

COX'S PROPORTIONAL HAZARD MODEL ANALYSIS OF CHILD SURVIVAL IN BANGLADESH

Abdul Hamid Chowdhury¹, Mohammad Emdad Hossain², Md. Musa Khan³,
Mohammad Nazmul Hoq⁴

Department of Business Administration, International Islamic University Chittagong,
BANGLADESH.

¹ ahamidc@gmail.com, ² mehapstat@gmail.com, ³ musa_stat@yahoo.com, ⁴ ronyfist@yahoo.com

ABSTRACT

This study utilizes data extracted from the Bangladesh Demographic and Health Survey (BDHS-2007) to investigate the predictors of child survival (age under 5 years) in Bangladesh. The cross-tabulation and Cox's proportional hazard model techniques have been used to estimate the predictors of child survival in Bangladesh. Parents' education, occupation of father, region, type of toilet facility, access to mass media, breastfeeding status, birth order, birth spacing with previous child, age of mother, age at first marriage and antenatal visit during pregnancy have been found significant effect on child survival by both cross-tabulation and Cox's proportional hazard techniques. Finally, these findings suggest that an increase in parents' education, breastfeeding to child, encourage child bearing age of mothers at 20-34 years, legal age at marriage and improve health care services, could in turn raise child survival and decrease child mortality in Bangladesh.

Keywords: Child survival, Proportional hazard model, Antenatal.

INTRODUCTION

The study of child mortality becomes one of the most important research issues of the developing countries including Bangladesh. According to UN Population Fund (2010) the total population of Bangladesh is 164.4 million whereas the area is only 1,44,000 km², which represents that Bangladesh is one of the most densely populated country in the world. Despite improvements in the general mortality, particularly infant and child mortality over the last three decades in Bangladesh, the level of infant or child mortality remains markedly high. Infant mortality dropped to about 52 per thousand live births in the 2007 Bangladesh Demographic and Health Survey (BDHS) from about 87 in the 1993 -1994 BDHS and child mortality dropped to about 14 per thousand live births in the 2007 BDHS from about 50 in the 1993-1994 BDHS (National Institute of Population Research and Training (NIPORT), 2009). Though such a reduction appears encouraging these national figures may mark large differentials in the risk of death that children of various sub groups of population are exposed to the decline in mortality may be attributed to the government's efforts to implement a public health program, including the immunization of children. Successive five-year national development plans have been emphasizing reductions infant and child mortality with varying targets. Some of the differentials are due to social and economic conditions (Bhuiya, 1989). Thus identification of the factors, which produce these differentials, is important to policy makers in their efforts to improve child survival. Socio-economic factors that have typically been examined in relation to differential child survival in developing countries include parental education (particularly that of mother), place of residence, father's occupation and household economic condition (Caldwell, 1979). Recently, many of the demographic surveys in developing countries have been designed to collect information on this household's

environmental condition. Mothers' demographic factors that have typically been examined in relation to the differential of child survival in developing countries (Chowdhury, 1981). Age of mother, birth order, birth interval and sex of child, which were the demographic characteristics, in relation to differential child survival (Ahmed, 1992). In a developing country like Bangladesh where the level of child mortality is high as judged by the standard of developing nation a study of factors influencing child mortality is of considerable relevance to planners and policy makers for the overall improvement of child survival and health. There is no doubt that both economic factors and modern technology have had impacts on mortality decline in the developing countries during the recent past. Perhaps, there are limits to the achievement of one in the absence of the other. It is believed that only after a nation in economic development crosses a certain threshold can health programs become fully effective to improve the mortality situation.

For Bangladesh, better survival for urban children was also observed in nationwide studies conducted during the seventies. One such study was the Bangladesh Retrospective Survey of Fertility and Mortality (BRSFM), where a substantially higher child mortality rate was observed for rural than urban areas (Census Commission, 1977). On the basis of Bangladesh Fertility Survey (BFS) data, a similar tendency of higher child mortality among rural children was reported by many investigations (Al-Kabir, 1984). With this in view an attempt was made to investigate the effect of selected socio-economic, demographic and environmental factors on child survival in Bangladesh. However, when the efforts of other variables like parental education, age of mother at birth facility were controlled, the pattern of urban-rural differentials' was reversed (Trussell & Slough, 1983). This indicated that the urban-rural differences might have been mediated through the other variables included in the analysis.

The review of literature of child survival shows that a number of variables are affecting child survival. However, the predictors of child survival are changing through time since the facilities and awareness are changing day by day. Hence, it is necessary to identify the segment of population where programs need strengthen in order to achieve the goal for increasing child survival.

Objective of the Study

In this study, an attempt has been made:

- I. To examine the predictors of child survival in Bangladesh.
- II. To identify the factors which are influencing child survival and
- III. To suggest viable strategies to increase child survival in Bangladesh.

DATA AND METHODOLOGY

This study uses data extracted from the Bangladesh Demographic and Health Survey (BDHS-2007), which was conducted during the period from 24 March to 11 August 2007, on behalf of the Government of Bangladesh by National Institute for Population Research and Training (NIPORT), with funding from the United States Agency for International Development (USAID)/Dhaka. The description of the survey can be found elsewhere. The sampling frame for the survey considered all households in Bangladesh from which a nationally representative sample of 10,819 households was selected; 10,461 were occupied. Of the households occupied, 10,400 (99.4%) were successfully interviewed. In these households, a total of 11,178 ever-married females aged less than 50 years were identified as eligible for individual interview. Of them, 10996 females (or 98.4%) were successfully interviewed. Among the 10996 ever-married females, the numbers of urban and rural respondents are 4151

(37.75%) and 6845 (62.25%), respectively. The sample had been taken 5 years prior to BDHS-2007 survey. A total of 6150 children, under-five years age have been selected in the study of whom 361 (5.87%) has already dead and 5789 (94.13%) have still surviving at date of survey. The associations between child survival and selected explanatory variables have been tested by applying cross-tabulation analysis. The cross-tabulation analysis is an important in first step for studying the relationship between child survivals with several characteristics. However, such analysis fails to address child survival predictors completely because of ignoring other covariates.

Cox's Proportional-Hazards Model

As mentioned, survival analysis typically examines the relationship of the survival distribution to covariates. Most commonly, this examination entails the specification of a linear-like model for the log hazard. Cox proportional hazards models are a class of [survival models](#) in statistics. Survival models relate to the time that passes before some event occurs to one or more [covariates](#) that may be associated with that quantity (Cox, 1972). Logistic regression models are usually used to identify the covariates for categorical variables by ignoring continuous events. In a proportional hazards model, the unique effect of a unit increase in a covariate is multiplicative with respect to the [hazard rate](#). Hence, Cox proportional hazard model has also been adopted in order to estimate independent effects of each variable while controlled for others. Cox proportional hazard analysis has carried out for the child according to the age at survived. The survival status of children whose were surviving at the time of survey is considered as censored events. In this regards, Cox proportional hazard model is most appropriate technique for analysis of such data. This analysis has considered all the covariates that have found significant in cross-tabulation analysis up to 10% level of significance.

Variables

In this study we consider the important variables which are education of mother; education of father; economic status; currently working status of mother; occupation of father; type of place of residence; region, Religion; type of toilet facility; sources of drinking water; access to mass media; breastfeeding status; birth order; birth spacing with previous child; age of mother; age at first marriage; sex of child; place of delivery and antenatal visit during pregnancy.

RESULTS AND DISCUSSION

In this section, we examine the predictors of child survival. Child survival reflects a country's level of socio-economic development and quality of life. Bangladesh has witnessed a large decline in child mortality during the last three decade. The child survival varies according to socio-economic, bio-demographic and health care characteristics of the population concerned. There are many predictors of child survival in a particular group of variables and it is necessary to analyze them separately in order to get the idea about the insight variation of that particular type of variables.

The distribution of child survival by socio-economic, bio-demographic and health care variables is shown in Table-1. Among socio-economic variables, parent's education has a positive strong relationship with child survival. The results indicate that the child survival rate is lowest (92.9%) for the children of illiterate mothers and highest (95.4%) for the children whose mother's education level is secondary and above. It is clear that the child survival rate increases with the increase of mother's education. Like mother's education,

father's education also plays significant role on child survival. Father's education level regards as a valid proxy of income and wealth status of the household in Bangladesh. It is likely that higher educated people belong to higher economic class. The child survival rate is highest (96.1%) for the children whose father's education level is secondary and above and lowest (92.7%) for children whose fathers' are illiterate.

The result depicts that child survival moderately increases as father education increases. Therefore, it may be concluded that child survival rate is high for the children whose parents are educated. The highest child survival rate (95.1%) has been found among the children whose mothers are rich and lowest (93.5%) for the mothers who are poor. Nevertheless, currently working status of mother has no significant effect on child survival.

Table 1. Percentage distribution of child survival according to selected variables

Selected Variables	Number of Children		Total	Percentage of Alive	Chi-square (χ^2)
	Alive	Dead			
<i>Education of Mother</i>					
Illiterate	1706(29.5%)	131(36.3%)	1837(29.9%)	92.9%	12.820***
Primary	1661(28.7%)	112(31.0%)	1773(28.8%)	93.7%	
Secondary +	2422(41.8%)	118(32.7%)	2540(41.3%)	95.4%	
<i>Education of Father</i>					
Illiterate	2068(35.7%)	163(45.2%)	2231(36.3%)	92.7%	27.386***
Primary	1506(26.0%)	109(30.2%)	1615(26.3%)	93.3%	
Secondary +	2215(38.3%)	89(24.7%)	2304(37.5%)	96.1%	
<i>Economic Status</i>					
Poor	2341(40.4%)	163(45.2%)	2504(40.7%)	93.5%	6.649**
Middle	1078(18.6%)	75(20.8%)	1153(18.7%)	93.7%	
Rich	2370(40.9%)	123(34.1%)	2493(40.5%)	95.1%	
<i>Currently Working Status of Mother</i>					
No	4405(76.1%)	278(77.0%)	4683(76.1%)	94.1%	0.157
Yes	1384(23.9%)	83(23.0%)	1467(23.9%)	94.3%	
<i>Occupation of Father</i>					
Agriculture	1288(22.2%)	93(25.8%)	1381(22.5%)	93.3%	6.839*
Business	1335(23.1%)	68(18.8%)	1403(22.8%)	95.2%	
Service	676(11.7%)	36(10.0%)	712(11.6%)	94.9%	
Others	2490(43.0%)	164(45.4%)	2654(43.2%)	93.8%	
<i>Type of Place of Residence</i>					
					5.587**

Urban	2004(34.6%)	103(28.5%)	2107(34.3%)	95.1%	
Rural	3785(65.4%)	258(71.5%)	4043(65.7%)	93.6%	
<i>Region</i>					28.099***
Barisal	749(12.9%)	42(11.6%)	791(12.9%)	94.7%	
Chittagong	1201(20.7%)	74(20.5%)	1275(20.7%)	94.2%	
Dhaka	1225(21.2%)	60(16.6%)	1285(20.9%)	95.3%	
Khulna	681(11.8%)	33(9.1%)	714(11.6%)	95.4%	
Rajshahi	917(15.8%)	50(13.9%)	967(15.7%)	94.8%	
Sylhet	1016(17.6%)	102(28.3%)	1118(18.2%)	90.9%	
<i>Religion</i>					
Muslim	5279(91.2%)	331(91.7%)	5610(91.2%)	94.1%	
Non-Muslim	510(8.8%)	30(8.3%)	540(8.8%)	94.4%	
<i>Type of Toilet Facility</i>					6.355**
Open Latrine	3457(59.7%)	223(61.8%)	3680(59.8%)	93.9%	
Sanitary Latrine	1428(24.7%)	70(19.4%)	1498(24.4%)	95.3%	
Others	904(15.6%)	68(18.8%)	972(15.8%)	93.0%	
<i>Sources of Drinking Water</i>					0.375
Pond/River/Others	5005(86.5%)	308(85.3%)	5313(86.4%)	94.2%	
Tube-well/Pipe	784(13.5%)	53(14.7%)	837(13.6%)	94.7%	
<i>Access to Mass Media</i>					3.500**
No Access	2200(38.0%)	155(42.9%)	2355(38.3%)	93.4%	
Having Access	3589(62.0%)	206(57.1%)	3795(61.7%)	94.6%	
<i>Breastfeeding Status</i>					1782.610***
Never Breast feeding	49(0.8)	130(36%)	179(2.9%)	27.4%	
≤11 months	1366(23.6%)	197(54.6%)	1563(25.4%)	87.4%	
12-23 months	1690(29.2%)	27(7.5%)	1717(27.9%)	98.4%	
≥24 months	2684(46.4%)	7(1.9%)	2691(43.8%)	99.7%	
<i>Birth Order</i>					11.545***
1	2500(43.2%)	137(38.0%)	2039(33.2%)	95.3%	
2-3	1902(32.9%)	123(34.1%)	2623(42.7%)	93.3%	

4 ⁺	1387(24.0%)	101(28.0%)	1488(24.2%)	93.2%	
<i>Birth Spacing With Previous Child</i>					30.452***
≤23 months	1686(29.1%)	154(42.7%)	1840(29.9%)	91.6%	
24-35 months	1258(21.7%)	70(19.4%)	1328(21.6%)	94.7%	
≥36 months	2845(49.1%)	137(38.0%)	2982(48.5%)	95.4%	
<i>Age of Mother</i>					6.963**
<20 years	818(14.1%)	67(18.6%)	885(14.4%)	92.4%	
20-34 years	4356(75.2%)	265(73.4%)	4621(75.1%)	94.3%	
>34 years	615(10.6%)	29(8.0%)	644(10.5%)	95.5%	
<i>Age at First Marriage</i>					6.623**
≤14 years	2298(39.7%)	160(44.3%)	2458(40.0%)	93.5%	
15-17 years	2246(38.8%)	143(39.6%)	2389(38.8%)	94.0%	
≥18 years	1245(21.5%)	58(16.1%)	1303(21.2%)	95.5%	
<i>Sex of Child</i>					0.420
Male	2929(50.6%)	189(52.4%)	3118(50.7%)	93.9%	
Female	2860(49.4%)	172(47.6%)	3032(49.3%)	94.3%	
<i>Place of Delivery</i>					1.375
Home	4784(82.6%)	307(85.0%)	5091(82.8%)	94.0%	
Hospital/Others	1005(17.4%)	54(15.0%)	1059(17.2%)	94.9%	
<i>Antenatal Visit During Pregnancy</i>					116.684***
No	2810(48.5%)	281(77.8%)	3091(50.3%)	90.9%	
At least one time	2979(51.5%)	80(22.2%)	3059(49.7%)	97.4%	
<i>Total (n)</i>	6150		6150	100%	

*** Significant at 1%, ** Significant at 5% and * Significant at 10%

Father's occupation is one of the important socio-economic characteristics of child survival. The child survival rate is highest (95.2%) for the children whose father's occupation is business and lowest (93.3%) for the children of agriculture father. The child survival of urban area is the higher (95.1%) than the rural area (93.6%). Among six administrative divisions, the child survival is highest (95.4%) in Khulna division and the lowest in Sylhet division. Types of toilet facility and access to mass media have been found positive statistical significant effect on child survival. Place of delivery, sources of drinking water and religion have no significant effect on child survival. Among the bio-demographic variables, breastfeeding status has been found with significant effect on child survival. The rate of child survival is the highest (99.7%) for the children whose mothers currently breastfed in 24 months and above and lowest (27.45%) for the children whose mothers never breastfed their

children. Among the total survivals, (43.2%) survival is found for first birth, (32.9%) and (24.0%) survivals are found in the birth order 2-3 and 4⁺ respectively. From the percentage of child survival, it is clear that child survival decreases steadily with birth order. The child survival rate is found to be the highest (95.3%) for first birth orders' children and the lowest (93.2%) for 4⁺ birth orders' children. The decrease in child survival rate with birth order may reflect a more intense competition faced by higher birth order children in terms of caregivers' time, medical resources and nutritious food while children needed. Birth spacing with previous child is found significant effect on child survival. The child survival rate are found (91.6%), (94.7%) and (95.4%) for birth interval with previous child, below 23 months, 24-35 months and 36 months and above respectively.

These results depict that the child survival rate increases gradually with birth spacing with previous child. The highest rate (95.5%) of child survival is found for the children whose mother's age is 35 years and above and the lowest (92.4%) for the children of below 20 years. Age at first marriage is an important predictor of child survival. Age at first marriage of mothers at 18 years and above is found to be the highest (95.5%) child survival and the lowest (93.5%) for the children whose mother's marital age below 15 years. Sex of child has no significant effect on child survival. The maternal health care services variables have strong indirect influence in increasing child survival, because the mothers who sought antenatal care during pregnancy are well aware about utilization of existing health facilities and they can properly utilize such facilities when needed for their child. The result reflects that the child survival rate is found higher (97.4%) for the children whose mothers receive at least one time antenatal check during pregnancy than the children whose mothers do not receive (90.9%) antenatal check during pregnancy.

Table 2. Cox's Proportional Hazard Analysis of Child Survival

<i>Variables</i>	<i>Odds Ratio [Exp(β)]</i>	<i>95% Confidence Interval of Exp(β)</i>	
		<i>Lower Limit</i>	<i>Upper Limit</i>
<i>Education of mother</i> (Illiterate)	1.00	-	-
Primary	1.115 ^{***}	1.036	1.199
Secondary and above	1.300 ^{***}	1.180	1.390
<i>Education of father</i> (Illiterate)	1.00	-	-
Primary	1.109 ^{**}	1.028	1.187
Secondary and above	1.096 [*]	1.008	1.201
<i>Economic status</i> (Poor)	1.00	-	-
Middle	1.022	.948	1.103
Rich	1500	1.370	1.770
<i>Father's occupation</i> (Agriculture)	1.00	-	-

Business	1.113 ^{***}	1.014	1.211
Service	1.123 ^{**}	1.046	1.232
Others	.941 [*]	.876	1.011
<i>Place of residence</i>			
(Urban)	1.00	-	-
Rural	.991	.931	1.055
<i>Region</i>			
(Sylhet)	1.00	-	-
Barisal	1.205 [*]	1.100	1.351
Chittagong	1.099 ^{**}	.999	1.208
Dhaka	1.144 ^{***}	1.041	1.258
Khulna	1.055	.949	1.174
Rajshahi	1.082	.979	1.195
<i>Type of toilet facility</i>			
(Open latrine)	1.00	-	-
Sanitary latrine	1.240 ^{**}	1.123	1.356
Others	1.058 [*]	.982	1.140
<i>Access to mass media</i>			
(No access)	1.00	-	-
Having access	1.087 ^{***}	1.021	1.115
<i>Breastfeeding status</i>			
(No breastfeeding)	1.00	-	-
≤11 months	8.905 ^{***}	6.692	11.850
12-23 months	5.488 ^{***}	4.128	7.296
≥24 months	2.683 ^{***}	2.021	3.561
<i>Birth order</i>			
(1)	1.00	-	-
2-3	1.290 ^{***}	1.203	1.383
4+	1.570 ^{***}	1.432	1.722
<i>Birth spacing with previous child</i>			
(≤23 months)	1.00	-	-
24-35 months	1.258 ^{***}	1.165	1.359
≥36 months	1.428 ^{***}	1.331	1.533
<i>Age of mother</i>			
(<20 years)	1.00	-	-

20-34 years	1.383 ^{***}	.348	.422
>34 years	.910 ^{***}	.764	1.056
<i>Age at first marriage</i>			
(≤14 years)	1.00	-	-
15-17 years	1.319 ^{***}	1.238	1.404
≥18 years	1.390 ^{***}	1.282	1.507
<i>Antenatal visit during pregnancy</i>			
(No)	1.00	-	-
At least one time	1.871 ^{***}	1.765	1.983

Reference category is marked by parenthesis, ^{***} Significant at 1%, ^{**} Significant at 5%, ^{*} Significant at 10%

Table-2 presents the odds ratio and confidence interval of odds ratio for child survival. In the odds ratio, asterisk sign indicate significant variables. The significant variables are found in cross-tabulation analysis have been considered as the covariate of Cox's proportional hazard model. This model is applied to identify the important factors of child survival. Since a considerable number of children are still surviving at the time of interview and so that they are considered as censored cases because their true durations of surviving cannot be observed. For this purpose, the dependent variable, age at child less than five years is dichotomized by assigning the value '0' for death child and the value '1' for alive child. The child survival is significantly 1.115 times and 1.30 times higher for the children whose mother's having primary, secondary and higher education as compared to the mother's who have no education. In the same way, the child survival is found to be 1.109 times and 1.096 times more likely than the children whose father's having primary, secondary and higher education respectively as compared to the fathers who have no education. These results clearly indicate that the child survival is increasing with increasing of parent's education and it is also found that parent's education has significant effect on child survival. This result may be due to fact that child survival is mainly affected by environmental factors and educated parents may be more conscious to the environment where child grow up.

Father's occupation is found to have significant effect on child survival. The child survival is higher 1.113 times and 1.123 times and lower 0.059 times for the children whose father engage in business, service and others job respectively as compare to the children whose father engage in agriculture. This may be due to the fact that a father engages in service may be higher educated and he provide better advantage (food, nutrition and health facilities) to his child than others. Socio-economic status and place of resident are important characteristics for child survival; but in this analysis, these variables have no effect on child survival. Administrative divisions are found to have partial significant effect on child survival. Child survival of Chittagong, Dhaka and Barisal divisions' are found to be 1.099 times, 1.144 times and 1.205 times more likely to compared with child survival of Barisal division. Type of toilet facility is found to have significant association with child survival. The child survival is found to have 1.240 times and 1.058 times higher for the children those who uses sanitary latrine and others toilet respectively as compared to child who use open latrine. Access to mass media is found to have significant effect on child survival. The child survival of having access to mass media is found to be 1.087 times more likely to compare with child survival having no access to mass media. Breastfeeding status of children has

significant effect on child survival. The child survival is found to be 8.905 times, 5.488 times and 2.683 times higher for the children whose mothers' breastfeed ≤ 11 months, 12-23 months and ≥ 24 months respectively to their children as compare to the children whose mothers do not breastfeed their children. Breastfeeding is universal in Bangladesh, and in current analysis, it is clear that breastfeeding has significant effect on child survival. Birth order is found to have statistically significant effect on child survival. The child survival of birth spacing with previous child is found to be 1.258 times and 1.428 times significantly higher for the children of 24-35 months and ≥ 36 month's birth spacing with previous child respectively as compared to the children of ≤ 23 months' birth spacing. Age of mother has significant impact on child survival. The odds ratios are found 1.383 and 0.910 for 20-34 years and >34 years of mothers respectively. This implies that the child survival is 1.383 times significantly higher and 0.91 times lower for the children whose mothers age are 20-34 years and >34 years respectively as compared to the mother's age <20 years. Age at first marriage is found significant effect on child survival. The child survival is 1.319 times and 1.390 times significantly more likely to the children of mother's age at first marriage at 15-17 years and ≥ 18 years respectively as compared to ≤ 14 years. Timing of antenatal check is found significant association with child survival. The child survival is 1.871 times higher for the children whose mothers receive at least one time antenatal check during pregnancy as compared to mothers who have not received any antenatal check during pregnancy.

CONCLUSION AND RECOMMENDATIONS

This study investigates the predictors of child survival in Bangladesh. It has utilized the national representative data from the Bangladesh Demographic and Health Survey (BDHS) - 2007. Both cross-tabulation and Cox regression analysis techniques have been applied to identify the important predictors of child survival. From the analyses several interesting decisions can be made, although the analysis itself was subject to various types of problems including small sample size for survival analysis. In addition, interpretations of the findings appear to be problematic in many cases. Sometimes, it is observed that logical or theoretical hypothesis are supported by the results of crude analysis (Like cross-tabulation) but are rejected as invalid when checked by those based on refined techniques such as Cox's proportional hazard model. Such a situation may be due to interrelationship between covariates.

The findings suggest that parents' education has been identified to be the most important socio-economic predictors of child survival that means child survival increase with increase in both mother's and father's education level. The study indicates that currently working status of mother has no significant impact on child survival but in both analyses father's occupation has played significant role in increasing child survival. Socio-economic status has found to have significant association with child survival by cross-tabulation analysis but it has found insignificant by Cox's proportional hazard analysis. Some characteristics have no major effect on child survival; these are religion, type of place of resident, region, mother's access to mass media, and type of toilet facility. Several bio-demographic variables have a substantial effect on child survival. Among these variables breastfeeding status, birth order, birth spacing with previous child, age of mother and age of first marriage have been found by both cross-tabulation and Cox's proportional hazard analysis. The antenatal visit during pregnancy has a principal effect on child survival in Bangladesh. Therefore, attention should be given to parents' education, occupation of father, type of toilet facility, mothers' access to mass media, currently breastfeeding, age of mother, age at first marriage and maternal health care factors in order to increase the child survival in Bangladesh.

REFERENCES

- Ahmed, T. (1992). Factors associated with child mortality in Pakistan and implications for the national health Programmer. *Asian and pacific population Forum*, 6(2), 391-409.
- Al-Kabir, A. (1984). *Effect of Community Factors on Infant and Child Mortality in Rural Bangladesh*. London: World Fertility Survey.
- Bhuiya, A. (1989). *Factors Affecting Child Survival in Matlab, Bangladesh, PhD Thesis Pape*. Department of Demography. Australian National University.
- Caldwell, J. C. (1979). Education as a factor in mortality decline: an examination of Nigeria Data. *Population Studies*, 33(3), 395-413.
- Census Commission. (1977). *Report on the Bangladesh Retrospective Survey of Fertility and Mortality*. Dacca: Census Commission, Ministry of Planning .
- Chowdhury, A. K. (1981). *Infant Deaths, Determinants and Dilemmas, Scientific Report No. 46*. Dacca: ICDDR, B.
- Cox, D. R. (1972). Regression Models and Life Tables (with Discussion). *Journal of the Royal Statistical Society , Series B* (34), 187—220.
- D, C., & R, O. (1984). *Analysis of Survival Data*. London: Chapman and Hall.
- Galway, K. B., Wolf, & R, S. (1987). *Child Survival: Risks and the Road to Health*. *Western House Institute for Research Development* .
- Hobcraft, J. N., McDoland, J. W. & Rutstein, S. O. (1985). Demographic determinants of infant and early child mortality: a comparative analysis. *Population Studies*, 39(3), 363-385.
- Islam, S. M. & Alam, M. F. (1996). Factor affecting child mortality in Bangladesh. *The Journal of Family Welfare*, 42(3), 13-18.
- Majumder, A. K. & Islam, S. M. (1993). Socio-economic and Environmental Determinants of Child Survival in Bangladesh. *Journal of Biosocial Science*, 25(3), 311-318.
- Moseley, w. H. & Chen, L. C. (1984). An analytical framework for the study of child survival in developing countries. *Population and Development Review*, 10(Supplement), 25-45.
- National Institute of Population Research and Training (NIPORT). (2009). *Bangladesh Demographic and Health Survey-2007*. Dhaka, Bangladesh: Mitra and Associates, Dhaka, Bangladesh, Macro International, Calverton, Maryland USA: Dhaka.
- Trussell, J. & Slough, H. C. (1983). A hazard model analysis of the covariance of infant and child mortality in Sri Lanka. *Demography*, 20(1), 1-26.