Levels And Patterns Of Child Mortality: Application Of Indirect Techniques
Q Chowdhury, R Islam, K Hossain

Citation

Abstract
The child mortality has been recognized as an excellent summary index of the standard of living and socio-economic development as well as community health system of a country. And it has been considered as a frantic topic to population research in Bangladesh. The purpose of this study is to estimate the general levels and patterns of child mortality in Natore Sadar upazila. The results show the probabilities of dying (nq0) by Brass, Trussel and Sullivan indicate that are higher for early age group of mother then decline in middle age group and again start to increase with the age of mother increases. The result implies upward patterns of male child mortality over female child but male child mortality patterns for Trussel technique stretch out upward to the patterns of other two techniques. The estimated probability of dying in case of duration of marriage, the male child mortality is higher over female child mortality of all marriage duration groups and the shorter as well as the longer duration, the probability of dying both for male and female are always shown upward patterns. In the study it can be observed baby born to mother below aged 19 years as well as above aged 35 or to mother whose duration of marriage year is less than 4 years as well as greater than 20 years has highest mortality risk.

INTRODUCTION
Bangladesh is currently one of the very few countries in the world, which is on target for achieving the Millennium Development Goal (MDG) 4 relating to child mortality. There have been very rapid reductions in mortality, especially in recent years and among children aged over one month. Neonatal deaths now contribute substantially (57%) to overall mortality of children aged less than five years. (Arifeen, 2008)

During the immediate past century, the world has dramatic mortality changes. In developing countries, mortality changes were more contrasted. In some cases, mortality decline started late and was very rapid (China, Sri Lanka, Cuba) or less rapid (most of Latin America); in other cases it started early but was slow, though regular (Bangladesh, Pakistan, India); in Africa it started late, and was slower than elsewhere; in Russia, it started later than in Europe, was quite rapid between 1945 and 1970, then stopped and even reversed recently (Meslé and Vallin, 1995). In some African countries, mortality is even expected to increase in the near future because of the AIDS epidemic, as exemplified by the case of Abidjan (Garenne et al., 1995), or because of major political crises.

Mortality changes are primarily due to public health interventions and to modern medicine, although life style, education and nutrition also play a significant role. In developing countries, small-scale health interventions have obtained very rapid mortality changes, even in the absence of any significant change in income, education or other socio-economic indicators. In three Gambian villages totaling about 2,000 people, infant mortality (age 0 to 1 year) and child mortality (age 1 to 5 years) have been reduced by 80% in a period of ten years (1974-1983) following the arrival of a full time physician and a nurse (Lamb et al., 1984). In Senegal, when compared to the baseline period (1984-1986), mortality of under-five children has been reduced by 52% (from 329 to 159 per 1,000) within only three years (1987-1989), following a massive 54 intervention, including mass vaccination, and systematic treatment of diarrhoea and of acute respiratory infections (Garenne et al., 1991).

In response to know deficiencies in vital registration systems and population censuses, various indirect methods for estimating fertility and mortality have been developed. It can also be used to reconstruct mortality Patterns, assuming a linear mortality decline. Indirect approaches have been used for evaluating health interventions (Ewbank, 1993), but have
been severely criticized (Chen et al., 1993). In the case of child survival, they seem to present two problems: a problem of accuracy, since their confidence intervals are larger than those of direct estimates (Garenne, 1982; Garenne et al., 1995), and a problem of fitting mortality changes other than regular linear decline.

Child mortality is an important indicator of the successful implementation of the Poverty Reduction Strategy Plan (PRSP) because the level of child mortality is a consequence of broad range of Government interventions. We strongly believe that this research will be helpful for the policy makers, demographers and other researcher for further study. The purpose of this article is to study the probability of dying of child for male, female and both sexes applying Brass, Sullivan and Trussel method.

**METHODS**

**SOURCES OF DATA**

To fulfill the above objectives of this study, the data is collected from Natore Sadar Thana of Natore District, Bangladesh using multistage sampling technique.

**METHODOLOGY**

The best-known and most widely applied estimation method developed by William Brass is the measurement of child mortality from the proportions dead of children ever born by women classified by age group (Brass, 1964, 1975). In the study, \( q(x) \) the probability of dying before age \( x \) is calculated (Brass et al., 1968) using the equation

\[
q(x) = D(i)K(i)
\]

The multipliers, \( K(i) \) is calculated by fitting regression coefficients \( a(i), b(i) \) and \( c(i) \) into the following equation:

\[
K(i) = a(i) + b(i)\frac{P1}{P2} + c(i)\frac{P2}{P3}
\]

Where \( K(i) \) is as defined above and \( P1, P2 \) and \( P3 \) are the mean parities for the respective age groups 15-19, 20-24 and 25-29. The values of the coefficients \( a(i), b(i) \) and \( c(i) \) are given in the UN (1983, 77).

The original method has been extended by a number of authors, notably Sullivan (1972), who extended the method to groups of women classified by age. In a modification of Brass’s technique Sullivan developed a simple linear regression model is of the form

\[
q(x)/D(i) = A+B\frac{p2}{p3}, \quad I = 2,3,4.
\]

Where \( A \) and \( B \) are two constants of the regression estimated from the model life tables.

Trussell (1975) expanded the model base of the estimation methods. Trussel’s model has been presented in the following form:

\[
q(x)/D(i) = a(i)+b(i)\frac{p1}{p2}+c(i)\frac{p2}{p3}
\]

Where value of \( a(i), b(i) \) and \( c(i) \) are estimated from the model life tables.

**RESULTS**

The data of this study are presented in Table 1 and the pattern of the sex ratio of CEB is shown in Figure 1.

**Figure 1**

Table 1: Children Ever Born and Children Surviving by Sex and Age of Mother of Natore Sadar Upazila in Natore District, Bangladesh, 2007

<table>
<thead>
<tr>
<th>Age group</th>
<th>Total number of women</th>
<th>Male</th>
<th>Female</th>
<th>Sex ratio of CEB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CEB</td>
<td>Dead</td>
<td></td>
</tr>
<tr>
<td>15-19</td>
<td>88</td>
<td>13</td>
<td>1</td>
<td>0.7677</td>
</tr>
<tr>
<td>20-24</td>
<td>250</td>
<td>149</td>
<td>10</td>
<td>0.719</td>
</tr>
<tr>
<td>25-29</td>
<td>186</td>
<td>162</td>
<td>9</td>
<td>0.9364</td>
</tr>
<tr>
<td>30-39</td>
<td>116</td>
<td>149</td>
<td>128</td>
<td>1.1641</td>
</tr>
<tr>
<td>35-39</td>
<td>82</td>
<td>134</td>
<td>119</td>
<td>1.126</td>
</tr>
<tr>
<td>40-44</td>
<td>38</td>
<td>68</td>
<td>66</td>
<td>1.0303</td>
</tr>
<tr>
<td>45-49</td>
<td>36</td>
<td>100</td>
<td>60</td>
<td>1.6667</td>
</tr>
<tr>
<td>Total</td>
<td>796</td>
<td>775</td>
<td>65</td>
<td>1.1086</td>
</tr>
</tbody>
</table>

**Figure 2**

Estimation of probability of dying, surviving, reference period of children using data classified by age group of mother are demonstrated in Table 2 are their corresponding figures are presented in Figure 2 to Figure 7.
Table 2: Estimation of Probability of Dying, Surviving, Reference Period of Children Using Data Classified by Age Group of Mother

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age group</th>
<th>Average parity per women</th>
<th>$p_0$</th>
<th>Average parity per women</th>
<th>$p_0$</th>
<th>Proportion of death</th>
<th>$d_0$</th>
<th>Maternal age</th>
<th>$z_0$</th>
<th>Reference Period</th>
<th>$y_0$</th>
<th>Reference Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1-5</td>
<td>0.4370</td>
<td>0.0509</td>
<td>0.5458</td>
<td>1</td>
<td>6.777</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>0.7965</td>
<td>0.0897</td>
<td>0.5428</td>
<td>1</td>
<td>6.669</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
<tr>
<td>Female</td>
<td>1-5</td>
<td>0.3850</td>
<td>0.0564</td>
<td>0.5135</td>
<td>1</td>
<td>6.753</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>0.5370</td>
<td>0.0827</td>
<td>0.5462</td>
<td>1</td>
<td>6.657</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
<tr>
<td></td>
<td>11-15</td>
<td>0.6180</td>
<td>0.0871</td>
<td>0.5653</td>
<td>1</td>
<td>6.610</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
<tr>
<td></td>
<td>16-20</td>
<td>0.6580</td>
<td>0.0871</td>
<td>0.5745</td>
<td>1</td>
<td>6.601</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
<tr>
<td></td>
<td>21-25</td>
<td>0.6980</td>
<td>0.0871</td>
<td>0.5836</td>
<td>1</td>
<td>6.592</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
<tr>
<td></td>
<td>26-30</td>
<td>0.7380</td>
<td>0.0871</td>
<td>0.5926</td>
<td>1</td>
<td>6.583</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
<tr>
<td></td>
<td>31-35</td>
<td>0.7780</td>
<td>0.0871</td>
<td>0.6016</td>
<td>1</td>
<td>6.574</td>
<td>-</td>
<td>6.3033</td>
<td>1.11</td>
<td>2005.0</td>
<td>0.11</td>
<td>2005.0</td>
</tr>
</tbody>
</table>

Figure 3: Patterns of proportion of children dead for male, female and both sexes

Figure 4: Patterns of average parity per women for male, female and both sexes child

Figure 5: Patterns of male child mortality using Brass, Sullivan and Trussel techniques

Figure 6: Patterns of female child mortality using Brass, Sullivan and Trussel techniques

Figure 7: Patterns of male child mortality using Brass, Sullivan and Trussel techniques

Figure 8: Patterns of female child mortality using Brass, Sullivan and Trussel techniques
The CEB and children surviving by sex based on duration of marriage of Mother are displayed in Table 3.

Table 3: Children Ever Born and Children Surviving by Sex Based on Duration of Marriage of Mother

<table>
<thead>
<tr>
<th>Duration of marriage group</th>
<th>Ever-married women</th>
<th>Male</th>
<th>Female</th>
<th>Sex ratio of CEB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>106</td>
<td>45</td>
<td>61</td>
<td>0.8036</td>
</tr>
<tr>
<td>5-9</td>
<td>223</td>
<td>144</td>
<td>79</td>
<td>1.8036</td>
</tr>
<tr>
<td>10-14</td>
<td>166</td>
<td>148</td>
<td>18</td>
<td>1.0617</td>
</tr>
<tr>
<td>15-19</td>
<td>109</td>
<td>149</td>
<td>60</td>
<td>1.0617</td>
</tr>
<tr>
<td>20-24</td>
<td>63</td>
<td>98</td>
<td>5</td>
<td>1.0538</td>
</tr>
<tr>
<td>25-29</td>
<td>37</td>
<td>73</td>
<td>12</td>
<td>1.1774</td>
</tr>
<tr>
<td>30-34</td>
<td>32</td>
<td>98</td>
<td>17</td>
<td>1.8148</td>
</tr>
<tr>
<td>Total</td>
<td>796</td>
<td>775</td>
<td>65</td>
<td>1.1774</td>
</tr>
</tbody>
</table>

Estimation of probability of dying, surviving, reference period of children using data classified by duration of marriage of mother are shown in Table 4 and corresponding figures are depicted in Figure 8 to Figure 11.
DISCUSSION

ESTIMATION OF CHILD MORTALITY USING DATA CLASSIFIED BY AGE OF MOTHER

Table 1 incorporated the data of this study. Before preceding the estimation of child mortality, a quick check of the consistency of the data is needed (UN, 1983). The ratios given in column (7) of the Table 1 fluctuate somewhat by age of mother but show no systematic pattern can be seen in Figure 1 and the overall sex ratio is acceptably close to the expected value of 1.08 (sex ratio of Natore Sadar upazila was 1.08, BBS, 2003). It is concluded that this test shows no clear deficiency in the data set.

In the study, average parity per women i.e. the mean number of children ever born of male, female are higher in the age group 40-44 that are 1.7895 and 1.7368 respectively. According to the rough the test, the data appear to be satisfactory, because in the study it is observed that average parities have been increased with the increase of age of mother, which illustrated in Figure 2.

Thus proportion of children dead of male, female and both sexes among those ever born to women aged 15-19 are 0.0769, 0.0588 and 0.0667 respectively. At the early age and age of mother 40-44 years, the proportions of dead children are high and middle age group of mother as well as at the end of reproductive span this pattern decreases gradually that are represented in Figure 3, especially above age 35.

In case of male children, it can be seen a very small decline of \( q(x) \) estimates (0.0765 to 0.0566) from the 25-29 year to 30-34 year age groups of mother and then are steadily increased which strongly suggesting that male child mortality has been falling for Brass technique. If it is ignored the value for women aged 15-19 (this value is almost always out of line with subsequent values, probably because the children of young women are, in fact, subject to higher mortality risk); it is to be obtained a increasing curve of \( q(x) \) estimates as against age group of mother. In case of female children, it can be observed a very small decline of \( q(x) \) estimates from age group 25-29 to 30-34 years and again decline from 40-44 to 45-49 years of mother aged. Patterns of male and female child mortality always keeps upward to the pattern of female child mortality can be shown in Figure 4.

For male children, mortality estimates \( q \) calculated through three techniques can be observed higher for early age group of mother then decline in middle age group and again start to increase with the age of mother increase. For male child of mother’s age group 20-24, probability of dying are 0.0632, 0.0624 and 0.0695 by the estimation technique Brass, Sullivan and Trussel respectively and it become lower in mother age group 25-29 are 0.0498 and 0.0778 for the estimation technique Sullivan and Trussel respectively. It starts to increase in mother age group 30-34 are 0.0546 and 0.0602 for the estimation technique Sullivan and Trussel. Pattern of male child mortality for Trussel technique always keeps upward to the patterns of other two techniques presented in Figure 5.

Mortality estimates \( q \) female child calculated through three techniques can be observed higher for early age group of mother then decline in middle age group and again start to increase with the age of mother increase (Figure 6). For female child in mother age group 20-24, probability of dying are 0.0131, 0.0141 and 0.0147 and it start to increase in mother age group 30-34 are 0.0234, 0.0218 and 0.0247 for the techniques for Brass, Sullivan and Trussel respectively.

For both sexes, \( q \) calculated through Trussel are relatively higher than other two methods (Figure 7). In mother age
group 20-24, probabilities of dying are 0.0387, 0.0398 and 0.0430 for Brass, Sullivan and Trussel respectively. In age group 25-29, probabilities of dying become 0.0420, 0.0410 and 0.0556 for the three estimation techniques respectively. Therefore, estimation through Brass, Sullivan and Trussel techniques it can be revealed that for age group 25-29, male child mortality are 76, 50 and 78 per 1000 live births respectively and female child mortality are 33, 32 and 36 per 1000 live births respectively. Where child mortality estimated through Trussel technique are higher over other two techniques for both male and female in the age group 25-29 and are more representative to express child mortality scenarios.

**ESTIMATION OF CHILD MORTALITY USING DATA CLASSIFIED BY DURATION OF MARRIAGE**

Data on the number of children ever born and children surviving is being obtained during a survey period that has been recorded not only by age of mother but also by the time elapsed since her first union that means legal marriage duration of couples are summarized in Table 3.

The sex ratio values (in Table 3) are exactly constant, but except for the referring to duration group 0-4 and 30-34 years, and the pattern of sex ratios are presented in Figure 8. In child mortality analysis, the average parity per women i.e. the mean number of children ever born of male, female are higher in the duration of marriage group 30-34 were 3.0625 and 1.6875 respectively and entirely the patterns of average parity per woman increased with the increased of duration of marriage of mothers that are shown in Figure 9.

The proportions of children dead also increase with marital duration. Proportion of children dead of male, female and both sexes among those ever born to women duration of marriage group 5-9 were 0.0282, 0.0143 and 0.0417 respectively and overly the shorter and the longer duration of marriage of women the proportions of dead are higher than other marriage durations of mother, which are illustrated in Figure 10.

The estimates of $q_1$ increase with the duration of marriage of mother. Estimation through Brass technique it can be revealed that for duration of marriage group 5-9 of mother, male child mortality is 42 per 1000 live births and female child mortality is 14 per 1000 live births. The estimated probability of dying in case of duration of marriage, the male child mortality is higher over female child mortality of all marriage duration groups and the shorter as well as the longer duration, the probability of dying both for male and female are always shown upwards patterns in this study which is actual child mortality scenarios of Natore Sadar upazila, 2007 (Figure 11).

**Conclusion and Recommendations**

A healthy and sound grown up generation can lead a nation to the way of prosperity and vision. So it is our respect duty to make the way smooth and clean for ensuring the proper grown up of new born baby and for launching on the development track of achieving PRSP goals as well as the United Nation’s Millennium Development Goal to reduce child mortality. In this study probabilities of dying ($q_0$) of child is higher for early age group of mother then decline in middle age group and again start to increase with the age of mother increase. In case of duration of marriage, probability of dying is higher in early marriage duration groups as well as in longer duration.

Therefore, for reducing child mortality in the study area as well as the majority of the developing countries like Bangladesh baby should be taken within mother age range 20-34 years or within duration of marriage 5-19 years of mother.

**References**

International Journal of Epidemiology, 22 Suppl. 1, S8- S14.
Author Information

Quamrul Hasan Chowdhury
Research Fellow, Department of Population Science & Human Resource Development, University of Rajshahi

Rafiqul Islam
Associate Professor, Department of Population Science & Human Resource Development, University of Rajshahi

Kamal Hossain
Lecturer, Department of Population Science & Human Resource Development, University of Rajshahi