infant/child mortality: fertility affects infant/child mortality and the converse. That fertility directly affects infant/child mortality has been well established. It is also accepted that in a noncontracepting population, the death of an infant/child who was being breastfed, quickens the next pregnancy because the curtailment of breastfeeding hastens the return of ovulation. This influence of infant/child mortality on fertility has been termed the "biological effect." Another way in which infant/child mortality might raise fertility is that parents having experienced infant/child loss may consciously attempt to replace the dying child. This phenomenon has been variously termed the nonbiological, behavioral, or volitional effect.

Preston generalized that the populations at the lowest and highest levels of socioeconomic development should exhibit the strongest effects of infant and child mortality on fertility, but he thought that this effect for the poor populations should be mainly biological. This generalization is contradicted by the findings of Snyder in Sierra Leone and of Adlakha in Turkey. The volitional effect of high mortality on high fertility was found in these two societies even though they are at low levels of socioeconomic development.

In both these Muslim countries, the cultural premium placed on sons may mean that the death of a son is experienced as an intolerable loss demanding another pregnancy in an attempt to replace him.

Son preference is also very strong in the Muslim society of Bangladesh. We have seen that in Bangladesh, the culturally prescribed number of living children is 4-5, two of whom are ideally sons. As such, the present study explored in detail, how the sex of the deceased child as well as the sex composition of his/her surviving siblings affects the reproductive behavior of the women in Bangladesh.

Two dimensions of reproductive behavior -- fertility subsequent to the death of a young child (under age five) and ever-use of contraception -- were investigated in four propositions. The present analysis considered the occurrence of a birth 10-24 months after the death of an older sibling as relatively rapid, and this rapidity was assumed to reflect a conscious desire to replace the dying child. Also, if the child replacement hypothesis operates, then women with child death experience will be less likely to have ever-used contraception. The contraceptive behavior of ever-married women of childbearing age was studied with the Bangladesh Fertility Survey data.

A logit regression analysis did not support the prediction that the death of a male child would be more likely than the death of a female child to be superseded by a new birth 10-24 months later. However, when the birth order of a dying son was five or less or when he left behind fewer than two surviving brothers, his death was much more likely to be followed by another birth 10-24 months later. These

findings suggest that when a son's expiration threatens to reduce the number of surviving offspring below five or the number of surviving sons below two, then his death provokes an attempt to replace him with another birth. Thus it appears that norms about the optimal number and gender of offspring guide reproductive behavior in Bangladesh. When infant/child mortality threatens the achievement of these norms, then pressures develop for additional pregnancies.

Failure ever to use contraception can be a strategy followed to maximize the number of pregnancies. This strategy can be conscious or not. We proposed that a woman would be less likely ever to use <u>any</u> contraception if she had ever lost a son through death than if she had lost daughters only. While this proposition was not true generally, it was true in those cases where the number of living children was five or fewer. Likewise, when all mothers (those who had and had not lost children to death before age five) were examined, we found that those with five or fewer surviving children who at the same time had fewer than two surviving sons were much more likely never to have used contraception. Therefore, it appears that high infant/child mortality discourages the use of contraception in Bangladesh because most women will not use it until they have more than five living children of whom more than two are male.

The findings of this research are in sharp contrast with those of Chowdhury, Khan and Chen (1976). Their data come from the vital registration system maintained at Matlab Thana, Comilla district of Bangladesh. As mentioned in Chapter II, these authors, after

controlling for the biological effects of breastfeeding on ovulation, found no evidence that the child death experience generates a child replacement motivational response. But the authors failed to recognize that the son preference in Bangladesh is so strong that the death of a male child is highly likely to be perceived as a much greater loss in comparison to a female child's death and as such the former might induce a high motivation for its replacement. In contrast, the death of a female child may even depress the motivation to have another child since the fear of having another daughter is always present -- unless the sex composition of the surviving siblings is heavily biased toward males. That is, if a husband and wife have many more than the culturally prescribed number of sons, they may desire one or two daughters in order to profit from the services rendered by both sons and daughters. Therefore, two opposing motivations to replace sons but not daughters might have caused the null results in the study by Chowdhury and his associates.

Another limitation of their study is their inability to take into account the fact that the child-replacement motivational response is likely to be strongest for the birth immediately following a death. The third factor that was also not taken into account in their research is that the number of surviving children and their sex composition might play important roles in shaping parents' motivation -- positive or negative -- to replace the dead child. Chowdhury and his colleagues implicitly assumed that there is no culturally prescribed ideal number of living children or living sons in Bangladesh or that such norms do

not guide motivations to replace the ones that die. We have seen that this is not the case. Indeed, this culturally prescribed ideal number of living children as well as living sons, as we have seen in the present research, is one of the key elements that gave rise to the behavioral response of the parents to their child's death.

In Bangladesh, where the implications of high fertility are Malthusian, the identification of the hindrances to the acceptance of family planning methods and thereby to the realization of the national population goal, is importantly related to the policy formulation. As such, this research has a number of policy implications.

One implication is that a reduction in infant/child mortality may be a prerequisite for higher use of contraception and lower numbers of live births. A step toward reducing infant/child mortality would be to improve the health of both women and children. The establishment of a larger number of Maternal and Child Health Clinics throughout Bangladesh would contribute toward this goal.

Son preference is basically related to economic and social security, specially in old age and this preference has a bearing on the replacement strategy but not independently of the number of surviving sons and the number of living children. Thus it appears that it is not son preference alone that inhibits use of contraception or quickens the next birth after a son's death but son preference plus a preference for 4-5 living children. Son preference could be restructured toward greater egalitarianism by a change in the economic roles females are permitted to play. If females are allowed equal access to

income-generating activities, then the economic value of females to their parents and husbands will increase at the same time that women gain greater control over their own lives. One result would probably be a reduction in son preference.

However, even if son preference is reduced in these ways, it is unlikely that parents would use contraception or would retreat from replacing the dead children until the high target number of living children is reduced from its present level. Thus, the main implication of this research is that the culturally prescribed number of living children will have to be brought down to the extent that it will meet the national goal.

One possible direction may be adoption of drastic measures by the Government for penalizing parents indirectly for having more than two children, regardless of their sex. This may entail limiting educational facilities to children of third or higher order births. But this is unlikely to produce a substantial impact on fertility, given that a very small percentage of children receive more than a few years of schooling. Moreover, this is against the ethical spirit since the victims are those who have no control over their own birth order. The same criticism may apply to a second drastic measure: limiting health facilities only to children of first and second orders.

Another possibility may be encouraging adoption of orphan children. We have seen that parents experiencing child deaths try to replace them to arrive at the culturally prescribed number of living children. However, replacement can also be achieved by adopting

orphans rather than by having new births, given that in Bangladesh many children lose their parents through death. This will redistribute a given number of children among parents. But, in general, adopted children are considered less desirable than natural children. As a result, in the near future, policies encouraging adoption are not likely to reduce fertility.

This suggests that to accomplish the national goal, the only route to follow may be massive socioeconomic development. Mass education might play a very important role in this regard. It will help elevate the aspiration levels of the people and the greater the aspiration level, the more the reduced fertility will be felt as advantageous. In addition, education helps to lessen the tendency to depend on one's children. But education creates a demand for jobs. As such, creation of large scale pensionable jobs in the rural areas might help people feel less need to produce more children to depend on. This may sound too theoretical and prohibitively expensive but in reality it may not be, provided national programs distribute the benefits of economic development broadly rather than enrich a microscopic few. In other words, resource distribution should be done to favor heavily those at the lower rung of the economic ladder, the people who are the majority of the Bangladeshi population. Mass education in conjunction with pensionable jobs that guarantee economic support in old age, might eventually produce much less need of a large number of children. Then the prevailing target number of children will probably decline. Thus, whatever programs the government adopts, it is the majority people who

have to feel that the reduced fertility will go in their favor. Otherwise, massive acceptance of family planning services in Bangladesh, would remain a question of remote future.

We have also seen that when the birth order of the dead son is more than five or if the number of living children is more than five, the parents do not feel motivated to replace the dead son. One possible explanation is that parents adopted a "hoarding strategy" in that they had "extra births" (more than five) as insurance. This part of the "child survival hypothesis" has not been explored in this research. Yet this is also an important policy-oriented area. Community-level factors might independently affect the actual and perceived risks of infant and child mortality. A community with high infant and child mortality may create the perception of greater risks to life such that the tendency to replace dying sons or to hoard living ones should be strong and the motivation to contracept should be weak. Further research is needed to look at how and which community-level factors affect the perceived risks of infant and child mortality and how these perceptions might structure attempts to hoard living children, to replace dying ones, and to avoid contraception.

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