RESEARCH ARTICLE

DIFFERENTIALS AND DETERMINANTS OF UNDER-FIVE MORTALITY IN BANGLADESH

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ABSTRACT

Childhood mortality remains one of the main problems in Bangladesh. Although Bangladesh has made remarkable progress in reducing mortality among under-five children over the last few years but it is still remain high. The purpose of this study is to observe the trends, differentials, and also to identify the determinants, of under-five mortality in Bangladesh. Data from Bangladesh Demographic and health Survey (BDHS)-2007 have been used. By using percentage distribution this study ascertained the differentials of under-five mortality. Also, Chi-square test has been used to identify the factors associated with under-five mortality. Cox proportional hazard model has been applied to find out the determinants of under-five mortality. The study results show that the under-five mortality is higher among children born as multiple births; children with first birth order and 7th or 7^+th birth order; children with preceding birth interval less than 18 months; mother's age at birth less than 20 years; mothers and fathers with no education; children from poor household; mother whose age at first marriage was less than 20 years; children from households without access to improved toilet facilities and improved source of drinking water. The findings of this study suggest that female education, mothers' knowledge and awareness regarding childhood disease, treatment, immunization and access to child healthcare should be enhanced.

INTRODUCTION

Children with under-five ages are the most important section of society, their growth and development has strong reflection on the future of a country (Gulati, 2010).

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Improvements in child health and survival can promote more balanced population dynamics of a country and so child health is a central issue on the public policy agenda of most of the developed and developing countries. But still today millions of children under the age of five die each year due to readily preventable causes. Every day, an estimated, 29000 children die before the age of five in

the world (Tadesse *et al.*, 2009). Recent estimates show that, in 2008, 8.8 million children died before reaching the age of five, the highest rates of mortality in children under-five continue to occur in sub-Saharan Africa and South Asia has the second highest rate of under-five mortality in the world (You *et al.*, 2009). Most of these children lived in developing countries and died from a disease or a combination of diseases or illnesses.

Mortality among children under five years of age has become the burning issue of the day and has received renewed attention as a part of the United Nation's Millennium Development Goals (MDG). The fourth goal of United Nation's MDG is to reduce under-five mortality by two thirds between 1990 and 2015 that is from 93 children of every 1,000 dying before age five in 1990 to 31 of every 1,000 in 2015 (UNICEF, 2009). The under-five mortality rate has declined throughout the world. In 1990, the under-five mortality was 93 per thousand live births, but the rate has declined to 67 in 2007; in that year, more than 12.6 million young children died from preventable or treatable causes; the figure has declined to around 9 million in 2009, despite population growth (UN, 2009). Developing countries has also improved much in reducing under-five mortality except some countries. For the developing regions, the under-five mortality rate dropped from 103 in 1990 to 74 in 2007 (UN, 2009).

With a population of 162.2 million, Bangladesh is one of the densely populated (1,127 persons per square kilometers) countries in the world (PRB, 2009). Bangladesh has faced many serious challenges in the field of health, education as well as to improve the quality of life of her population. Bangladesh has made remarkable progress over the last few decades, with sustained macroeconomic stability, improved health and education and a steady decline in poverty levels. Despite these improvements, childhood mortality remains one of the main problems in Bangladesh due to high prevalence of malnutrition and childhood diseases such as acute respiratory infections (ARI), measles, diarrhoea, cough, fever etc. The childhood mortality still remains high in some vulnerable groups and areas. The child mortality in the poorest households and in hard to reach areas is approximately 50 per cent higher than those in the wealthiest areas (UNICEF, 2008). Neonatal and perinatal causes contribute to near half of all under-five deaths (Government of Bangladesh and UN, 2005). One neonate dies in every three to four minutes, making 14 neonates deaths every hour in Bangladesh (UNICEF, 2008). Healthcare facilities for children in Bangladesh remain limited and inadequate; besides a lack of health personnel, medicines and other facilities are not uniformly available (Mondal *et al.*, 2009) which are

responsible for high early childhood mortality in Bangladesh. Moreover, the nutritional status of mother and children are very poor. Childhood mortality in Bangladesh has long been a topic of interest to population and health researchers because of its apparent relationship with fertility and indirectly with acceptance of modern contraception (Rahman, 2009). The target for Bangladesh related to MDGs is to reduce under-five mortality from 151 deaths per 1,000 live births in 1990 to 50 in 2015 (Arifeen, 2008). The rate of loss of early years of life is an outcome of socio-economic, environmental, biological and cultural factors although it is very difficult to identify which factors are more responsible for childhood mortality. Thus proper estimation of level and trends and finding associated factors for under-five mortality would be helpful for policy makers, program designers/ planners to design or redesign program(s) or existing program(s) for reducing under-five mortality.

Objectives

The specific objectives of this study are as follows:

   a) to examine the levels and trends of under-five mortality
   b) to identify the determinants of under-five mortality

Data and Methodology

For studying differentials and determinants of under-five mortality in Bangladesh data come from Bangladesh Demographic and Health Survey (BDHS)-2007. The BDHS-2007 asked all ever-married women aged 15-49 years to provide a complete history of their live births, including the sex, month, and year of each birth, survival status, and age at the time of the survey or age at death. Age at death was recorded in days for children dying in the first month of life, in months for children dying before their second birthday and in years for children dying at later ages. Missing respondent, non-dejure residents and non- response cases for the question related to child mortality and child nutrition (height and weight without flagged) were not included in the analysis. Chi-square test has been used to identify the factors associated with under-five mortality. For analyzing time to the event(death) / survival data, Cox proportional hazard model can be used which provides an opportunity to explore the effects of various time independent covariates on the timing of death (Haque, 2009). Cox proportional hazard model is applied to find out the determinants of under-five mortality. In this analysis, interested event is the death of under-five children and all children born in 1997-2006 are

considered as exposure to the risk of death. Observation starts at the time of birth and ends when child died or for right-censored cases after the fifth birthday of the child. To ensure statistically reliable estimates, the analysis is restricted to 10 years before the BDHS-2007 survey which implies that analyses considered only those children who were born between the years 1997-2006. For Cox proportional hazard analysis, the dependent variable is the likelihood (or risk) of death and the status variable considered in this study as death of under-five child which coded as 1 if under-five child died up to his/her fifth birthday.

RESULTS AND DISCUSSION

Trends and differentials of under-five mortality

Bangladesh is one of the few countries in the world, which is on the track of achieving the Millennium Development Goal 4 (MDG 4) to reduce under-five mortality by two-thirds between 1990 and 2015. Already Bangladesh has able to halving the under-five mortality in 2004 since 1990. In 1990, the under-five mortality was 151 deaths per thousand live births, in 2004 the rate was decreased to 74 deaths per thousand live births and in 2008 it is estimated to 54 deaths per thousand live births. Besides under-five mortality, Bangladesh has able to improve the overall childhood mortality situation. Infant mortality, which is a very sensitive indicator, is also declining. Table 1 shows the declining trend of neonatal, post-neonatal, infant, child and under-five mortality rates according to BDHS surveys. From table1, it is observed that the mortality among the under-five children of Bangladesh has declined. Bangladesh has also achieved improvement in reducing the death in neonatal, post neonatal and in infancy period. For finding the differentials of under-five mortality in Bangladesh percentage distribution of under-five mortality by some child and maternal related and socio-economic variables is presented in table 2. The same table also presents the χ^2 test results to examine the association between covariates and under-five mortality.

Table 2 shows that the number of live births between the years 1997-2006 was 12,317 and the number of under-five deaths during the same period was 890 (7%). The under-five mortality was extremely high for multiple births (35%) as compared to singleton births (7%). Children with first birth order (9%) and with 7 or 7+ birth orders (9%) died more than the children with 2-3 birth orders (6%) and 4-6 birth orders (8%) before the age of five. The number of deaths among the under-five children was higher for children whose preceding birth interval were less than 18 months (15%) and also the under-five deaths were found highest among the mothers whose age at the time of birth of their dead children were less than 20 years. From table 2 it is also evident that the under-five mortality was lower among children of secondary (5%) and higher educated (2%) mothers than children of mothers with no education (9%) and with primary education (7%). Similar results also found incase of father's education. Table 2 further shows that as compared to household with access to hygienic toilet and improved source of drinking water, the percentages of under-five mortality were higher among children living in households without access to hygienic toilet and improved sources of drinking water. It is observed from the chi-square test results that most of the covariates have statistically significant association with under-five mortality (table 2). The result shows that some child and maternal related and socio-economic variables have significant association with under-five mortality.

Determinants of under-five mortality

The mortality among the under-five children is disproportionately higher among high-risk groups such as infant of multiple births. In Bangladesh, Multiple births are strongly negatively associated with child survival independent of other risk factors (Hong, 2006). Multiple births are complicated by a higher risk of disease and pregnancy complication of mothers, which results into increasing risk of child and maternal mortality. Multiple birth children have also a higher risk

Table 1. Trends in Early Childhood Mortality, Bangladesh, 1994-2007

BDHS Surveys	Reference Period	Neonatal Mortality	Post-neonatal mortality	Infant Mortality	Child Mortality	Under-five Mortality
1993-1994	1989-1993	52	35	87	50	133
1996-1997	1992-1996	48	34	82	37	116
1999-2000	1995-1999	42	24	66	30	94
2004	1993-2003	41	24	65	24	88
2007	2002-2006	37	15	52	14	65

Source: BDHS-2007

of suffering from malnutrition, which is also associated with early loss of lives. The results from Cox proportional hazard model (table 4) show that children

effect on under-five mortality. Results indicated that the risk of under-five mortality was higher among children of first birth order and children with 7th or 7+th birth

Table 2. Distribution of under-five mortality, Bangladesh, 2007

Maternal related and Socio-economic factor	Total children	Number of under-five deaths	Percentage	χ^2 value
Type of Birth				236.8***
Singleton	12109	818	6.8	
Multiple	208	72	34.6	
Birth Order of child				23.50***
1	3616	308	8.5	
2-3	5242	313	6.0	
4-6	2812	214	7.6	
7or 7+	647	55	8.5	
Sex of Child				0.363
Male	6274	462	7.4	
Female	6043	428	7.1	
Preceding Birth interval				137.00***
First Birth	3635	315	8.7	
<18 months	712	107	15	
18-24 months	1198	116	9.7	
25-35 months	1910	129	6.8	
36 or 36+ months	4862	223	4.6	
Age at birth of mother				123.00***
<20	3349	338	10.1	
20-29	5752	395	6.9	
30-39	1844	144	7.8	
40 or 40+	1372	13	0.9	
Mothers' education				75.541***
No education	4362	408	9.4	
Primary	3952	290	7.3	
Secondary	3253	177	5.4	
Higher	750	15	2.0	
Fathers' education				49.62***
No education	4733	411	8.7	
Primary	3476	276	7.9	
Secondary or Higher	4108	203	4.9	
Economic status of household				24.409***
Poor	5283	452	8.6	
Well-off[1]	7034	438	6.2	
Age at first marriage of mother				
<20	11412	837	7.3	2.733*
20+	905	53	5.9	
Type of toilet facility				37.70***
Flash toilet and pit latrine with slab	5516	315	5.7	
Open pit	4401	353	8.0	
Others[2]	2400	222	9.2	
Source of Drinking water				28.420***
Improved[3]	5042	289	5.7	
Non improved[4]	7275	601	8.3	
Total	12317	890	7.23	

Note: *** Significant at p<.01, ** Significant at p<.05, *Significant at p<.10; [1] includes middle and rich households; [2]includes bucket, hanging toilet/hanging latrine, no facility/bush/field etc. [3] includes piped water into dwelling/yard/plot, public tap/standpipe, tube well, protected dug well, rainwater. Authors' calculations based on BDHS-2007 data; [4] includes unprotected dug well, unprotected spring, surface water etc. Rainwater; [4]includes unprotected dug well, unprotected spring, surface water etc. Authors' calculations based on BDHS-2007 data

born to multiple births were associated with 68% higher risk of dying before the age of five than the children born singleton births. Birth order of a child has very strong

order. Sex of child is also an important factor in variation of child mortality. Preceding birth interval is the length of time between a child's birth and a previous and/or

subsequent sibling's birth. Short birth interval is strongly associated with child mortality. Short intervals between two pregnancies of mother have insufficient time to restore their nutritional reserves, which can adversely affect fetal growth and development (Mondal *et al.*, 2009). Again first birth marks a woman's transition into

Table 3. Description of covariates for Cox proportional hazard model.

Covariates	Categories
Type of Birth	1=Singleton, 2=Multiple
Birth Order	1=first, 2=2-3, 3=4-6 and 4=7 or 7+
Sex of Child	1= Male and 2= Female
Preceding Birth interval	1=First Birth, 2=<18 months, 3=18-24 months, 4= 25-35 months and 5=36 or 36+ months
Age at birth	1=<20 years, 2=20-29 years, 3=30-39 years and 4=40 or 40+ years
Mothers' education	0=No education, 1=Primary 2=Secondary and 3=higher
Fathers' education	0=No education, 1=Primary and 2=Secondary or higher
Economic status	1=Poor (includes poorest, poorer and poor) 2=Well-off (includes middle and rich)
Age at first marriage	1=<20 years and 2=20+ years
Type of toilet facility	1=Flash toilet and pit latrine with slab, 2=Pit latrine and 3=Others
Source of Drinking water	1=Improved and 2=Non-improved

Table 4. Relative risk of dying before the age of five among the Children, Bangladesh

Maternal related and Socio-economic factor	Co-efficient (β)	Relative Risk (RR)	95% CI for exp (β)	
			Lower	Upper
Type of Birth				
Singleton (RC)	——	1.00	——	——
Multiple	0.521	1.684***	1.292	2.195
Birth Order				
1	0.325	1.384	0.569	3.368
2-3	-0.161	0.852*	0.593	1.223
4-6	-0.333	0.717**	0.512	1.003
7or 7+(RC)	——	1.00	——	——
Sex of Child				
Male	0.113	1.120	0.979	1.282
Female(RC)	——	1.00	——	——
Preceding Birth interval				
First Birth	——	1.00	——	——
<18 months	0.064	1.066	0.816	1.392
18-24 months	-0.145	0.865	0.693	1.079
25-35 months	-0.124	0.883	0.668	1.167
36 or 36+ months(RC)	-0.408	0.665	0.292	1.512
Age at birth of mother				
<20(RC)	——	1.00	——	——
20-29	0.000	0.998	0.821	1.216
30-39	-0.064	0.938	0.693	1.269
40 or 40+	-0.255	0.775	0.403	1.491
Mothers' education				
No education	0.328	1.389**	0.796	2.421
Primary	0.474	1.606*	0.923	2.794
Secondary	0.591	1.806**	1.046	3.117
Higher(RC)	——	1.00	——	——
Fathers' education				
No education	0.081	1.085	0.892	1.319
Primary	0.024	1.024	0.841	1.249
Secondary or Higher(RC)	——	1.00	——	——
Economic status of household				
Poor	0.010	1.010	0.868	1.176
Well-off (Middle and Rich) (RC)	——	1.00	——	——
Age at first marriage of mother				
<20	0.051	1.053	0.769	1.441
20+(RC)	——	1.00	——	——
Type of toilet facility				
Flash toilet and pit larine with slab (RC)	——	1.00	——	——
Open pit	0.037	1.038	0.884	1.219
Others	0.086	1.090	0.899	1.322
Source of Drinking water				
Improved(RC)	——	1.00	——	——
Non improved	0.134	1.143	0.838	1.560

Note: RC= reference category; *** Significant at p<.01, ** Significant at p<.05, *Significant at p< .10
Authors' estimation based on BDHS-2007 data

motherhood but this can be a tragic event in many cases both for mother and child. Table 4 shows that, children with preceding birth interval less than 18 months had 1.07 times higher risk of dying before the age of five than children of first birth. Again, Children with preceding birth interval 18-24 months had 14%, children with preceding birth interval 25-35 months had 12%, children with preceding birth interval 36 months or more had 44% lower risk of childhood mortality than first birth children.

In this study, an association has found between the mothers' age at childbirth and mortality among under-five children in Bangladesh. Babies born to teenage mothers are known to be at increased risk of childhood mortality due to physical immaturity of teenagers (Friede *et al.*, 1987). Result shows that risk of dying of children whose mother's age at the time of birth were 20-29 years, 30-39 years and 40 or 40+ years were reduced by 0.99, 0.94 and 0.78 times respectively compared to children with mothers' age less than 20 years.

Research findings from many studies showed that strong association exists between mother's education and child mortality. Education contributes to use of modern technology, participation in family planning, regulate income, occupation, family status and knowledge on disease prevention, which can reduce childhood mortality. Mother's education seems to be directly associated with child health. Study result shows that under-five children of parents with higher education are less likely to die compared to children of parents with no education (table 4). Type of toilet and source of drinking water are directly associated with childhood mortality. Some diseases, which transmitted through unhygienic toilet and unimproved source of drinking water can cause many deaths among children. It is generally expected that, household with better source of drinking water and better sanitation facilities will have lower childhood mortality. It is observed that children born in households where open pit latrine used had 1.04 times and children born in households where there was no toilet facility and used other unhygienic toilet had 1.09 times higher risk of childhood mortality than children born in families with flash toilet or pit latrine with slab. Children born to mothers in households without access to improved source of drinking water were associated with 14% higher risk of dying before the age of five compared to those children with access to improved source of drinking water.

Conclusion

The findings of the study show that mortality among under-five children is decreasing but it is still high in Bangladesh. Results also show that the under-five mortality is higher among children born in multiple births; children with first birth order and 7th or 7+th birth order; male children; children with preceding birth interval less than 18 months; mother's age at birth less than 20 years; mothers and fathers with no education; children from poor household; mother whose age at first marriage was less than 20 years; children from households without access to improved toilet facilities and improved source of drinking water. The findings of this study suggest that female education, mothers' knowledge and awareness regarding childhood disease, treatment, immunization and access to child healthcare should be enhanced. Births should be reduced to very young (<20 years) mothers and higher order births should be decreased. Government should take appropriate step to increase people's awareness about health care and hygiene practices because increasing awareness of the population relating to healthcare and hygiene is a prerequisite to decrease child mortality.

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