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Socio-economic determinants of neonatal, post neonatal, infant and child mortality

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The infant and child mortality is an excellent summary index of the level of living and socio-economic development for any country. The aim is to determine socio-economic factors that affect infancy and childhood mortality. The result shows that neonatal mortality rates (NNMR), post-neonatal mortality rates (PNNMR) and infant mortality rates (IMR) are higher among illiterate reproductive mothers and of whom houses have unhygienic latrine. The Chi-square (χ^2) test result implies that mother's education, types of latrine and electricity have significant association with neonatal, post neonatal, infant and child mortality. Multivariate analysis results indicate that mother's education and occupation have momentous influence on mortality of post-neonatal period but in infant and child period, parents' education and occupation, types of latrine and electricity have significant effects on mortality. Therefore, education, sanitation facility as well as electrification of households need to be set absolute priority to reduce infant and child mortality in Bangladesh.

Key words: Neonatal mortality rate (NNMR), post-neonatal mortality rate (PNNMR), infant mortality rate (IMR), child mortality rate (CMR), Chi-square (χ^2) test, logistic regression analysis, odds ratio.

INTRODUCTION

In socio-economical aspect, Bangladesh is one of the most densely populated countries comprising a 1, 47,570 square kilometers area with a population of 161 millions (916 people per square kilometers) (Ahmed, 2008); is comparatively disadvantage in terms of child mortality indicator. In addition, proportion living below the poverty line is 43.3% of the total population and proportion living below the extremely poverty line is 18.7% of the total population. Population growth rate is 1.42. According to the World Fact Book 2007, we came to know that the infant mortality rate is 59.12 per 1000 live births and the mortality under-five is 73 per live births (CIA, 2007).

Within-country studies, it shows that low economic status has association with increased rates of infant and child mortality (Wagstaff, 2000; Moser et al., 2005; Fenn et al., 2007; Gwatkin et al., 2007). Socioeconomic status has also strong relation to maternal education level,

which influences the risk of disease through child-rearing practices such as breastfeeding, appropriate care-seeking (Bicego and Boerma, 1993). Caldwell argued that the maternal education of women plays an important role in determining child survival even after controlling for a number of socioeconomic factors (Caldwell, 1984). Several other studies also established the influence of maternal education on infant and child mortality (Cleland et al., 1988; Cleland and Streatfield, 1992; Boerma and Bicego, 1992).

Improved sanitary conditions, access to safe drinking water and information education and communication (IEC) programme are important factors contributing to a decline in infant mortality (Martin et al., 1983; Peterson et al., 1986; DaVanzo and Habicht, 1986).

Attention need to be given to female education and expansion of public health system in order to reduce the risk of IMR and child mortality rate (CMR) (Kabir et al., 2001). The relative importance of socio-economic determinants to infant and child mortality risks varies with the level of social and economic well-being of a society

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(Gubhaju et al., 1991).

According to Population and Development Indicators for Asia and the Pacific report, 2008, ESCAP, in 2008 SAARC countries', infant and under five mortality rates (156 and 234 per 1,000 live births, respectively) is highest in Afghanistan, and lowest in Sri Lanka (infant and under five mortality rates are 11 and 13 per 1,000 live births, respectively). In Bangladesh, infant and under five mortality rates are 52 and 68 per 1,000 live births, respectively, in 2008, which are still very high (UN, 2008). Thus, the main objectives of this study is to estimate the levels and patterns of infant and child mortality and to find out the impact of socioeconomic factors on neonatal, post neonatal, infant and child mortality based on sample survey over Natore sadar upazila.

DATA AND METHODOLOGY

We have conducted a research study on infant and child mortality among reproductive aged women (aged 15 - 49 years) of Natore sadar upazila in Natore district of Bangladesh from November to December 2007. Data were collected from all eligible reproductive aged women who participated in the study after giving them a brief description of the purposes. The selected 796 women were chosen through using multi-stage sampling design for investigating socio-economic factors that affect childhood mortality. This study was followed a personal interview approach for the purpose of data collection and took direct interview of women with the help of questionnaire. Statistical Package for Social Sciences (SPSS), version 10.0 package program was used for analyzing the data. The contingency analysis is used to test significance association between the different phenomena on the basis of classification of variables or attributes by applying the Chi-square (χ^2) test in

which $\chi^2 = \sum \frac{O_{ij}^2}{E_{ij}} - N$, follows a χ^2 distribution with (r-1) (c-

1) degrees of freedom. In order to observe the effects of the independent variables (X) on the dependent variable (Y), we preferred a binary logistic regression analysis. The logistic function may be written as (Cox, 1958):

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

where,

$$z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7$$

and $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ and β_7 are regression parameters. For the predicted variables.

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

$$\begin{cases} 1, & \text{if post neonatal mortality occurs,} \\ 0, & \text{if it does not occur.} \end{cases}$$

For Model 2: Y=

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

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

And for the explanatory variables,

$$X_1 = \text{Mother's education} = \begin{cases} 1, & \text{if literate,} \\ 0, & \text{otherwise} \end{cases}$$

$$X_2 = \text{Father's education} = \begin{cases} 1, & \text{if literate,} \\ 0, & \text{otherwise.} \end{cases}$$

$$X_3 = \text{Mother's occupation} = \begin{cases} 1, & \text{if professional,} \\ 0, & \text{otherwise.} \end{cases}$$

$$X_4 = \text{Father's occupation} = \begin{cases} 1, & \text{if professional,} \\ 0, & \text{otherwise.} \end{cases}$$

$$X_5 = \text{Monthly income of household} = \begin{cases} 1, & \text{if taka 2500+,} \\ 0, & \text{otherwise.} \end{cases}$$

$$X_6 = \text{Types of latrine} = \begin{cases} 1, & \text{if hygienic,} \\ 0, & \text{otherwise.} \end{cases}$$

$$X_7 = \text{Electricity} = \begin{cases} 1, & \text{if yes,} \\ 0, & \text{otherwise.} \end{cases}$$

In multivariate approach, we have built four logistic models for socio-economic variables present in Table 4.

RESULTS

The distributions of economic conditions and social benefits have close relation with infant and child morbidity patterns of a community. In this study, we observe that 25.4% mothers have not received any formal education, 30.5% mothers have completed primary education level and 44.1% mothers have completed secondary and above education level; 32.3% father's of children are illiterate, 24.2% primary education and 43.5% secondary and above level education (Table 1). The respondents main occupation is housewives (94.3%) and other occupations are services, business and others occupation such as servant, jobs, street worker. The husbands' occupational categories indicate that 30.5% are labor, 28.5% business holder, 21.6% services holder and

Table 1. Percentage of women aged 15 - 49 years according to some selected socio-economic characteristics.

Background characteristics	Number of cases	Percentages
Mother's education		
Illiterate	202	25.4
Primary level	243	30.5
Secondary or higher	351	44.1
Father's education		
Illiterate	257	32.3
Primary level	193	24.2
Secondary or higher	346	43.5
Mother's occupation		
Services	14	1.8
Business	12	1.5
Labor	6	.8
Housewife	751	94.3
Other	13	1.6
Father's occupation		
Services	172	21.6
Business	227	28.5
Labor	243	30.5
Farmer and Other	154	19.3
Household income		
<2500	195	24.5
2500-3500	291	36.6
3500-4500	96	12.1
4500+	214	26.9
Type of latrine		
Sanitary	528	66.3
Pacca	55	6.9
Katcha	201	25.3
Hanging	11	1.4
Open and others	1	.1
Has electricity		
No	260	32.7
Yes	536	67.3

19.3% are in farmer and other occupation. The highest proportion of family (36.6%) belong to income range TK 2500 - 3500, 26.9% family in TK 4500+ and 24.5% family are in the income range TK <2500. The study results show that 66.3% families have sanitary latrine, 25.3% have katcha latrine, 6.9 and 1.4% have pacca and hanging latrine, respectively. Majority (67.3%) of the total respondents has electricity in their household and 32.7%

mother's families have no electricity.

Socio-economic differentials of NNMR, PNNMR, IMR and CMR

In the developing countries, many researchers identified that several socio-economic factors have strong relationship with NNMR, PNNMR, IMR and CMR differentials (Table 2). Various estimates suggest that infant mortality in Bangladesh has fallen from a rate of around 150 per thousand live births in the mid-1970s (CPD, 1981; Kantner and Frankenberg, 1988; Majumder, 1989) to a range of 100 – 115 in the late 1980s (Mitra et al., 1990; BBS, 1990; Huq and Cleland, 1990).

Mortality levels at all ages have inverse relation to mother's education. Infant mortality rate (IMR) among children born to women with no education is 68 deaths per 1,000 births compared with 33 deaths per 1,000 births among children born to women who have completed secondary school or higher (UNFPA, 2003). The results indicate (Table 4) that NNMR, PNNMR, and IMR and CMR are higher in illiterate mothers group (e.g., NNMR is 125.00, PNNMR is 166.67 and CMR is 59.52 per 1000 live births) while lower in mothers who have some secondary education (e.g., NNMR is 26.32, PNNMR is 26.32 and IMR is 52.63 per 1000 live births). However, CMR is lower for mothers with some primary education (child death rate is 8.62 per 1000 live births).

Father's education level also shows the same result as mother's education that higher mortality in illiterate fathers (e.g., NNMR is 90.91 and CMR is 40.82 per 1000 live births). NNMR is lower for fathers with some secondary education (51.28 per 1000 live births). PNNMR is high in illiterate fathers group (100 per 1000 live births) and low for fathers with some secondary education (25.64 deaths per 1000 live births). IMR is high for fathers group who have no education (100 per 1000 live births) and low for fathers with some secondary education (76.92 deaths per 1000 live births).

Cross-national studies in developing countries suggested that there is negative relationship between maternal work and infant and child survival (Hobcraft et al., 1984; Basu and Basu, 1991; Sivakami, 2003; Kishor and Parasuraman, 1998). Although, female labour force participation is low in Pakistan (Ahmed and Ali, 1992), the incidence of CMR is higher among working than non-working mothers.

We observe from the results that NNMR, PNNMR are higher in those who with occupation labor and others (e.g., NNMR is 166.65, and PNNMR is 134.13 and CMR is 90.91 per 1000 live births) while lower for children of mothers who are housewives (e.g., NNMR is 36.59 and PNNMR is 36.59 and CMR is 17.24 per 1000 live births). It appears from the result that NNMR, PNNMR rates are higher for labor (e.g., NNMR is 85.71 and PNNMR is 142.86 per 1000 live births) while lower for children of fathers who are engaged in service (e.g., NNMR is 58.82,

Table 2. NNMR, PNNMR, IMR and CMR by some selected socioeconomic characteristics.

Socioeconomic characteristics	NNMR (per 1000 live births)	PNNMR (per 1000 live births)	IMR (per 1000 live births)	CMR (per 1000 live births)
Mother's education				
Illiterate	125.00	166.67	291.67	59.52
Primary level	–	34.48	34.48	8.62
Secondary or higher level	26.32	26.32	52.63	11.56
Father's education				
Illiterate	–	100.00	100.00	8.62
Primary level	90.91	90.91	181.82	40.82
Secondary or higher level	51.28	25.64	76.92	18.87
Mother's occupation				
Professional	–	44.13	44.13	71.43
House wife	36.59	36.59	73.18	17.24
Labor and others	166.65	134.13	299.98	90.91
Father's occupation				
Service	58.82	58.82	117.65	14.08
Business	–	120.00	120.00	17.09
Labor	85.71	142.86	228.57	26.79
Farmer and others	–	–	–	27.40
Monthly household income				
<2500	80.00	160.00	240.00	23.81
2500-3500	29.41	29.41	58.82	19.61
>4500	50.00	50.00	100.00	31.58
Types of latrine				
Unhygienic toilet	93.75	156.25	250.00	47.62
Hygienic toilet	16.95	16.95	33.90	11.19
Electricity				
No	75.00	150.00	225.00	40.65
Yes	19.61	–	19.61	12.00

PNNMR is 58.82, and CMR is 14.08 per 1000 live births)

Monthly household income also determines the economic status, nutrition and housing condition, access to health care and clothing of a family. The results reveal that NNMR, PNNMR and IMR are higher for household income level with <2500 taka (e.g., NNMR is 80.00 and PNNMR is 160.00 per 1000 live births), while NNMR, PNNMR and IMR are lower for household income level with 2500 - 3500 taka (e.g., NNMR is 29.41 and PNNMR is 29.41, IMR is 58.82 and CMR is 19.61 per 1000 live births). Exception can be seen in case of CMR which is higher in the household income level with >4500, is 31.58 per 1000 live births.

Lopez observed that availability of better toilet facility have a positive influence on child mortality in many

countries (Lopez et al., 1983). The study results show that the households that have hygienic latrines considerably had lower mortality (e.g., NNMR is 16.95, PNNMR is 16.95, IMR is 33.90 and CMR is 11.19 per 1000 live births) while higher mortality for the households that have unhygienic latrines (e.g., NNMR is 93.75, PNNMR is 156.25 and CMR is 47.62 per 1000 live births) (Table 4).

The salient features of test results with socio-economic attributes

In the light of socioeconomic factors, infant and neonatal mortality have significant association with mother's education, father's occupation, monthly income, types of

Table 3. Results of contingency analysis according to socioeconomic factors with neonatal, post-natal, infant and child mortality.

Attributes	Neonatal mortality				Post-natal mortality			
	Cal. χ^2 value	Df.	Asy Sig (ρ)	Sig	Cal. χ^2 value	Df.	Asy Sig (ρ)	Sig
Mother's education	4.672	1	0.031	Sig**	9.568	1	0.002	Sig*
Father's education	2.132	1	0.144	Insig	0.0601	1	0.438	Insig
Mother's occupation	0.126	1	0.722	Insig	3.353	1	0.067	Sig**
Father's occupation	3.908	1	0.048	Sig**	2.667	1	0.102	Insig
Monthly income of household	5.550	1	0.018	Sig**	11.280	1	0.001	Sig*
Types of latrine	4.376	1	0.036	Sig**	9.097	1	0.003	Sig*
Electricity	3.320	1	0.068	Sig***	12.645	1	0.000	Sig*
Television	4.070	1	0.044	Sig**	6.158	1	0.013	Sig**

	Infant mortality				Child mortality			
	Cal. χ^2 value	Df.	Asy Sig (ρ)	Sig	Cal. χ^2 value	Df.	Asy Sig (ρ)	Sig
Mother's education	9.228	1	0.002	Sig*	5.079	1	0.024	Sig**
Father's education	0.102	1	0.750	Insig	1.744	1	0.187	Insig
Mother's occupation	1.423	1	0.233	Insig	2.131	1	0.144	Insig
Father's occupation	4.383	1	0.058	Sig***	0.506	1	0.477	Insig
Monthly income of household	6.956	1	0.008	Sig*	0.005	1	0.943	Insig
Types of latrine	13.361	1	0.000	Sig*	8.812	1	0.003	Sig*
Electricity	15.202	1	0.000	Sig*	6.758	1	0.009	Sig*
Television	10.204	1	0.001	Sig*	2.118	1	0.146	Insig

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

latrine and electricity. Post-neonatal mortality is also associated with mother's education, mother's occupation, monthly income, types of latrine and electricity. However, child mortality has significant association only with mother's education, types of latrine and electricity. Especially, mother's education, monthly income of household, types of latrine, electricity and television are important aspect, which have a great influence on the survival of young children (Table 3).

Socio-economic determinants of neo-natal, post-neonatal, infant and child mortality

In the logistic regression analysis, our dependent variables are the survival status of neonatal, post neonatal, infant and child to identify the significant effects and to assess the relative importance of the selected socio-economic variables (such as level of education of the parents, occupation, family income, type of toilet facility and access to electricity) on neonatal, post neonatal, infant and child mortality. This multivariate analysis estimates the regression co-efficient, significance probability and relative odds ratio for each category of the categorical variables presented in Table 4.

From Table 4, Model 1 includes the neonatal mortality as the dependent variable and the entire selected socio-economic related characteristic as the independent variables. According to the fitted model as shown in Table 4, there are no socio-economic variables that are statistically significant at 1, 5 and 10% level. Model 2 considers the post-neonatal mortality as the dependent variable and some selected socio-economic related characteristic as the independent variables. From Table 4, only 2 explanatory variables out of 6 independent variables are statistically significant at 5% level. These significant predictors of post-neonatal mortality are mother's education and mother's occupation. In addition, highly educated mothers probably have more resources available to deal with negative reproductive patterns (Robitaille and Kramer, 1985).

In the study, it is evident that mother's education is significant at 5% level. The risk of post neonatal mortality for literate mothers is 0.067(93.3%) times lower than that of illiterate mother. we observe that mother occupation has positive significant effects on post neonatal mortality. Regression coefficient for professional mother group is 3.113. The odds ratio for professional mother group is 22.498, which indicate the risk of post neonatal mortality for professional mother, which is 22.498 times higher,

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

Socioeconomic characteristics	Model 1 for neonatal mortality		Model 2 for post-neonatal mortality		Model 3 for infant mortality		Model 4 for child mortality	
	Coefficient (β)	Odds ratio	Coefficient (β)	Odds ratio	Coefficient (β)	Odds ratio	Coefficient (β)	Odds ratio
Mother's education								
Illiterate ®	...	1.000	...	1.000	...	1.000	...	1.000
Literate	-1.316	0.268	-2.706**	0.067	-1.834**	0.160	-2.099**	0.123
Father's education								
Illiterate ®	–	–	...	1.000	...	1.000	...	1.000
Literate			1.067	2.906	1.740**	5.697	2.889**	17.979
Mother's occupation								
Non professional ®	...	1.000	...	1.000	...	1.000	...	1.000
Professional	-5.492	0.002	3.113**	22.498	2.200**	9.025	2.754**	15.704
Father's occupation								
Non professional ®	...	1.000	...	1.000	...	1.000	...	1.000
Professional	-7.344	0.001	0.145	1.156	0.079	1.082	0.337	1.401
Monthly income of household								
<2500 ®	...	1.000	...	1.000	...	1.000	...	1.000
2500+	-1.103	0.332	-1.997	0.136	-0.234	0.791	1.125	3.080
Types of latrine								
Unhygienic ®	...	1.000	...	1.000	...	1.000	...	1.000
Hygienic	-1.032	0.356	-1.739	0.176	-1.465	0.231	-1.881**	0.152
Electricity								
No ®	...	1.000	–	–	...	1.000	...	1.000
Yes	-0.270	0.763			-2.290**	0.101	-1.742**	0.175
Constant	-2.925	0.054	-2.865	0.057	-2.977	0.051	-4.948	0.007

*Significance at $p < 0.01$; ** Significance at $p < 0.05$; *** Significance at $p < 0.10$; (R): reference category.

risk than post neonatal mortality for non-professional mother.

Model 3 includes the infant mortality as the dependent variable and some selected socio-economic related characteristic as the independent variables. In Table 4, we can see that only 4 variables out of 7 variables are statistically significant at 5% level. The significant predictors of infant mortality are mother's education, father's education, mother's occupation and electricity. It may construct evident from Table 4 that mother's education is significant at 5% level. The risk of infant mortality for literate mothers is 0.160 (84.0%) times lower than the infant mortality for illiterate mother. Father's education is significant at 5% level. The risk of infant mortality for literate father is 5.697 times higher than

infant mortality for illiterate father.

From Table 4, it is observed that mother occupation has significant effects on infant mortality. Regression coefficient for professional mother group is 2.200. It is clear that among the occupational group, the category professional has a positive effect on infant mortality. The odd ratio for professional mother group is 9.025, which indicate the risk of infant mortality for professional mother have 9.025 times higher risk than infant mortality for non-professional mother. Electricity has significant effects on infant mortality. Regression coefficient for the families having electricity is -2.290. We may notice that electricity has a negative effect on infant mortality. The odd ratio for the families having electricity is 0.101 that indicate the risk of infant mortality for the families having electricity

have 0.101 (89.9%) times lower risk than infant mortality for the families that had no electricity.

Model 4 includes the child mortality as the dependent variable and as of the selected socio-economic, related characteristics are the same as independent variables, according to the fitted model shown in Table 4. Five variables out of seven variables are statistically significant. These significant predictors of child mortality are mother's education, father's education, mother's occupation, types of latrine and electricity. It is obvious that mother's education is significant at 5% level. The risks of child mortality for literate mothers is 0.123 (87.7%) times lower than the child mortality for illiterate mother. The risk of child mortality for literate father is 17.979 times higher than the child mortality for illiterate father. Mother occupation has significant effects on child mortality. Regression coefficient for professional mother group is 2.754 and is positively significance at 5% level. The odds ratio for professional mother group is 15.704 that indicate the risk of child mortality for professional mother with 15.704 times higher risk than child mortality for non-professional mother.

The regression coefficient for the hygienic toilet facility for household, which is one of the important factors in increasing child mortality, is -1.881 and is negatively significant at 5% level. The odds ratio for hygienic toilet is 0.152, which indicates that risks of child mortality for the household had hygienic toilet is 0.152 (84.8%) times lower than the child mortality for the household had hygienic toilet. Electricity has significant effects on child mortality. Regression coefficient for the families having electricity is -1.742 and is negatively significant at 5% level. The odds ratio for the families having electricity is 0.175, which indicate that the risk of infant mortality for the families having electricity have 0.175 (82.5%) times lower risk than child mortality for the families that had no electricity.

DISCUSSION AND CONCLUSION

Socio-economic variables (e.g., place of residence, religion, marital status, education, occupation, family income, household income etc.) reflect the socio-economic status of a community that have a high influence on morbidity and mortality level. Parent's occupation determines the economic status, nutrition and housing condition, access to health care and clothing of a family. Infant and child mortality reflect a country's level of socioeconomic development and quality of life. It is also important for monitoring the progress of the United Nations Millennium Development Goal to reduce child mortality. From our study, we observe that mother's education and occupation, type of latrine and electricity are the influential factors of neonatal, post neonatal, infant and child mortality. Hence, the following recommendations may suggest that, based on the present study, could help planners and policy makers to take appropriate decision

to reduce infant and child mortality of not only the study area but also whole country:

1. Both male and female education participation needs to increase because it consequently brings an improvement in infant and child mortality situation.
2. Sanitation facilities of the family should improve.
3. IEC programs directed to enlighten mothers on the health services of children available in their communities should improve through effective participation of government, NGOs as well as mass media.

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