Infant Mortality in Bangladesh: An Analysis of Causes During Early Neonatal, Late Neonatal and Postnatal Periods

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Abstract

Although the overall mortality has shown a little decline over the past few years in Bangladesh, infant mortality, particularly during the neonatal period is still high. Employing the 2004 Bangladesh Demographic and Health Survey (BDHS) data, the present study made an attempt to detect the risk factors associated with child death at the various levels of infancy. Kaplan-Meier (P-L) method and Cox Proportional Hazards model were utilized for this purpose. Among the covariates studied, health care and delivery complication related variables were found to be significantly related to child death, particularly to those dying during the early days of life. It is argued in the present study that if the pregnant women are encouraged to take more antenatal care, it may help them to identify any complication which they might face during delivery and can be taken to the hospital immediately in the case of any emergency. This might help reducing a significant number of child deaths during infancy particularly those occurring during the early neonatal period.

I. Introduction

Mortality differentials reflect the level of socioeconomic development of a country. Infant and child mortality situations are particularly important as they make a substantial contribution to the current and future population trends, knowledge of which is of fundamental importance to the government for planning and evaluating population and health programs and policies.

An explanation of infant mortality is also important to plan future policy to reduce the level of fertility. The linkage between infant and child mortality and fertility is well documented in the literature. An investigation of the relationship between child mortality and subsequent fertility in Nepal suggested that the death of a child shortens subsequent birth interval by 5.42 months compared to a surviving child (Khatiwada DP, Thailand, Mahidol university, 1999, viii, p. 62). In an analysis of data for Colombia, Kenya, Sri Lanka, and Pakistan, women who had lost a child reported more of a desire for additional children than those who had not lost a child. (Richter K., Adlakha A., 1989). Choudhury et.al. (1992) in Bangladesh showed that couples who lost a child often stopped practicing contraception in order to have another child. Islam et. al. (1996, p. 57) in their study argued that both biological and behavioral factors may increase the level of fertility as a response to infant and child mortality.

Although continued declines are observed in child and under-five mortality in Bangladesh over time, infant mortality seems to have leveled off during recent years. Between the two most recent five years periods (1995-1999 and 1999-2003), only a 1.5 percent decline in infant mortality was observed. A child's risk of dying is observed to be the highest during the first month of life. More than 60 percent of infant deaths occur during the neonatal period (BDHS Report, 2004, p. 117). Therefore, government policies need to focus more on neonatal deaths in the effort of lowering infant mortality.

The present study made an attempt to explain how the differences in socioeconomic, demographic and other health care and delivery complications related factors cause differences in the rate of child death during the early neonatal, late neonatal and postnatal periods.

II. Data and Methods

The data used in the present study come from the nationally representative 2004 Bangladesh Demographic and Health Survey (BDHS) of 11,440 ever-married women aged 10-49 years. Survival information on children born during five years preceding the survey date was employed. Altogether, 6679 births were recorded during that period of which 408 had died in infancy. The remaining 6271 children had either survived beyond infancy (beyond their first birthday) or were censored by the survey date.

The analysis starts with univariate technique. Kaplan-Meier also known as Product-Limit (P-L) method (Lee, 1992) was employed at this stage. The event under consideration for this is an infant death occurred during his/her first year of life which is further categorized into early neonatal, late neonatal and postnatal deaths. Of the infant deaths, 203 had died within first seven days of life (early neonatal), 61 had died during 8-28 days (late neonatal) and the rest 144 had died after 28th day but before reaching their first birthday (postnatal). P-L method estimates the proportions of children surviving beyond early neonatal, late neonatal and postnatal periods over various categories of selected explanatory variables.

The proportional hazards model developed by Cox (1972) is used for multivariate analysis. The dependent variable in the hazards analysis corresponds to the survival time of the infants. This is measured in days from birth to death if death had occurred within their first year of life and is considered as complete information otherwise, from birth to survey date which is considered as incomplete information. The results are presented in Tables 1 and 2.

III. Results and Discussion

We start the discussion with the P-L estimates of the proportions of children surviving beyond early neonatal, late neonatal and postnatal periods over the various categories of selected explanatory variables. For socioeconomic variables, the differences in survival probabilities are not noticeable accept for a few cases. The first variable examined is mother's education. The impact of mother's education on the survival of young children is well recognized. In the present study, however, mother's education exhibits a

positive impact on child survival only for postnatal period. The proportion of children surviving beyond that period increases by 2.5 percent with a change in mother's education from none to primary.

Similar results were observed for both wealth status and religion. Children from rich families as well as non-Muslim children showed higher survival probabilities only during postnatal period.

Among the demographic and reproductive factors considered, mother's age at birth appeared to be a highly significant predictor of infant death. The age category 20-29 years appeared to be the safest age for bearing children. Children born to either younger or older mothers are found to be associated with increased risk of death all through infancy. The impact of mother's age on their child's survival is most pronounced for older mothers, and during postnatal period. Ninety two percent children born to older mothers survived the postnatal period which is 2.7 percent less than those born to mothers aged 20-29 years at the time of delivery.

Birth order of child is found to make substantial differences in the survival probabilities at different stages of infant death. The first child appeared to have the lowest survival probabilities all through infancy. Children born in order 2-4, on the other hand, had the highest proportion of surviving. Among all the children those born in order 5^+ had the lowest survival probability during postnatal period. These children are 3.2 percent less probable to survive beyond that period compared to those born in order 2-4.

No noticeable differences in the survival probabilities between male and female children are observed except for early neonatal period. Despite the fact that females are biologically more fit to survive the infancy, they appeared to have only 0.5 percent higher probability of surviving the early neonatal period compared to their male counterparts. For the remaining two stages of infancy, children from both sexes appeared to be almost equally likely to survive. The discrimination against female children in allocating food and care might be responsible for such findings.

 P-L estimates indicate the presence of strong relationship between all the health care related factors and child survival in Bangladesh. Mothers who are reported to have 1-3 antenatal visits are found to reduce their childs' death by 2 percent in early neonatal, 3 percent in late neonatal and 5.3 percent in postnatal period compared to those who have not had any antenatal care at all. Children Delivered at home/other places are found to have higher survival probabilities both during early and late neonatal periods compared to those delivered at hospitals and clinics. The result suggests that the mothers usually seek medical help only when there is any serious complication. Transportation problem in such cases, particularly in rural areas would often worsen the situation. Most of the deliveries taking place at hospitals/clinics thus face the consequence of death in early days of their lives.

Excessive bleeding at the time of delivery is found to increase the risk of child death by 3.2 percent in early neonatal, 3.4 percent in late neonatal and 3.6 percent in postnatal periods respectively.

According to P-L estimates both high fever and convulsion of mother at the time of delivery are strongly related to child survival. Presence of high fever during delivery increases child death by 4.8 percent in early and late neonatal and 5.3 percent in postnatal periods. Similarly, children born to mothers who have not had convulsion during deliveries are 4.8 percent more probable to survive their first seven days of life compared to those whose mothers had convulsion. The difference between the two groups further increases to 5.7 percent for late neonatal and 6.6 percent for postnatal babies.

Prolonged labor is found to reduce child survival by 2.8 percent in early neonatal and 3 percent in the remaining two stages of infant death.

Cox proportional hazards model was fitted to determine the relative risk of dying in infancy between various categories of selected covariates. The results suggest that higher education of mother reduces the hazards risk of infant mortality. The effects are, however, not statistically significant. Child's risk of dying in infancy increases if mother is working outside home. Child born to rich family are less likely to die in infancy compared to their counterparts born to poor/middle class families. Urban children are 1.6 times more likely to die in infancy than those born in rural areas. The risk of dying for Muslim infants is 30 percent higher than that for non-Muslim children. Children whose mothers were members of NGOs were less likely to experience death in infancy. It should be mentioned here that among the socioeconomic variables considered, only mothers education and working status showed statistically significant association with child survival.

Among the demographic characteristics studied, mother's age at birth and preceding birth interval are found to be statistically associated with child survival. Children born to older mothers have 43 percent higher risk of dying during infancy compared to those born to mothers aged 20-29 years. Births preceded by an interval of 37^+ months have significantly lower risk of dying compared to those preceded by an interval of 25-36 months (reference category). Births proceeded by shorter interval ($\leq$ 24 months), on the other hand, are 31 percent more likely to die in infancy compared to those in the reference category.

Among the health care related variables, antenatal visits and place of delivery showed strong relation with the child survival. For antenatal care, '1-3 visits' is considered as the reference category. A comparison with this category suggests that children born to mothers who had 4+ visits are half as likely to die in infancy compared to those in the reference category. Children born to mothers who have not had any antenatal care, on the other hand, are 2.5 times more likely to die during infancy compared to those whose mothers had '1-3' visits.

For place of delivery 'deliveries at home/other places' is considered as the reference category. Deliveries at hospitals/clinics' are 1.6 times more likely to die in infancy than those in the reference category. It is already mentioned that complicated cases are usually delivered at hospitals and therefore, have higher risk of death.

Giving colostrums immediately after birth may reduce the child death during infancy, the finding is not, however statistically significant. As indicated by the odds ratio it appears that almost 20 percent of the child death can be avoided by giving colostrums to the newborns immediately after birth.

Of all the factors related to delivery complications, prolonged labor and convulsion showed statistically significant association with child survival. Children born to mothers reported to have prolonged labor or convulsion during delivery have almost 40 percent higher risk of dying during infancy compared to those not suffering form those complications.

The presence of the other two factors: excessive bleeding and high fever during delivery although are found to be associated with increased odds of death, the results are, however, not statistically significant.

IV. Conclusion and Recommendations

Four million children die each year worldwide in their first four weeks of life implying a global average of 30 neonatal deaths per 1000 live births. Ninety nine percent of these deaths occur in low-income and middle-income countries (Lawn et. al., 2006). According to BDHS report, 2004, infant mortality rate in Bangladesh is 65 deaths per 1000 live births which indicate that 1 in 15 children born in this country dies before reaching their first birth day. Among these infants, the newborn constitute the highest risk group. Of the 65 infant deaths, 41 die within their first month of life (BDHS Report, 2004, p. 117). Therefore, without substantial reduction in mortality in early days of life, infant mortality can not be reduced to the desired level.

Many of the infant deaths, particularly those occurring during the early days of life can be prevented and for this it is important to know what is causing them. Various causes and risk factors are associated with increased risk of infant deaths at its different levels. In the present study the link between several socio-economic, demographic and health care related factors and child death at different stages of infancy is examined. In the univariate analysis, P-L method is used to estimate the proportion of survivors beyond early neonatal, late neonatal and postnatal periods over different categories of selected covariates followed by multivariate proportional hazards analysis.

In the P-L analysis all the health care related factors exhibit substantial differences in different levels of infant mortality. Among all, antenatal visits, however, appeared to be the strongest determinant of infant death. It is observed that 1-3 antenatal visits can save 2 in 100 early neonatal deaths, 3 in 100 late neonatal deaths, and 5 in 100 postnatal deaths.

Any of the complications during delivery may cause a significant number of child deaths all through infancy. For instance, if convulsion during delivery could be avoided, it might have saved 5 percent early neonatal, 6 percent late neonatal and 7 percent post natal deaths.

In the hazards analysis no significant influence of the selected socio-economic factors on child survival is observed except for mother's education and working status. Of the demographic and reproductive factors, older mothers are found to be associated with higher risk and a birth interval of 37+ months is found to be associated with lower risk of child death. No evidence of any gender discrimination in the hazards risk is observed.

The hazards analysis once again confirms the importance of antenatal care in child survival. Among the factors related to health care other than antenatal visits, place of delivery exhibits strong association with infant death. It is seen that deliveries taken place at hospitals have higher risk of death than those at home.

Among the four complications that might occur during delivery, prolonged labor and convulsion are found to be significantly associated with infant deaths. Relating to place of delivery, it may be concluded that if women with such complications could be taken to the hospitals in time, a substantial number of infant deaths could be avoided. These findings have important policy implications.

To increase the overall child survival, it is important to improve the socio-economic conditions of the country which may take a long time. It is depicted in the present study that most of the infant deaths which occur during first month of life are related to health care and delivery complications related factors. Therefore, for immediate benefit, it is most important to educate people about antenatal care which may help them to identify any complication which they might face during delivery and can be taken to the hospital immediately if they face any.

Table. 1. Product limit estimates of proportion of children in Bangladesh surviving beyond early neonatal, late neonatal and postnatal periods by selected variables.

Variables	Infant mortality status		
	Early Neonatal (N=203)	Late Neonatal (N=61)	Postnatal (N=144)
Socioeconomic			
Mother's education			
None	0.9651	0.9518	0.9185
Primary	0.9726	0.9620	0.9437
Secondary+	0.9717	0.9685	0.9533
Working status	0.9622	0.9533	0.9250
Yes	0.9711	0.9615	0.9404
No			
Wealth status	0.9677	0.9556	0.9288
Poor+Middle	0.9725	0.9679	0.9513
Rich			
	0.9697	0.9589	0.9362
Residence	0.9694	0.9639	0.9411
Rural			
Urban			
	0.9693	0.9599	0.9360
Religion	0.9726	0.9658	0.9544
Muslim			
Other	0.9681	0.9603	0.9443
	0.9701	0.9605	0.9355
Member of NGO			
Yes			
No			

Table. 1. Continued

Variables	Infant mortality status		
	Early Neonatal (N=203)	Late Neonatal (N=61)	Postnatal (N=144)
Demographic and Reproductive			
Mother's age at birth	0.9621	0.9515	0.9313
<20 years	0.9773	0.9690	0.9472
20-29 years	0.9609	0.9527	0.9202
30-39 years			
Birth order of child	0.9571	0.9452	0.9248
1	0.9759	0.9692	0.9504
2-4	0.9721	0.9596	0.9187
5+			
Gender of child	0.9670	0.9599	0.9369
Male	0.9723	0.9610	0.9385
Female			
	0.9619	0.9476	0.9220
Preceding birth interval	0.9732	0.9665	0.9367
<= 24 months	0.9768	0.9724	0.9563
25-36 months			
37+ months			
Health care			
	0.9598	0.9458	0.9117

Antenatal visits	0.9803	0.9764	0.9651
No visits	0.9834	0.9813	0.9782
1-3 visits			
4+ visits	0.9519		
	0.9720	0.9481	0.9362
Place of delivery		0.9621	0.9379
Hospital/clinic			
Home/other places	0.9801		
	0.9663	0.9708	0.9498
Colostrums		0.9572	0.9338
Immediately(within1hr)			
Not immediately			
Delivery Complications	0.9461	0.9348	0.9126
	0.9745	0.9658	0.9429
Prolonged labor			
Yes	0.9410	0.9298	0.9053
No	0.9730	0.9641	0.9415
Excessive bleeding			
Yes	0.9235	0.9144	0.8877
No	0.9713	0.9628	0.9402
High fever			
Yes	0.9227	0.9056	0.8738
No	0.9707	0.9624	0.9400
Convulsion			
Yes			
No			

Table. 2. Cox Proportional Hazards estimates for the effect of selected variables on mortality in Bangladesh.

Variables	Coefficient	Relative Risk	p-value
Socioeconomic			
Mother's education	0.263	1.301	0.034
None	-	-	-
Primary (ref)	-0.055	0.946	0.707
Secondary+			
Working status			
Yes	0.220	1.246	0.076
No (ref)	-	-	-
Wealth status			
Poor+Middle (ref)	-	-	-
Rich	-0.098	0.907	0.443
Residence			
Rural (ref)	-	-	-
Urban	0.149	1.161	0.207
Religion			
Muslim	0.264	1.303	0.198
Other (ref)	-	-	-
Member of NGO			
Yes	-0.072	0.930	0.551
No (ref)	-	-	-
Demographic and Reproductive			
Mother's age at birth			
<20 years	-0.117	0.889	0.394
20-29 years (ref)	-	-	-
30-39 years	0.357	1.429	0.034

Variables	Coefficient	Relative Risk	p-value
Birth order of child			
1	0.252	1.287	0.131
2-4 (ref)	-	-	-
5+	-0.021	0.979	0.900
Gender of child			
Male	0.027	1.027	0.787
Female (ref)	-	-	-
Preceding birth interval			
<= 24 months	0.268	1.308	0.103
25-36 months (ref)	-	-	-
37+ months	-0.319	0.727	0.038
Health care			
Antenatal visits			
No visits	0.930	2.534	0.000
1-3 visits (ref)	-	-	-
4+ visits	-0.556	0.573	0.031
Place of delivery			
Hospital/clinic	0.499	1.646	0.004
Home/other places (ref)	-	-	-

Table 2: Continued

Variables	Coefficient	Relative Risk	p-value
Colostrums			
Immediately (within1hr)	-0.192	0.825	0.130
Not immediately (ref)	-	-	-
Delivery Complications			
Prolonged labor			
Yes	0.331	1.392	0.007
No (ref)	-	-	-
Excessive bleeding			
Yes	0.243	1.275	0.113
No (ref)	-	-	-
High fever			
Yes	0.269	1.309	0.178
No (ref)	-	-	-
Convulsion			
Yes	0.370	1.447	0.079
No (ref**)**	-	-	-

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