WHAT EXPLAINS THE REDUCTIONS IN INFANT AND CHILD MORTALITY IN MATLAB, BANGLADESH?

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ABSTRACT

Infant and child mortality rates have decreased substantially in Matlab, Bangladesh over the last two decades. We use data from the Matlab Demographic Surveillance System on nearly 94,000 singleton live births that occurred between 1987 and 2002 to investigate the extent to which the change in mortality over time can be explained by changes in social characteristics and reproductive behaviors. We estimate Cox Proportional Hazards models for four periods of infancy and childhood. Preliminary results show that changes over time in reproductive patterns and in other social characteristics explain up to 35% of the improvement, but a large percentage in the improvement can't be explained by observable variables over time. In the full paper, we will do a decomposition to assess which specific variables' changes played the largest role in the drop in mortality. We will also assess the extent to which the *effects* of explanatory variables changes over time.

INTRODUCTION

Infant and child mortality rates have decreased substantially in Matlab, Bangladesh, in the last two decades. The drop has been steeper in the Maternal Child Health-Family Planning (MCH-FP) Area than in the Comparison Area. Over this period many of the variables that affect infant and child mortality have changed as well: e.g., birth intervals have become longer, women are having fewer children, and women's education has increased. In this paper, we use data on nearly 94,000 singleton live births from the Matlab Demographic Surveillance System (DSS) to investigate the extent to which changes in reproductive patterns and in other key explanatory variables explain why infant and child mortality rates are lower between 1995 and 2002 than in 1987 to 1994.

STUDY SETTING AND DATA

Our study uses data from the Matlab subdistrict of Bangladesh, a poor country in South Asia. The rural Bangladeshi subdistrict of Matlab is well known for its DSS operated by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B). The DSS, which began in 1966, covers a large population (220,000 people in 2002) collects information on pregnancies, births, deaths, migrations, marriages, divorces, and household splits. Until 1999, data were collected by Community Health Research Workers (CHRWs) through fortnightly household visits. Since then, CHRWs have recorded events through monthly household visits.

The DSS data we use here contain information on 93,521 singleton births between 1987 and 2002, of which 7,728 died before age 5. The DSS data on the occurrence and timing of pregnancy outcomes and of deaths are of very high quality because they have been collected during regular household visits by trusted female community health workers.

METHODS

In the first stage of analysis, we show mortality rates in the four subperiods of infancy and childhood (first-week, late neonatal [2^{nd}-4^{th} week], 5^{th}-52^{nd} week, and 2^{nd}-5^{th} year) for our two designated calendar-year periods: 1987-1994 and 1995-2002. We adjust for censored observations by using the survival time commands in Stata 9.0.

We then use χ^2 tests to compare the reproductive variables between the two time periods. The reproductive variables of interest are maternal age; birth parity; the duration of the interval between the end of the preceding pregnancy and the birth under consideration (or "index birth"), which we refer to as the *inter-outcome interval* (IOI); the duration of the subsequent interpregnancy interval (in particular, whether the woman became pregnant again before the index child's first birthday); and the type of outcome of the previous pregnancy (i.e., whether a live birth, a miscarriage, and induced abortion, or a stillbirth). We do not consider years before 1987 in our analysis sample because information on the duration of the preceding pregnancy interval is frequently missing for them. (In particular, in the dataset we are using, we don't know the dates of pregnancy outcomes that occurred before 1982.)

In the second stage of analysis, we use multivariate modeling techniques to estimate the effects of being born between 1995 and 2002 (compared to being born between 1987 and 1994) on mortality in the four subperiods of infancy and childhood. For each subperiod, we estimate a Cox proportional hazards model for data on the age of the child's death (in days) to assess influences on whether the child died during the subperiod under consideration. For first-week mortality, we consider the sample of all singleton live births. For each subperiod after that, the sample is children that survived until the beginning of that subperiod. The proportional hazards model enables us to include censored observations in our analyses (e.g., children who were less than 5 years old at the end of our study period or those who migrated out of the study area before the end of the subperiod under consideration).

We first model mortality risk controlling only for whether the birth occurred between 1995 and 2002 (Model 1). We then add (in Model 2) controls for the non-reproductive behavior variables we consider (maternal and paternal education, father's absence, religion, household space [the total square footage of all dwellings owned by the household], sex of the child, and the child's month of birth) to control for differences in them between the areas. Then (in Model 3), we add to the hazard model the reproductive-pattern explanatory variables (maternal age, birth parity, the duration of the preceding inter-outcome interval, the type of outcome of the previous pregnancy, and an interaction between the shortest IOI [< 15 mos.] and the outcome of the preceding pregnancy). If pregnancies that occurred more recently have reproductive patterns that are associated with lower risks of infant and child mortality (e.g., fewer short intervals between pregnancies), then controlling for these variables should account for some of the mortality differences between the two time periods. Any remaining differences are due to changes over time in variables we do not consider. We will assess the extent to which the differences between the two time periods in each reproductive behavior variable explain the mortality differences. We will then do an analysis that allows the *effects* of the explanatory variables (i.e., their coefficients) to change over time to see if changes in these effects contributed to mortality changes over time.

RESULTS

Comparison of Mortality Rates over time

In Table 1, we show mortality rates (deaths per thousand children alive at the beginning of the interval) for the four subperiods of infancy and childhood for both of our time periods. The third column shows the associated significance level of the Mantel-Haenszel estimate comparing the two rates.

For each subperiod of infancy and childhood, the mortality rate decreased substantially between the two time periods. For example, in the early time period (1987-1994), first week mortality was at 30.1 births per

1000 live births compared to 25.6 in the later time period (1995-2002). For week 2-4 mortality and week 5-52 mortality, the difference between the two time periods is even larger: 15.3 vs. 8.2 and 33.7 vs. 19.2, respectively. In the age 1-5 subperiod, the mortality rate in the early time period is 27.4 deaths per thousand children alive at the beginning of the interval in 1987-1994, compared to 22.4 in 1995-2002. All of these differences are statistically significant at P<.001.

Comparison of Social and Reproductive Characteristics over Time

In this next section, we will discuss the comparison of our reproductive and social characteristics over time. (The tables are not included in this extended abstract. They will include the reproductive variables of inter-outcome interval, preceding pregnancy outcome, birth parity, and mother's age and the social and other characteristics are maternal and paternal education, father's presence in the household, religion, household space, birth month, and sex of the child. For each variable we will test whether the differences in the means or distributions changed significantly between 1987-94 and 1995-2002.)

Hazards Model Results

Table 2 shows the exponentiated coefficient on the 1995-2002 variable in the three models described above for each of the four subperiods of infancy and childhood that we consider. The number shown can be interpreted as the relative hazard of mortality in the more recent time period (1995-2002) compared to that in the earlier time period (1987-1994). For each pair of nested models shown (e.g., Model 1 compared with Model 2, Model 1 with Model 3, and Model 1 with Model 4, etc.), the likelihood ratio test satisfies p<.001. This means that the contributions of the additional groups of variables in Model 2 and Model 3 are worth the degrees of freedom.

For first week mortality, mortality is 15.0% lower in the 1995-2002 time period than in the earlier time period (1987-1994). In this subperiod, the mortality difference between time periods barely changes when we control for the non-reproductive control variables or the reproductive-pattern variables. This suggests that the reductions in mortality are due to other factors, such as changes in knowledge and behavior over time and improved care of pregnant women and their children, not considered here.

There have been large reductions between the 1987-94 and 1995-2002 in mortality during weeks 2-4, weeks 5-52, and ages 1-5 of life. Around 10-35% of this change can be attributed to changes in the social characteristics and reproductive behaviors considered here. Nonetheless, most of these large drops in mortality cannot be attributed to changes in the variables considered here. Further research in the full paper will assess the effects of changes in each explanatory variable, to see which changes contributed most to the part of the mortality decline we are able to explain. (To have a sizable effect either the variables changed markedly over time or it has a large coefficient or both.) We will allow for the possibility that some changes (e.g., an increase in the proportions of the births that are first parity) may have been in a direction that, other things the same, would have led to an *increase* in mortality over time.

We will also use interactions with calendar-year period to assess the extent to which the *effects* of the explanatory variables changed over time.

Table 1. Mortality rates (deaths per thousand children alive at the beginning of the subperiod) and associated rate ratios for four subperiods of infancy and childhood for singleton live births for two time periods, 1987-1994 and 1995-2002

	1987-1994	1995-2002	Significance level of Mantel-Haenszel Test of Ratio^
First Week Mortality	30.1	25.6	***
Week 2-4 Mortality	15.3	8.2	***
Week 5-52 Mortality	33.7	19.2	***
Age 1-5 Mortality	27.4	22.0	***

^ This is the test of whether the ratio differs significantly from 1.0.

+ p<.10 * p<.05 ** p<.01 *** p<.001.

All rates were calculated using Stata 9.0 using the “strate” command, which accounts for the censored observations.

Table 2. Effect of time (having a birth in 1995-2002 relative to 1987-1994) on mortality for four subperiods of life. All numbers represent the hazard ratio on the 1995-2002 variable from a Cox proportional hazards model. All standard errors are adjusted for the clustering that arises because some women have more than one child in the sample

First Week Mortality	**Hazard Ratio**
Model 1	0.850***
Model 2	0.829***
Model 3	0.845***

Week 2-4 Mortality	**Hazard Ratio**
Model 1	0.538***
Model 2	0.576***
Model 3	0.591***

Week 5-52 Mortality	**Hazard Ratio**
Model 1	0.558***
Model 2	0.634***
Model 3	0.634***

Year 1-5 Mortality	**Hazard Ratio**
Model 1	0.704***
Model 2	0.771***
Model 3	0.811***
Model 4	0.809***

+ p<.10, * p<.05, ** p<.01, *** p<.001.

Model 1 contains only a dummy variable for 1995-2002 as an explanatory variable.

Model 2 contains control variables for maternal education, paternal education, father's absence, religion, household space size, month of birth, and sex of child.

Model 3 contains all of the variables included in Model 2 plus the reproductive variables (inter-outcome intervals, outcome of preceding pregnancy, an interaction between outcome of preceding pregnancy and inter-outcome intervals <15 months, birth parity, and maternal age) as explanatory variables.

Model 4 (only for Year 1-5 Mortality) contains all of the variables in Model 3, plus a dichotomous variable indicating whether the mother was pregnant again by the time of the index child's first birthday.