Proceedings of the Australasian Conference on Business and Social Sciences 2015, Sydney
(in partnership with The Journal of Developing Areas)
ISBN 978-0-9925622-1-2

WOMEN EMPOWERMENT AND INFANT MORTALITY IN BANGLADESH

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ABSTRACT

This study attempts to investigate the effects of women empowerment on infant mortality in Bangladesh. Four indicators have been considered to measure four dimensions of women empowerment: the level of education, participation in household decisions, autonomy in movements and employment status. Rotated factor analysis technique is used to construct the last three dimensions. The Weibull parametric survival model has been specified and estimated using the Bangladesh Demographic and Health Survey (BDHS) data of 2011. The results show that three measures of empowerment (level of education, participation in household decisions and autonomy in movements) contribute significantly to the reduction of infant mortality rate. But women employment is associated with increased mortality for infants. The findings of the study have a number of policy implications on this issue for a developing country like Bangladesh.

JEL classification: I15; I10; O15

Keywords: Women Empowerment, Infant Mortality, Survival Model, Rotated Factor Analysis, Bangladesh.

INTRODUCTION

Infant mortality rate (IMR) is a widely used indicator of health status of all population as well as the level of development of a country (Reidpath and Allotey, 2003). It is defined as the number of deaths in children under the age of one year per 1000 live birth. The reason behind the use of IMR as a measure of health status of the population is that the causes of infant mortality are strongly related to general living condition, social well-being, quality of the environment and the level of economic development, that affect the health of entire population. Further, the IMR as a measure of health status can be calculated easily and more accurately with less data.

The IMR, which has declined significantly over time, still remains high in many developing countries and varies widely across countries (WHO, 2013; Schell, et. al. 2007). High IMR, which indicates poor health of the population, has important implications at both micro and macro levels. Poor health results in a lower quality of human resources and lower productivity. Efforts are being made and strategies are being developed across all developing countries to reduce IMR to an acceptable level. Accordingly UN Millennium Development Goal 4 (MDG4) set the target to reduce the under- 5 mortality rate by two-thirds by 2015 from 1990 level (WHO, 2013).

There is a healthy body of literature on the determinants of infant mortality. Pamuk, Fuchs and Lutz (2011) compared the relative effects of education and economic resources on infant mortality in 43 developing countries. Using multilevel regression models at the family, community, and country level they found strong effects of per capita GDP, completion of secondary education on the infant mortality. Barker (2011) studies the determinants of child mortality across 28 Indian states with the help of multivariate regression model. He finds that female literacy and child vaccination rate are the strongest determinants of child mortality. Health expenditure, GDP as well as per capital GDP are not found significant. Tacke and Waldmann (2013) examine the effect of relative income on infant mortality in selected countries and conclude that infant mortality can be reduced by reducing the income inequality. Schell et al. (2007) assess the relative importance of major socioeconomic determinants of IMR using country level

ISBN 978-0-9925622-1-2

data from 152 countries using multivariate regression technique. Of the five explanatory variables used in the study, per capita national income, young female literacy, and income inequality predicted 92 percent of the variation in national IMR whereas public spending on health and poverty rate are not found significant. A cross-section study covering 117 countries by Zakir and Wunnava (1999) demonstrates that fertility rate, female participation in the labour force, per capita GNP, and female literacy rates significantly affect infant mortality rates.

The effect of socioeconomic status on infant mortality in Uruguay has been studied by Jewell, Martinez and Triunfo (2014). The results of the study indicate that the most important predictors of infant mortality are a full gestational period, mother's educational attainment, marital status, and the type of hospital used for delivery. Using Taiwanese data from 1997 to 2009, Chang et al. (2014) finds that there is a negative association between higher birth weight and infant mortality when other factors are controlled. Agha (2000) shows that poverty, parents' education, mother's age and birth order are factors affecting child survival in Pakistan. The study on Nepal by Suwal (2001) examines the main determinants of infant mortality using a logistic regression model and finds that among all variables analyzed parity, place of residence, immunization, and ethnicity are important factors. Black, Morris and Bryce (2003) illustrate that under-nutrition, infectious and communicable diseases are often associated with child deaths. However, causes of child death vary substantially across countries. According to WHO (2005) 73% of the under-5 child mortality is attributable to pneumonia, diarrhea, malaria, measles, sepsis, preterm delivery and asphyxia including 54% responsible for four communicable diseases. Titaley et al. (2008) use multilevel logistic regression to investigate the determinants of neonatal mortality in Indonesia and find that the odds of survival depend on region, percentage of deliveries assisted by trained delivery attendants, employment status of the parents, birth interval and postnatal care.

A number of studies have been undertaken to explore the determinants of infant mortality in Bangladesh. Using both bivariate and multivariate analysis Kamal (2012) shows strong negative association between maternal education and neonatal mortality in Bangladesh. Maternal age, religion, birth order and antenatal care utilization are also found significant determinants of neonatal mortality in Bangladesh. Hong and Ruiz-Beltran (2007) use multivariate survival model to analyze infant's survival in Bangladesh. The findings of the study indicate that receiving prenatal care during pregnancy significantly increases infant's survival when other factors are controlled. However, many explanatory variables such as maternal education, nutritional status, household access to hygienic toilet, location of residence included in the analysis are not found significant. Rubayet et al. (2012) identifies community initiatives, donor funding, which increase the coverage of key interventions including skilled birth attendance and postnatal care as important factors of neonatal mortality in Bangladesh. Rahman (2013) employs the Cox proportional hazard model to investigate the factors affecting child survival in Bangladesh. He finds that antenatal care utilization, place of delivery, and mother's education are important determinants of child mortality in Bangladesh. The study by Pervin et al. (2012) shows that antenatal care visits are associated with increased facility-based delivery, which can increase perinatal survival in Bangladesh.

Women empowerment has been recognized as one of the most important factors of development and thus, it is identified as one of the development goals of national governments and international agencies (Malhotra and Schuler, 2005). In a theoretical model Eswaran (2002) analytically shows that if the bargaining power of the wives relative to their husbands increases then it results in a decline in fertility and in child mortality rates. In a district-wise analysis of the census data of India, Murthi, Guio and Dreze (1995) find that variables pertaining to women's empowerment (female literacy and female labour force participation, in particular) significantly explained variations in child mortality, fertility, and gender inequality in child mortality. Shelah el al. (2001) has proposed that female autonomy is a key factor in explaining some important difference in the demographics between the northern and southern states of India. Kravdal (2004) observes that the lower child mortality is associated with women's autonomy. There exists a bivariate relationship between a high mean autonomy level and women without child mortality in Egypt (Kishor, 1995). Hossain and Hoque (2015) show that women empowerment contributes significantly to the antenatal care utilization in Bangladesh.

Women empowerment seems to be related to the fertility and child mortality in developing countries. Duflo (2012) highlights three dimensions of women empowerment: (i) education, (ii) participation in decision making process, and (iii) involvement in economic activities. An educated woman is expected to be more enlightened and be more conscious and therefore can make better decisions for her as well as for the family (Hossain and Hoque, 2015). She may be better informed about how the health care system functions and can get better access to it. Further, she can easily interact and communicate with health service providers to get required care for her as well as for her newborn

ISBN 978-0-9925622-1-2

(Bloom et al., 2001). That is, an educated woman is expected to utilize all available resources and information effectively which reduce the risk of child morbidity and mortality.

In many developing countries, where a man is normally the head of a household makes most of the household decisions, and the wife experiences no equity in this process (Holland & Hogg, 2001). For instance, men often control the financial matters no matter who earns the cash and make decisions regarding major household purchases. This translates into financial vulnerability and lack of autonomy of a woman and more dependent on her spouse. In such cases, a woman who needs health care services has to rely on husband's judgment and willingness to spend on such cares (Hossain and Hoque, 2015). It can be hypothesized that the higher the participation in the household decisions making process by women the higher is the likelihood of receiving heath care, which may increase the survival of the child in a developing country.

But unfortunately, most of the studies on infant mortality do not address the role of women empowerment on child mortality exclusively. Analysis of infant mortality without including women empowerment, which is one of the important factors results in specification problem. The present study is an attempt to void this gap in the literature. The objective of the study is to examine the role of women empowerment on child mortality in Bangladesh.

Over the last thirty years Bangladesh has emerged as one of the success stories worldwide regarding healthcare achievements despite of high population density, low per capital income, widespread poverty and low per capita expenditure on healthcare, corruption and political fragmentation. Since 1980 maternal mortality has dropped by more than 75%, while infant mortality has dropped by more than half since 1990 (WHO, 2013). Maternal and child under five mortality rates are estimated to be 2.4 and 48 per 1000 in 2010 respectively (WHO, 2013). As a result life expectancy at birth climbs to 70 years in 2011 (WHO, 2013).

Women empowerment appears to be one of the key factors behind the success of healthcare in Bangladesh. Appropriate education policy targeting girls' and access to microcredit institutions, which provide credit, healthcare services and education, has increased women empowerment remarkably in Bangladesh (World Bank, 2013). Given the situation prevails in Bangladesh it is of interest to examine the role of women empowerment on the determinants of infant mortality in Bangladesh. The findings of this study contribute to the existing literature by demonstrating that different dimensions of women empowerment can influence infant mortality significantly.

The reminder of the paper is organized as follows. Section 2 presents a discussion on data and methodology. In Section 3, we present results of the study and their interpretations. The findings of the study are discussions in section 4. Concluding remarks and policy recommendations are made in Section 5.

METHODOLOGY AND DATA

Data and Weights

The data used in this study are from the 2011 Bangladesh Demographic and Health Survey (BDHS), a nationally representative sample survey. The 2011 BDHS survey contains information of all ever-married women aged 12-49 residing in the selected households. A sample of size 7318, those who were ever-married of age group 12-49 and have given birth in last five years has been selected. The BDHS survey provides useful statistics that can be used to determine changes in key areas of development in Bangladesh, including maternal and child health, domestic violence, education and poverty reduction. (see NIPORT et al. 2013). The survey is conducted through collaboration between the National Institute of Population Research and Training (NIPORT) of the Ministry of Health and Family Welfare, ICF International/Macro International/ORC Macro, and Mitra and Associates.

The BDHS survey data were collected using stratified multi-stage cluster sampling. Hence the sample data is not an identical and independently distributed (iid) sample and observations are selected using non-simple random sampling technique. Non-simple random sampling, which is well known as complex survey sampling, consists of various probabilities of selections at different levels. The weight to each individual is inversely proportional to the probability of selection. Sampling weights that come with the survey data are used in estimation, instead of simple

ISBN 978-0-9925622-1-2

random sampling weight. The weight series is rescaled following BDHS manual. We use calculated normalized weight such that sum of all normalized weights is equal to one.

Measuring Women Empowerment

The BDHS survey contains a number of variables that can be used to measure different dimensions of women empowerment. In the survey, respondents were asked about who makes particular decision, such as major household purchase, respondent's own healthcare, use of contraception. Four options were offered to each question in the survey: a) respondent alone, b) respondent and spouse jointly, c) husband alone and d) someone else. Binary response variables are created by merging categories a) and b) to be "1" to denote that the respondent participates in decision making; and c) and d) to be "0" to denote that the respondent does not participate in the decision making process. Following Hossain and Hoque (2015) rotated factor analysis technique has been used to construct dimensions of women empowerment other than education. Nine variables included in the factor analysis are: choosing contraceptive method, deciding the use of contraception, decision about respondent's own health, participation in major household purchases, visiting families and relatives, employment status, decision about child healthcare, freedom of going to heath center alone, and freedom of going to health center with a young child.

Using the principal component analysis on the above variables, three factors are extracted that represent three dimensions of women empowerment. These dimensions are named as freedom of movement, decision making power in the household and employment status. Table 1 presents the summary of factor analysis, where three factors together account for more than 63 percent of the variations in the sample data. Adding respondent's level of education with these three factors, we have four indicators to measure four dimensions of women empowerment.

Table 1 Factor analysis results measuring women empowerment at household level

Factor/Dimension	Eigen value	Explained Variance (in proportion)	Cumulative proportion of variance
Factor 1:			
Freedom of movement	2.89	0.3026	0.3026
Factor 2:			
Participation in household decisions	1.79	0.2123	0.5149
Factor 3:			
Involve in economic activity	1.03	0.1198	0.6347

Models and Variables

The study uses the survival model (Hosmer and Lemeshow, 1999), which is most appropriate to analyze the survival of child under one year. In the survival model there should be event and presence of censoring at the end of the follow up. The dependent variable in duration of time specified as the number of days to a death or the number of day to the date of first birthday (one year) from the birth. For each child, who has born at time t=0, the (instantaneous) hazard ratio function at t>0 is assumed to take the following hazards form:

$$\lambda(t,x) = h_0(t)\exp(x'\beta) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, $\lambda(t,x)$ is the hazard function at T=t for given covariate vector x; $h_0(t)$is the baseline hazard function at T= t; and $\beta$is the vector of regression parameter.

Most survival models assume proportional hazards. That is they assume that there is an underlying hazard rate over time, and differences in the covariates simply lead to differences in the relative hazard rate at a point in time. That is, they assume no interaction between time and covariates. Unlike proportional hazard model, the Weibull parametric model as given below, is flexible and allows for the inclusion of covariates of the survival times.

$$\lambda(t,x) = h_0(t)\exp(x'\beta) = \lambda p(\lambda t)^{p-1}\exp(x'\beta) \quad \ldots\ldots\ldots\ldots\ldots (2)$$

ISBN 978-0-9925622-1-2

Where, p can be any positive value including 1, where hazard rate is constant.

Specification and descriptive statistics of the explanatory variables

The explanatory variables include a set of variables most commonly used by past studies with the addition of women empowerment category. That is, different dimensions of women empowerment are included along with other variables to see if they explain infant mortality. All explanatory variables are divided into five categories: (i) women empowerment; (ii) healthcare; (iii) demographic; (iv) socio-economic; and (v) geographic. Four dimensions (level of education, power in the household decision making process, freedom of movement and employment status) have been used to measure the women empowerment. The specification and descriptive statistics of all variables included in the empowerment category are presented in Table 2(a). Nearly 30% of the respondents have primary education, 43% have secondary education and only 8.5% have post-secondary education. The mean years of education is estimated to be 5.6 years with a standard deviation of 3.87. Respondents' participation in different household decision varies from 56% in major household purchases to 70% in seeking child healthcare (Table 2a). Similarly, the degree of autonomy in different types of movement ranges between 59% and 66%. Only 11% of the respondents are employed in income generating activities (Table 2(a)).

Table 2a Specification and descriptive statistics of the women empowerment variables (n=7318)

Name of the variable	Description and specification	Mean	St. Dev	Min	Max
Education					
Primary	Respondent's highest level of education is primary (1=yes; 0=no)	0.299	0.458	0	1
Secondary	Respondent's highest level of education is secondary (1=yes; 0=no)	0.433	0.495	0	1
Post-secondary	Respondent's highest level of post-secondary is primary (1=yes; 0=no)	0.085	0.279	0	1
Years of education	Respondent years of schooling	5.645	3.871	0	18
Decision about					
Contraception use	Respondent had say in the use of contraception (1=yes; 0=no)	0.613	0.487	0	1
Contraception method	Respondent had say in choosing the contraception method (1=yes; 0=no)	0.666	0.472	0	1
Own health	Respondent had say about seeking own healthcare (1=yes; 0=no)	0.609	0.488	0	1
Children health	Respondent had say about seeking children's healthcare (1=yes; 0=no)	0.697	0.460	0	1
Major HH purchase	Respondent had say on major household purchase (1=yes; 0=no)	0.555	0.497	0	1
Visiting families	Respondent had freedom over visiting family members (1=yes; 0=no)	0.585	0.493	0	1
Going aloe to health center	Respondent had freedom to go to health center alone (1=yes; 0=no)	0.634	0.482	0	1
Going health center with young children	Respondent had freedom to go to health center with a young child (1=yes; 0=no)	0.336	0.472	0	1
Employment	Respondent employed to generate income (1=yes; 0=no)	0.105	0.306	0	1

ISBN 978-0-9925622-1-2

Table 2b Specification and descriptive statistics of the other explanatory variables

variable	Description and specification	Mean	St. Dev	Min	Max
Antvisit 2 or 3	Respondent had 2 or 3 antenatal care visits (1=yes; 0=no). Default is zero or one visit	0.261	0.439	0	1
Antvisit 4 or more	Respondent had 4 or more antenatal care visits (1=yes; 0=no else). Default is zero or one visit	0.264	0.441	0	1
Delivery with assistance	Respondent had delivery with assistance of qualified health professionals (1=yes; 0=no)	0.780	0.414	0	1
Age at first birth	Respondents had age 15 years or less at first birth (1=yes; 0=no)	0.204	0.403	0	1
Birth order	Respondent had 3 or more birth (1=yes; 0=no)	0.364	0.481	0	1
Previous birth interval	Respondent had 13 month or less interval with the previous birth (1=yes; 0=no)	0.010	0.096	0	1
Birth in last 3 years	Respondent had birth in the last 3 years (1=yes; 0=no)	0.638	0.481	0	1
Starting breastfeeding	Respondent started breast feeding within 1 hour of the delivery (1=yes; 0=no)	0.825	0.381	0	1
Size of the child	Respondent gave birth to a child of average or above average size (1=yes; 0=no)	0.705	0.456	0	1
Gender of the child	Respondent gave birth to a male child (1=yes; 0=no)	0.518	0.499	0	1
Size of the household	Number of family members in the respondent's household	6.078	2.830	2	31
Access to electricity	Respondent's household had electricity (1=yes; 0=no)	0.551	0.497	0	1
Spouse Occupation	Respondent's spouse is a professional or big business man (1=yes; 0=no)	0.214	0.330	0	1
Wealth index1	Respondent's household wealth index belongs to middle income group (1=yes; 0=no). Default is poor	0.192	0.394	0	1
Wealth index2	Respondent's household wealth index belongs to richer or richest income group (1=yes; 0=no). Default is poor	0.408	0.492	0	1
Religion	Religion of respondent's family is Islam (1=yes; 0=no)	0.901	0.298	0	1
Urban	Respondent live in urban areas (1=yes; 0=no)	0.317	0.465	0	1
Rajshahi	Respondent live in Rajshahi division (1=yes; 0=no). Default is Barisal division	0.261	0.439	0	1
Khulna	Respondent live in Khulna division (1=yes; 0=no). Default is Barisal division	0.120	0.325	0	1
Sylhet	Respondent live in Sylhet division (1=yes; 0=no). Default is Barisal division	0.145	0.352	0	1
Chittagong	Respondent live in Chittagong division (1=yes; 0=no). Default is Barisal division	0.190	0.392	0	1
Dhaka	Respondent live in Dhaka division (1=yes; 0=no). Default is Barisal division	0.168	0.374	0	1

The specification and descriptive statistics of other explanatory variables are presented in Table 2b. Healthcare variables include utilization of antenatal care, delivery with the assistance of qualified health professionals. Two variables are specified to measure the effect of three status of antenatal care utilization, such as zero or one antenatal care visit, two or three antenatal care visits and four or more antenatal care visits. The distribution of respondents by antenatal care visits shows that 26% receive two or three visits; another 26% receive four or more visits and remaining 47% either have zero visit or no visits at all. Seventy eight percent of the respondents have delivery assisted by qualified health professionals (Table 2b). Seven demographic variables (age at first birth, birth order, previous birth interval, birth in the last three years, starting breastfeeding, size of the child and gender of the child), five socio-economic variables (size of the household, access to electricity, wealth index1, wealth index2 and religion) and six geographic variables (urban and five divisional dummies such as Rajshahi, Khulna, Sylhet, Chittagong and Dhaka) are included in the analysis. The specification of each of these variables along with its descriptive statistics is shown in Table 2b. Note that five divisional dummies (with Barishal being the default division) are specified to represent six divisions of Bangladesh.

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RESULTS AND DISCUSSION

Distribution of IMR by characteristics

Table 3 presents the distribution of IMR by different measures of women empowerment as well as by some other selected characteristics. The IMR has been estimated for Bangladesh to be 49 per 1000 live birth. The distribution shows that IMR decreases gradually with the increase in the level of mothers' education. For example, IMR is 25.6 for the children of those mothers having post-secondary education as oppose to 69 for other children whose mothers have no education. Similar trend shows for antenatal care visits (Table 3). Increased mothers' participation in household decision making process and higher autonomy in movement are inversely associated with the IMR (Table 3). For example, IMR shows 28 for the children of those women who have some say in using contraception as oppose to 83 for others whose mothers do not have any say in the use of contraception. But unfortunately, it is high for the children of employed women compared to that of unemployed women (Table 3).

Kaplan-Meier survival probabilities of infants of women with and without different measures of empowerment have been estimated and they are presented in Figures 1(a) to 1(c). Figure 1(a) shows the probabilities of infant survival if mothers completed secondary education as opposed to no education. Similarly, Figures 1(b) and 1(c) show how the likelihood of survival varies if mothers participate in household decision making process and have some freedom to move respectively. These figures clearly demonstrate that women empowerment appears to influence the likelihood of infant survival. The LR (likelihood ratio) test statistics are calculated.

ISBN 978-0-9925622-1-2

Table 3 Sampling distribution of Infant mortality rate by different measures of women empowerment and by some other selected characteristics

Characteristics	Measure of the variable	Weighted sample	Sampling distribution (%)	IMR per 1000 live birth
Bangladesh		7318	-	49.2
Mother's education:	No education	1332	18.20	69.07
	Primary education	2191	29.64	55.6
	Secondary education	3171	43.33	41.0
	Post-secondary edu	624	8.53	25.6
Use of contraception:	No say	2829	38.66	82.8
	Some say	4489	61.34	28
Contraception method:	No say	2443	33.38	90
	Some say	4875	66.62	28.8
Seeking own healthcare:	No say	2858	39.05	52.4
	Some say	4460	60.95	47
Seeking Child healthcare:	No say	2220	30.33	76.6
	Some say	5098	69.66	37.2
Major HH purchases:	No say	3256	44.49	52.2
	Some say	4062	55.51	45.4
Visiting families/friends:	No say	3036	41.49	54.2
	Some say	4282	58.51	42.2
Visit health center alone:	No	2681	36.64	62.6
	Yes	4637	63.36	41.4
Visit health center with a young:	No	2458	33.59	56.4
	Yes	4860	66.41	35
Employed:	No	6553	89.55	46.4
	Yes	765	10.45	73.2
Ant care visit:	0 visit	2445	33.41	64.6
	1 visit	1030	14.07	50.4
	2 or 3 visit	1910	26.10	35.6
	4 or more visit	1933	26.41	42.4
Delivery with assistance:	No	1607	21.96	52.2
	Yes	5711	78.04	48.4
Breast feeding:	No	2161	29.53	96.2
	Yes	5157	70.47	29.4

ISBN 978-0-9925622-1-2

Figure 1(a) Kaplan-Meier survival function with and without secondary education

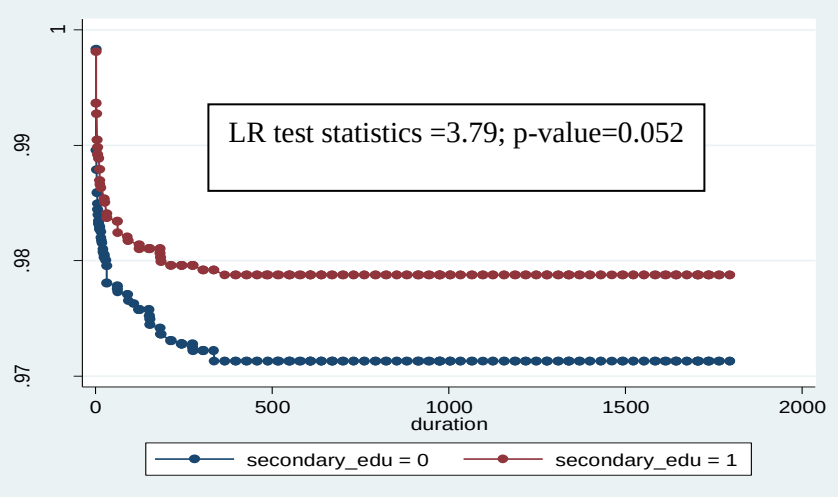


Figure 1(b) Kaplan-Meier survival function with and without participation in HH decision making process

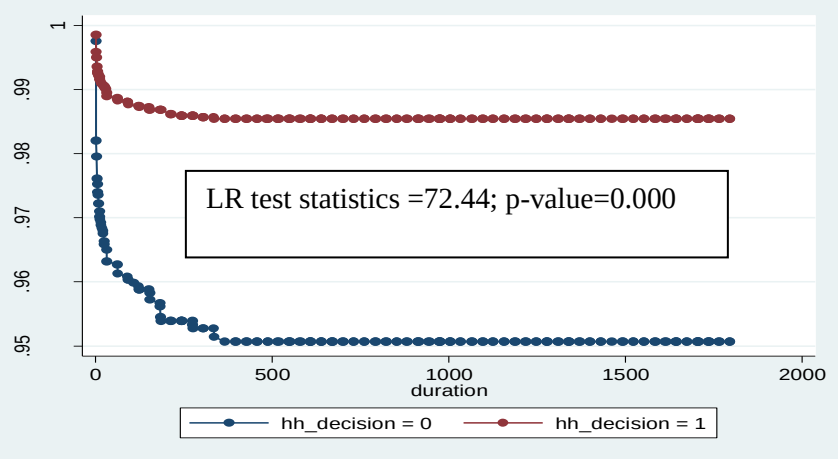
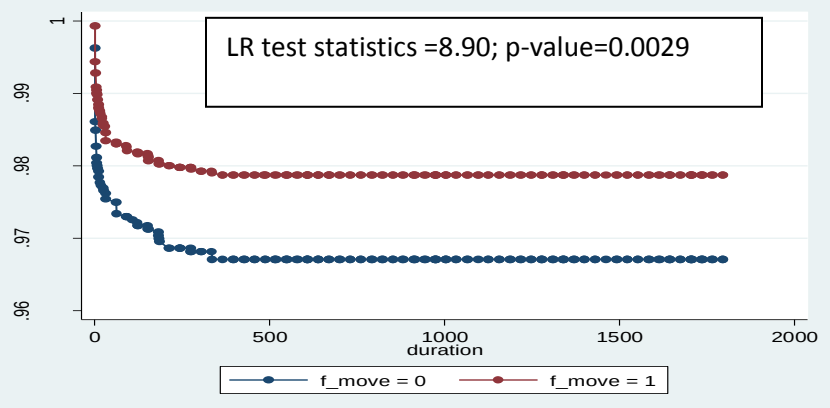


Figure 1(c) Kaplan-Meier survival function with and without freedom of movement



and presented on each graph. They show that the difference in the probability of survival with and without characteristic is significant in each case at 5% or less.

ISBN 978-0-9925622-1-2

Hazard ratio of multivariate analysis

This section presents the hazard ratio estimates of infant mortality using Weibull multivariate parametric survival method. Two models are specified. The first model, which is called the basic model, includes all variables that are used by previous studies on child survival across countries including mother's education. The second model, we call the full model, includes all variables of the basic model plus three additional dimensions of women empowerment such as freedom of movement, participation in household decisions and employment status, which are not included in the previous studies.

All of the previous studies on child survival use cox proportional hazard model. The cox proportional hazard model assumes p in equation (2) to be 1. Unlike the Cox proportional hazard model, the Weibull survival model is a flexible form of parametric model, with p (in equation 2) can take any positive value including 1. The estimate of Weibull survival model provides us log(p), which is found significant at 5% level indicates that the Weibull survival model is the appropriate method to be used for the data set. The value of p is estimated to be 0.23, which means infant mortality declines over time without the effect of any other factors.

The estimated results of both models are presented in Table 4. If one compares the full model with the basic model, one finds the superiority of the full model over the basic model with respect to the value of Wald Statistics[1]. The Likelihood Ratio (LR) test has been performed to see if three additional variables together are significant. The Chi-square statistics is estimated to be 63.5 (Table 4) indicating that all three additional variables together in the full model are highly significant suggesting that they are relevant variables need to be included in the model. Yet none of the previous studies on this issue include these variables. In the absence of these relevant variables in the model the parameter estimates become biased as well as inefficient.

The results of the full model are explained only. The estimated results of the full model show that the data fits the model very well as indicated by the Wald Statistics. The signs of the coefficients of all explanatory variables meet a priori expectation. Of the total 26 parameter estimates including constant (in the full model), 10 are significant at 1%, 6 are significant at 5%, 3 are significant at 10% and remaining 7 are not found significant at acceptable level.

[1] The value of Wald Statistics increased by more than 100 in the full model compared to that of the basic model.

ISBN 978-0-9925622-1-2

Table 4 Hazard ratio estimates of infant mortality in Bangladesh using Weibull survival method

Variables	Model 1: Basic model			Model 2: Full model		
	Coefficient	St. error[2]	p-value	Coefficient	St. error[1]	p-value
Constant	0.070	0.047	0.000	0.158	0.103	0.005
Healthcare variables						
Ant visits 2 or 3	0.630	0.156	0.062	0.644	0.161	0.079
Ant visits 4 or more	0.689	0.182	0.159	0.719	0.187	0.205
Delivery with assistance	0.628	0.153	0.057	0.582	0.143	0.027
Demographic variables						
Age at first birth 15 or less	1.188	0.251	0.415	1.191	0.255	0.415
Birth order 3 or more	1.291	0.294	0.262	1.480	0.326	0.075
Previous birth interval 13	4.065	2.085	0.006	3.288	1.816	0.031
Birth in last 3 years	2.405	0.475	0.000	2.117	0.437	0.000
Starting breastfeeding	0.344	0.061	0.000	0.367	0.065	0.000
Size of child at birth	0.811	0.171	0.320	0.847	0.182	0.441
Gender of the child	1.181	0.205	0.339	1.180	0.207	0.346
Socio-economic variables						
Size of House Hold	0.751	0.071	0.002	0.765	0.066	0.002
Electricity	0.427	0.090	0.000	0.480	0.101	0.001
Wealth index2	0.827	0.282	0.003	0.950	0.352	0.007
Wealth index3	0.734	0.272	0.007	0.850	0.343	0.013
Muslim	1.197	0.348	0.537	1.141	0.337	0.655
Geographic variables						
Urban	1.145	0.259	0.550	1.277	0.295	0.289
Rajshahi	0.550	0.142	0.020	0.538	0.140	0.017
Khulna	0.471	0.161	0.028	0.481	0.165	0.033
Sylhet	1.187	0.325	0.530	0.913	0.247	0.736
Chittagong	0.515	0.148	0.021	0.415	0.119	0.002
Dhaka	0.589	0.167	0.063	0.552	0.149	0.023
Empowerment variables						
Education	0.933	0.028	0.021	0.947	0.029	0.075
Freedom of movement				0.544	0.096	0.001
Freedom of choice				0.319	0.059	0.000
Employment				1.842	0.467	0.016
Diagnostics						
Estimate of log(p)	-1.481	0.038	0.000	-1.451	0.039	0.000
Estimate of p	0.227			0.234		
Wald Statistics	155.46			251.53		
Chi-square for LR test				63.5		

[2] Robust st. error

ISBN 978-0-9925622-1-2

The effect of different measures of women empowerment on the odds of infants' survival

All four variables used to measure women empowerment are significant (in the full model). Of the four variables, the effects of three variables on the infant mortality show negative. The coefficient of education is found to be 0.947[3]. This indicates that infant mortality is expected to decrease by more than 5% for every one year increase in years of mother's schooling. That is, there is a negative relationship between mother's level of education and the infant mortality. The coefficients of the variables measuring the participation of household decision making process and freedom of movement are estimated to be 0.544 and 0.319 respectively (Column 5; Table 4). These results indicate that the likelihoods of infants' death are 46% and 68% less if mothers participate in household decisions and they have freedom to move respectively compared to those of reference groups. The hazard ratio of women employment shows 1.842 suggesting that the odds of infants' deaths are expected to be 84% more if mothers participate in income generating activities compared to their counterparts.

The effect of other variables on the odds of infants' survival

Besides the variables measuring the women empowerment there are four other categories of variables included in the model to explain the variation in the odds of infants' survival. These are: healthcare variables, demographic variables, socio-economic variables and regional variables. Healthcare variables include degree of utilization of antenatal care and delivery with assistance. The coefficient of antenatal care with 2 or 3 visits is significant and it shows the value of 0.644, which indicates that women with 2 or 3 antenatal care visits have 36% less likely of their infant die compared to those who have no or one antenatal care visit. The coefficient of antennal care with 4 or more visits is 0.719 but is not significant at acceptable level. The estimated hazard ratio of delivery with assistance is found to be 0.582 and it is highly significant. It implies that the survival of infant can be increased by 42% if delivery of the child is assisted by a qualified health professional.

Among seven demographic variables four are significant. Of the four significant variables, previous birth interval and birth in the last three years show the largest detrimental effect on the infants' survival. The odd ratio of previous birth interval is 3.288 indicating that infants' deaths are expected to be about 3.3 times higher if mothers' previous birth interval is 13 months or less compared to their reference category. Likewise if women gave birth in the last three years then their infants' deaths are expected be 2.1 times high compared to other women who do not gave birth in the last three years. Starting time of breastfeeding with an odd ratio of 0.367 is one of the most important factors reducing infants' death. The coefficient of this variable shows that those mothers, who provide breastfeeding within one hour of the birth have 63% lower probability of their infants to die compared to others, who do not provide breast feeding within one hour of the birth. The odd ratio of birth order is 1.48, suggests that the survival of the infant decreases by about 48% if mother gave three or more births. Mother being 15 years or less at first birth (age at first birth) and child being male decreases the infant's survival; on the other hand, size of the child being average or above average increases infant's survival. However, these variables are not found significant at acceptable level.

All but one (religion) socio-economic variables used in the model are highly significant. The hazard ratio of household size is 0.765 indicating that infant's survival increases with the increase in household size. The odd ratio of the access to electricity shows 0.480. This suggests that the likelihood of infant survival is 52% more if households have electricity as oppose to other households without electricity. Two dummy variables are specified to represent three wealth indices. The odd ratios of wealth indices imply that the probabilities of infant survival increase with the increase in wealth. For example, the hazard ratio of wealth index3, 0.850 indicates that the chances of infant survival is expected to be 15% higher if the child is born in a rich family compared to a poor family.

[3] In the Survival model the hazard ratio of the reference category is considered to be 1. Further it assumes that the hazard of a particular group with specific characteristics is proportional to that of the reference category.

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The variables under geographic region include urban and five division dummies[4]. The odd ratio of urban is 1.277 suggesting that infants born in urban areas are expected to survive less compared to their counterparts in the rural areas. However, this variable is not significant. Of the five divisional dummies all are significant except one. The probability of infant survival is the highest if the child is born in Chittagong division; it is the lowest if the child is born in Dhaka division.

DISCUSSIONS

Unlike previous studies on the determinants of infant mortality, this study shows the relationship between different measures of women empowerment and infant mortality in Bangladesh. The likelihood of infant mortality is substantially less for the children of those mothers, who are empowered, particularly through education, participation in the household decision making process and autonomy in the movement (Table 3). That is, women empowerment appears to influence the odds of infants' survival (Figure 1(a) to 1(c)).

The multivariate survival model is used to examine the role of four dimensions of women empowerment on the probability of infant's survival when all other relevant factors are controlled. Of the four dimensions of empowerment, three contribute positively to the survival of infant. Mothers' participation in the household decision making process and autonomy in the movement are the two most important factors contribute to the reduction of infant mortality. Compared to no participation in household decisions and no autonomy of movement, having mothers' participation in the household decisions and autonomy in the movement can increase the likelihood of infants' survival by 46% and 68% respectively (Table 4). An empowered woman has more control over her own and child healthcare, which eventually reduce infant mortality. Shelah, Yypij and Gupta (2001) find higher rates of fertility, greater infant and child mortality in the North India compared to those of the South India, where women's status is generally lower. Consistent with the previous research (Agha, 2000; Suwal, 2001; Pamuk, Regina and Wolfgang, 2011; Kamal, 2012) mother's education also plays an important role to the reduction of infant mortality rate. However, Hong and Ruiz-Beltran (2007) do not find mother's education to be significant determinant of infant mortality for Bangladesh.

The women empowerment measured by employment status shows a positive effect on the infant mortality. That is, the risk of infant's death is high for a working mother compared to a non-working mother. There is no a priori expectation about the effect of women employment on the odds of infant survival. It may be positive or negative (Suwal, 2001). The infants may have higher likelihood of survival because of additional expenditure for their wellbeing with the income of the mothers' paid employment. On the contrary, mother's employment may results in less care and infrequent breastfeeding, which may reduce the chance of infants' survival (Shrestha et al., 1987). Thus, the net effect of women employment on infant mortality is uncertain. The studies on Nepal (Suwal, 2001), India (Kishor and Parasuraman, 1998; Basu and Basu, 1991) and Indonesia (Titaley, 2008) also find the negative effect of mothers' employment on child survival.

The delivery with assistance by qualified health professions is one of the very important factors in reducing the odds of infant mortality. This finding is supported by Suwal (2001). The number of antenatal care visits plays a role in increasing infants' survival. Having 2 or 3 antenatal care visits by mother during pregnancy can decrease infants' mortality significantly. Four or more antenatal care visits appears to be not necessary as they are not found significant. Adequate access to prenatal care is likely to increase the access to delivery care and post natal care, which may contribute to the reduction of infant mortality. This finding is similar to that of previous studies (Hong and Ruiz-Beltran, 2007; Suwal, 2001; Pervin, 2012).

[4] In Bangladesh there are six administrative divisions (Barisal, Rajshahi, Khulna, Sylhet, Chittagong and Dhaka). Five divisional dummies are used to represent six divisions with Barisal being default division.

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A number of demographic characteristics influence the likelihood of infant survival. Survival of infant can be increased substantially if child is provided breastfeeding within one hour of the birth. Early breastfeeding may provide required nutrients, which help develop baby's immune system and subsequently increase the probability of survival. The odds of infants' mortality are extremely high if mothers' duration of previous birth interval is 13 months or less. Similarly, they are expected to be high if mother have 3 or more births and/or gave birth in the last three years. These findings suggest that too many births in the past, particularly with short duration decreases the likelihood of the survival of newly born baby. It is to be noted that gender of the child does not play a significant role on the survival of the child. If parents have gender preference they are expected to provide extra care to the child of their preferred gender to increase his/her survival. Thus, the result of this study implies that gender preference does not exist in Bangladesh.

Among socio-economic characteristics that contribute to infant's survival are household sizes, access to electricity and wealth indices. The odds of child survival increase with the increase in the size of household. This may be because newly born may have more and better care in the extended families with more members in the household. Households having electricity contribute infant mortality negatively. The reason may be that household with electricity also usually have access to hygiene toilet and safe drinking water, which contribute in reducing infant mortality as they reduce the spread of communicable diseases. Children born in middle income and rich families are most likely to survive more compared to those in poor families. This is because families with more wealth and income have ability to care for mother and the baby, which may increase the chances of the survival of the newly born. These findings are consistent with the previous studies (Hong and Ruiz-Beltran, 2007; Pamuk, Regina and Wolfgang, 2011). Unlike other studies (Suwal, 2001), religion does not influence the likelihood of infant's survival in Bangladesh.

The odds of infant's survival are significantly affected by the place of residence. They are the highest for Chittagong division and the lowest for Barisal division. The differences in the availability of health facilities, communication, custom, culture etc. may be responsible for these differences. Compared to rural area, infant mortality appears to be high in urban area. This finding is supported by Agha (2000) and Hong and Ruiz-Beltran (2007).

CONCLUSIONS AND POLICY IMPLICATIONS

Infant mortality, an indicator of health status is widely used to measure the progress as well as level of development of a country. Continuous efforts are being made to reduce IMR in all developing countries, where IMR remains high. Bangladesh has achieved a remarkable success on health, evidenced by a significant fall in maternal and infant mortalities and rise in life expectancy. This study attempts to investigate the role of women empowerment on the determinants of infant mortality in Bangladesh. The study employs the 2011Bangladesh Demographic and Health Survey (BDHS) – a nationally representative sample survey. Following Duflo (2012) and using rotated factor analysis technique four dimensions of women empowerment have been constructed (Hossain and Hoque, 2015). They are: (i) mother's level of education, (ii) participation in household decision making process, (iii) autonomy in the movement, and (iv) employment status. Hypotheses have been tested to see if each of dimensions influences the infant mortality.

The distribution of IMR and the Kaplan-Meier survival probabilities by different measures of women empowerment clearly demonstrate that women empowerment appears to play a role on infant mortalities. The Weibull parametric survival model has been specified and estimated to examine if dimensions of women empowerment influence the likelihood of infants' survival, when all other relevant factors are controlled. The results of the basic model incorporating all factors used in the previous studies are compared with those of the full model with all of the variables of the basic model and all dimensions of empowerment. The comparison shows that the full model is

ISBN 978-0-9925622-1-2

superior in every respect suggesting that models of infant mortality specified by other researcher likely to be miss-specified, which may result in inconsistent parameter estimation.

The estimation of our full model shows that the data fits the model very well. All explanatory variables meet a priori expectations. The results show that three dimensions of women empowerment such as mother's level of education, participation in household decisions and autonomy of movement contribute significantly to the reduction of infant mortalities. But the employment status of empowerment shows a positive effect on infant mortality suggesting that the risk of infant's death is high for a working women compared to a non-working woman. Mother's employment may result in less care and infrequent breastfeeding, which may cause to reduce the chances of infant's survival.

Other important factors affecting the survival of infants include healthcare variables (such as antenatal care visits, delivery with assistance), demographic variables (such as birth order, previous birth interval, birth in the last three years, starting time of breastfeeding), socio-economic variables (such as household size, access to electricity, wealth indices) and geographic variables (such as divisional dummies). Having 2 or 3 antenatal care visits by mother during pregnancy can reduce infant mortalities. The delivery of child assisted by a qualified health professional can increase infant's survival. Similarly, infant's survival can be increased substantially if breastfeeding is provided within one hour of the birth. Too many births in the past (measured by previous birth interval, birth in the last three years and birth order), particularly with short duration decreases the chance of survival remarkably. Economic conditions as measured by household wealth and access to electricity affect infant mortalities negatively. Locations of the household also play a role in determining infant mortalities.

The study has number of policy implications for all developing countries like Bangladesh. First, women empowerment is one of the key factors of reducing infant mortalities, which subsequently contribute to the improvement of health status and the level of development. All efforts should be made to increase the women empowerment, particularly girts' education, participation in household decisions and autonomy in movements. Second, the employment of women in economic activity has been associated with increased mortality of infant. However, this conclusion does not imply that women employment should be discouraged; instead it emphasized the need for viable child care alternatives for working women and renegotiation of gender role and gender relations. Third, healthcare services, particularly antenatal care and delivery services should be extended and make available to all pregnant women.

Fourth, women as well as their families should be warned about the consequences of the high birth order with short interval by broadcasting more educated programs through mass media. Fifth, poverty emerges as one of the obstacles to the reduction of infant mortality. Respondents belong to poor families do not have ability to seek care for pregnant mother and her new born baby. Therefore, poverty eradication policy should be pursued effectively. In the short-run, special program targeting the poorest section of the community should be undertaken to provide necessary maternal and child healthcare services. Sixth, the findings of the study show that there exists disparity in the distribution of infant mortality among the regions. To address this disparity the allocation of resources should be taken into account the regional needs and degree of inequality. Finally, the study shows that access to electricity can influence the reduction of infant mortality. This suggests that efforts to increase the coverage of electricity should be extended, which will bring many benefits to the society including the reduction of infant mortality rate.

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