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Effects of Demographic Characteristics on Neonatal, Post neonatal, Infant and Child Mortality

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Abstract: The majority of the developing countries in the world have been given highest priority for reducing child mortality in the first few years of life (less than five years child). Bangladesh has also taken especial care for reducing infant and child mortality. The purpose of this study was to detect demographic factors that responsible for neonatal, post-neonatal, infant and child mortality. Infant and Child mortality rates (it was calculated as the number of neonatal, posts-neonatal, infant and child deaths per 1000 live births), Contingency analysis and Logistic regression procedures have been applied. The result showed that Neonatal Mortality Rate (NNMR), Post-eonatal Mortality Rate (PNNMR), Infant Mortality Rate (IMR) and Child Mortality Rate (CMR) were found to be higher in mothers who were married before 15 years of age, in mother's late duration of marriage age 15+ years, in mothers group who didn't feed their baby. The Chi-square (χ^2) test result implied that age at marriage, interval between last and previous child and breastfeeding were highly significantly associated with neonatal, post-neonatal mortality. Logistic results indicated the important predictors that have significant influence on neonatal mortality such as breast feeding practice but in post-neonatal period, duration of marriage, order of birth and birth interval have significant effects and on infant and child mortality, age at marriage, duration of marriage, birth interval and birth order and breast feeding have significant influence. This study suggests that age at marriage; birth interval and breast-feeding practice of women should be improved not only in the community levels but also in Bangladesh for reducing infant and child mortality.

Key words: Chi-square (χ^2) test, demographic factors, infant and child mortality rate, logistic regression analysis, neonatal, post-neonatal

INTRODUCTION

The last few decades have brought significant improvements in child health sectors in Bangladesh through family planning programs. According to Population and Development Indicators for Asia and the Pacific Report 2008, in SAARC countries' infant and under five mortality rates (156 and 234 per 1,000 live births respectively) were highest in Afghanistan, and lowest in Sri Lanka (infant and under five mortality rates were 11 and 13 per 1,000 live births respectively). In Bangladesh, infant and under five mortality rates were 52 and 68 per 1,000 live births respectively in 2008 which was still very high (UN, 2008).

Many studies have shown that the infant and child mortality influenced by a number of socio economic and demographic factors such as sex of the child, mother's age at birth, birth order, preceding birth interval, length and survival of preceding sibling(s). These factors were the most important determinants of infant and child mortality in Bangladesh (Majumder, 1989, 1990, 1991; Majumder *et al.,* 1993). Gubhaju *et al.* (1991) showed that sex, and birth order of the child, maternal age at birth, birth interval, and survival of earlier sibling(s) has significant effect on infant and child mortality. However, the relative importance of these factors in relation to infant and child mortality risks varies with the level of social and economic well-being of a society. A number of studies conducted in different parts of the world by Stockel and Chaudhury (1972), Adlakha (1973), Feeney (1980) and Hobcraft *et al.* (1985) have revealed the influence of maternal age at delivery on the health and survivorship of children. Since a very young mother usually less than 20 years of aged mother is biologically not fully mature and the chances of pregnancy related complications are high and she might not be able to provide good care for the infants effectively. Woman with short birth intervals have insufficient time to restore their nutritional reserves, a situation, which is thought to be adversely, affected fetal growth. This situation may have a deficit on the nutrition of the young's child (Winikoff, 1983; Boerma and Bicego, 1992).

Hong(2006) showed that levels of infant and child mortality in many developing countries remain unacceptably high, and they are disproportionably higher among high-risk groups such as newborn and infant of

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multiple births. A mother's poor health and poor nutritional status may also have postnatal consequences such as impaired lactation and render her unable to give adequate care to her children (Retherford *et al*., 1989). Some studies show that infant mortality is higher for boys than for girls but child mortality is lower for boys (Huq and Cleland, 1989; Kabir and Chowdhury, 1992).

Knowledge of some of the factors affecting infant mortality is a fundamental requirement for devising appropriate policies and strategies to accelerate decline in infant and child mortality. Therefore, the fundamental objective of this study was to identify the existing entire demographic causes of infant and child mortality. This research will be helpful for the policy makers, demographers and other researcher for further investigation.

MATERIALS AND METHODS

A study on infant and child mortality was conducted from November to December 2007 among reproductive aged women (aged 15-49 years) of Natore sadar upazila in Natore district of Bangladesh. All eligible reproductive aged women (15-49 years aged women) were requested to participate in the study after being given a brief description of the purpose and procedures of the study. To investigate demographic information on women, 796 women were selected as the study population through using multi-stage sampling technique. A structured questionnaire was developed to explore the determinants of infancy and childhood mortality, after a long discussion with an expert group in this area (all faculty of our department). A personal interview approach was followed for the purpose of data collection. The information was collected with the help of questionnaire. The data were analyzed by using SPSS, version 10:

Infant mortality: it is the probability of dying before the first year of life (deaths <1 year of age child). It is divided into two categories such as neonatal mortality that occurring during the first month of life (deaths <1 month of age child) and post-neonatal mortality (deaths 1 to 11 month of age child) that occurring during the remainder of the first year. The formulas for computing these rates are:

Infant mortality rate (IMR) =

$$\frac{\text{Infant deaths}\left(D_{0-52\,weeks}\right)}{\text{Live births under 1 year}\left(B_0\right)} \times 1000$$

Neonatal mortality rate (NNMR) =

$$\frac{\text{Neonatal deaths}\left(D_{0-4\,weeks}\right)}{\text{Live births under 1 year}\left(B_0\right)} \times 1000$$

Post neonatal mortality rate (PNNMR) =

$$\frac{\text{Post neonatal deaths}\left(D_{1-11\,months}\right)}{\text{Live births under 1 year}\left(B_0\right)} \times 1000$$

Child mortality: it is the probability of dying between the first and fifth birthday (deaths 1 to <5 years of old children).

Child mortality rate (CMR) =

$$\frac{\text{Child deaths}\left(D_{1-<5\,years}\right)}{\text{Live births from 1 to under 5 years}\left(B_{<5\,years}\right)} \times 1000$$

A contingency analysis was used to test for association between the different phenomena on the basis of classification of variables or attributes by applying the Chi-square (χ^2) test, in which, $\chi^2 = \sum \frac{O_{ij}}{E_{ij}} - N$ follows a χ^2 distribution with (r-1)(c-1) degrees of freedom. A logistic regression analysis was performed in order to observe the effects of the independent variables (X) on the dependent variable (Y). The logistic function can be written as (Cox, 1958):

$$E(Y/Z=z) = \frac{e^z}{1+e^z}$$

where, $z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$ and β_0, β_1, β_2, β_3, β_4 and β_5 are regression parameters, to be determined from the data. For the predicted variable

For Model 1: $Y = \begin{cases} 1, \text{if neonatal mortality occure}, \\ 0, \text{otherwise}. \end{cases}$

For Model 2: $Y = \begin{cases} 1, \text{if post neonatal mortality occure}, \\ 0, \text{if it does not occure}. \end{cases}$

For Model 3: $Y = \begin{cases} 1, \text{if infant mortality occure}, \\ 0, \text{otherwise} \end{cases}$

For Model 4: $Y = \begin{cases} 1, \text{if child mortality occure}, \\ 0, \text{if it does not occure}. \end{cases}$

And for the explanatory variables

X_1 = Age at marriage = $\begin{cases} 1, \text{if } 15+ \text{ years}, \\ 0, \text{otherwise}. \end{cases}$

X_2 = Duration of marriage = $\begin{cases} 0, if\ 0-4\, years, \\ 1, if\ 5-14\, years \\ 2, if\ 14+\, years \end{cases}$

X_3 = Birth order = $\begin{cases} 0, if\ <2, \\ 1, if\ 2, \\ 2, if\ 2+ \end{cases}$

X_4 = Birth Interval between last & previous child =

$$\begin{cases} 0, if\ <24\, months, \\ 1, if\ 24-36 months, \\ 2, if\ 36+months \end{cases}$$

X_5 = Breast feeding = $\begin{cases} 1, if\ yes, \\ 0, otherwise. \end{cases}$

RESULTS

The percentage of respondent's age 20-24 years was 23.6%, in age 25-29 years 23.4% and less than 20 years was 18.8%. Mother's duration of marriage age above 15 years was 30.3%, 5-9 years was 28.1%, 0-4 years and 10-14 years were 21.5% and 20.1% respectively. Children of 1st birth order, 2nd birth order greater than three were 40.1, 32.0 and 28.0% respectively. Most of the children (32.7%) have birth interval of less than 36 months while 29.8% children have birth interval of 36-48 months and 27.5% children have birth interval above 48 months. The study results also showed that majority number of mothers (96.7%) have breast-fed to their baby and 3.3% mothers never breastfed (Table 1).

The study results showed that Infant and Child mortality differentials were high for mothers who married before age 15 years (e.g., PNNMR was 208.33; IMR was 50.00 and CMR was 72.46 per 1000 live births). It can be seen that short duration of marriage (0-4) NNMR, PNNMR, and IMR were found to be lower. The results had 51.28 NNMR, PNNMR was 51.28 and IMR was 102.56 per 1000 live births whereas it was found to be higher in mother's those have longer duration of marriage age 15 years and above (e.g., NNMR was 84.13, PNNMR was 134.13, IMR was 216.66 and CMR was 50.85 per 1000 live births) (Table 2).

Higher birth orders are more likely to be born to older mothers and these children may face competition for resources such as food and medical care (Rutstein, 1984). It was observed that NNMR, PNNMR, IMR and CMR were experienced higher for birth order 3 and above (e.g., IMR was 334.14 and CMR was 50.63 per 1000 live births) and lowers for the 2nd order birth of IMR and the single birth order for CMR (e.g., IMR was 32.26 and CMR was 6.13 per 1000 live births).

Preceding birth intervals, subsequent pregnancy and breastfeeding duration each have an independent influence on early mortality risk (Majumder, 1990). The most striking findings are found in the relationship between mortality rates and the preceding birth interval. Retherford *et al.* (1989) observed that short birth interval (less than 24 months) have increased mortality. Our study results also raveled that NNMR, PNNMR, IMR and CMR were found to be higher for the mothers having interval between last and previous child <24 months (e.g., NNMR was 166.67 and CMR was 78.95 per 1000 live births) while lower for the mothers having interval between last and previous child 48 and above months (e.g., NNMR was 34.13, IMR was 34.13 and CMR was 14.93 per 1000 live births).

Many studies form the Asia and the Pacific region recommended that IMR and CMR and infectious are fortified by breastfeeding. Rahman *et al.* (2005) showed that the risk of infant and child mortality was higher for children whose mothers never breast-feed than for children who were breast-feed. In the study Table 2 confirms NNMR, PNNMR, and IMR and CMR were higher in mothers who didn't feed their baby (e.g., IMR was 727.27 and CMR was 375.00 per 1000 live births) while lower in mothers whom have feed their baby (e.g., IMR was 25.00 and CMR was 13.70 per 1000 live births).

The Salient Features of Test Results with Demographic Attributes: With respect to demographic factors, neonatal and post-neonatal mortality were significantly associated with age at marriage, interval between last and previous child and breastfeeding. Infant and Child mortality were significantly associated with age at marriage, duration of marriage, birth order, interval between last and previous child and breastfeeding. Especially, age at marriage, interval between last and previous child and breastfeeding are important factors, which have a great influence on the survival of young children (Table 3).

In the Logistic regression analysis, our dependent variables were the survival status of neonatal, post neonatal, infant and child. The results were used to assess the significant effects with relative importance of the selected demographic variables (such as age at marriage of mother, duration of marriage, birth order, birth interval between last and previous child.) on neonatal, post neonatal, infant and child mortality considering the model 1, 2, 3 and 4 respectively. Table 4 represents the estimates

Table 1: Percentage of women aged 15-49 years according to the selected demographic characteristics of Natore Sadar Upazila in Natore District, Bangladesh

Background characteristics	Number of cases	Percentages	Background characteristics	Number of cases	Percentages
			Interval between last		
Age at marriage:			and previous child:		
<15	169	21.2	<36	230	32.7
15-19	434	54.5	36-48	210	29.8
>19	193	24.2	48+	264	27.5
Duration of marriage:			Breast feeding:		
0-4	171	21.5			
5-9	224	28.1			
10-14	160	20.1	No	23	3.3
15+	241	30.3	Yes	681	96.7
Birth order:			Breast-feeding of last child:		
1	282	40.1	< 12	129	18.9
2	225	32.0	12-23	214	31.4
3+	197	28.0	24-35	316	46.4
			>36	22	3.2

Table 2: NNMR, PNNMR, IMR and CMR by some selected demographic characteristics of Natore Sadar Upazila in Natore District, Bangladesh, 2007

Characteristics	NNMR = $\frac{D_{0-4weeks}}{B_0} * K$	PNNMR = $\frac{D_{1-11months}}{B_0} * K$	IMR = $\frac{D_{0-52weeks}}{B_0} * K$	CMR = $\frac{D_{1-<5years}}{B_{<5years}} * K$
Age at marriage:				
<15	41.67	208.33	250.00	72.46
15-19	63.83	21.28	84.11	9.48
>19	–	–	–	10.75
Duration of marriage:				
0-4	51.28	51.28	102.56	50.85
5-9	–	–	–	12.35
10-14	76.92	–	76.92	–
15+	84.13	134.13	216.66	41.67
Birth order:				
1	–	71.43	71.43	6.13
2	32.26	–	32.26	22.90
3+	166.67	166.67	334.14	50.63
Interval between last & previous child (in month) :				
<24 months	166.67	250.00	416.67	78.95
24-36	38.46	76.92	115.38	29.41
36-48	–	44.28	173.91	–
48+	34.13	–	34.13	14.93
Breast feeding:				
No	363.64	363.64	727.27	375.00
Yes	–	25.00	25.00	13.70

Note: K =1000

of Logistic regression co-efficient, significance probability and relative odds ratios, which are calculated for each category of the categorical variables.

According to the fitted model 1 as shown in Table 4, only 2 explanatory variables out of 5 variables as age at marriage and breast-feeding were statistically significant at 5 and 10% level while model 2 highlighted 4 variables were significant at 5 and 10% level except breastfeeding. Mother's breastfeed concept and birth interval between two births were significant effect on both infant and child mortality (Table 4).

The regression coefficients for age at marriage of mother 15 and above years were -2.921, -3.487, -3.889 and -1.956 which implies that length of age at marriage has negative impact on neonatal, post-neonatal, infant and child mortality level. It was also significant at 5% level. The odds ratios for age at marriage 15 and above years is 0.054 that indicates the risk of neonatal mortality have

Table 3: Results of contingency analysis according to demographic factors with neonatal, Post-natal, Infant and child mortality in Natore Sadar Upazila, Natore, Bangladesh

	Neonatal mortality				Post-natal mortality			
Attributes	Cal. χ^2 value	df.	Asy Sig (ρ)	Sig	Cal. χ^2 Value	df.	Asy Sig (ρ)	Sig
Age at marriage	5.390	1	0.020	Sig**	12.691	1	0.000	Sig*
Duration of marriage	4.583	2	0.101	Insig	2.117	2	0.347	Insig
Birth order	1.400	2	0.497	Insig	4.513	2	0.105	Insig
Interval between Last and previous child	7.452	2	0.024	Sig**	15.404	1	0.000	Sig*
Breast feeding	16.289	1	0.000	Sig*	42.322	1	0.000	Sig*
	Infant mortality				Child mortality			
Attributes	Cal. χ^2 value	df.	Asy Sig (ρ)	Sig	Cal. χ^2 Value	df.	Asy Sig (ρ)	Sig
Age at marriage	8.044	1	0.005	Sig*	7.352	1	0.007	Sig*
Duration of marriage	9.516	2	0.009	Sig*	4.720	2	0.094	Sig***
Birth order	5.778	2	0.056	Sig***	2.783	2	0.249	Insig
Interval between last and previous child	27.334	1	0.000	Sig*	13.147	1	0.000	Sig*
Breast feeding	90.575	1	0.000	Sig*	14.980	1	0.000	Sig*

*: Significance at p<0.01, **: Significance at p<0.05, ***: Significance at p<0.10
χ^2_{10}= 2.705 with 1 d.f.; χ^2_{10}= 4.605 with 2 d.f.;
χ^2_{05}= 3.841 with 1 d.f.; χ^2_{05}= 5.991 with 2 d.f.;
χ^2_{01}= 6.635 with 1 d.f.; χ^2_{01}= 9.210 with 2 d.f.

Table 4: Logistic regression estimates for the effects of demographic variables with neonatal, post neonatal, infant and child mortality as the dependent variables

	Model 1 for Neonatal mortality		Model 2 for Post-neonatal mortality		Model 3 for Infant mortality		Model 4 for Child mortality	
Demographic characteristics	Coefficient (β)	Odds ratio	Coefficient (β)	Odds ratio	Coefficient (β)	Odds ratio	Coefficient (β)	Odds ratio
Age at marriage:								
<15 years ®	...	1.000	...	1.000	...	1.000	...	1.000
15+ years	-2.921**	0.054	-3.487***	0.031	-3.889**	0.020	-1.956**	0.141
Duration of marriage:								
0-4 years ®	...	1.000	...	1.000	...	1.000	...	1.000
5-14 years	-1.693	0.184	-3.246**	0.039	-1.345	0.261	-1.256	0.285
14+ years	-1.322	0.267	-6.130**	0.006	3.630**	37.708	-1.868	0.154
Birth order:								
<2 ®	-	-	...	1.000	...	1.000	...	1.000
2			-0.3.98***	0.672	-0.770	0.463	1.329	3.777
2+			3.387**	29.567	2.766	15.901	2.578***	13.173
Birth Interval between last & previous child:								
<24 months ®	...	1.000	...	1.000	...	1.000	...	1.000
24-36 months	-1.327	-0.265	-1.237	0.290	-1.281	0.278	-0.922	0.398
36+ months	-1.991	0.137	-2.198***	0.111	-3.765**	0.023	-2.015	0.133
Breast feeding:								
No ®	...	1.000	-	-	...	1.000	...	1.000
Yes	-2.682***	0.068			-10.574*	0.000	-2.085***	0.124
Constant	0.724	2.062	-0.517	0.596	2.139	8.492	-0.831	0.436

*: Significance at p<0.01, **: Significance at p<0.05, ***: Significance at p<0.10, (R): Reference category

0.054 (94.6%) times lower than marriage occurred before 15 years of age. It is known that breast-feeding could potentially be a confounding factor, since it effects both neonatal survival and length of the birth interval. The estimated regression coefficient and the odds ratio with breast-feeding were -2.682 and 0.068 respectively, which implied that negatively significant at 1% level and ever breastfed neonates have 0.068 (93.2%) times lower risk of death than ever breastfeed.

The most striking finding could be found in the relationship between post-neonatal mortality rates and the length of the interval between births. The information provide here indicates that short birth intervals significantly reduced a post-neonatal probability of

survival. In this analysis, the risk of post-neonatal mortality was 0.290 (71.0%) and 0.111 (88.9%) times lower for the birth had the interval with previous birth were 24-36 months and 36+ months respectively than the birth; had the interval with previous birth were <24 months.

The regression coefficient for age at marriage after 15 years of age was -3.889 and the odds ratio was 0.020 that indicated the risk of infant mortality who have married at 15 and above years of age; have negative impact and 0.020 (98.0%) times lower risk than marriage before 15 years of age.

The estimated regression coefficient and the odds ratio with breast-feeding infant was -10.574, which have negative significant effect at 1% level on infant mortality. The same pattern result was also found in case of child mortality.

DISCUSSION

Social variables as well as Demographic variable (e.g., respondent's age, age at marriage, birth order, interval between last and previous child, breast feeding etc.) play an important role in effecting the infant and child mortality. The demographic variables include early marriage; shorter birth interval and never breastfeeding of the children have higher infant and child mortality rates with significant effect under this study. The relationship between mother's age at birth and childhood mortality rates of both the youngest and oldest mothers experienced the highest mortality risks. The 2004 BDHS showed a similar pattern for all mortality estimates except CMR (BBS, 2003). For biological reason of mother's health; it is observed that high risk of IMR and CMR at the children birth in the early age of mother or in late age of mother. First-born children of very young mothers are at risk of dying while infants because of their mother's physical immaturity (Gubhaju, 1986).

This study provides short birth intervals significantly reduce a child's probability of surviving. Breastfeeding could potentially be a confounding factor. Since, it affects both child survival and the length of the birth interval. Children with short preceding birth intervals are less likely than others to have ever born breastfeed (Retherford, 1989). For infant mortality, Kim (1988) observed that in traditional societies, the demographic factors have more impact than the socioeconomic factors. In the early stage of development (with a moderate level of infant mortality), the demographic factors are replaced by socioeconomic factors. At later stages of development, the effects of demographic factors remain with absolute differences being very small.

CONCLUSION

Overall progress of society and nations largely depends on declined trend of infant and child mortality. Demographic characteristics such as age at marriage, birth interval between last and previous child and breast-feeding are the momentous factors that keeping exceedingly impact on neonatal, post neonatal, infant and child mortality. Therefore, the following recommendations can be suggested based on the present study. It may help planners and policy makers to take appropriate decision to reduce infant and child mortality not only of the study area but also of Bangladesh.

- An increase age at marriage of woman would encourage for reducing infant and child mortality in rural areas.
- Breast-feeding combats with various infectious disease and strengthened essential antibody system of the children. So, it is necessary to encourage the women to breast-feed their children.
- Programs would be directed to inform society on age at marriage of women; birth interval between two babies, breastfeeding practice of mothers and through effective participation of government, NGOs, religion leader, mass media. That could play a very effective role in saving life of many children in Bangladesh.

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