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A Multivariate Analysis of Social and Economic Determinants of Neonatal and Infant Mortality in Four Rural Thanas of Bangladesh

Abstract

Recent work on the correlates of neonatal, infant and child mortality in the Matlab research area of Comilla District in Bangladesh suggests that effects of social and economic variables on neonatal and infant mortality are absent, but that such effects are pronounced among children over 12 months. This paper uses a new longitudinal demographic data base to examine these effects in Rural Bangladesh where special health services such as those available in Matlab have not yet been introduced. A multivariate hazards model is estimated which shows that maternal education and household economic status have no effect on neonatal or post neonatal mortality. Among neonates, maternal age has no effect on the odds of dying. Among post neonates mortality risks arc inversely related to maternal age. The number of children dead among children ever born is directly associated with neonatal mortality, but is insignificant as a predictor of post neonatal mortality. The finding that social and economic status indicators are weak prc-dicators of infant mortality is consistent with findings from other areas of rural Bangladesh.

Introduction

STUDIES of national infant mortality rates consistently show an inverse relationship with data on economic development, and studies relating individual infant mortality risks to household economic status typically corroborate with aggregate data analyses. Research has also demonstrated the distinct additive effect of maternal education. While advances in public health technology have long been recognized as determinants of trends in infant mortality, there is thus increasing attention in the literature to social and economic status

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1. See for example, Shin (1975), Preston, (1980), and Antonovsky and Bernstein, (1977).
2. See, for example, Gortmaker (1979) and Frenzen and Hogan (1982). Several studies have emphasized the role of household economic status in the neglect of children and elevated risks of morbidity (see, for example, Scrimshaw, 1978).
3. Caldwell (1979), while acknowledging the importance of economic status, emphasizes the distinct effect of education and posits that maternal education is more important than household economic status in Nigeria. Ruzicka and Kanitkar (1972) present similar evidence of the importance of maternal education as a covariate of mortality among children aged 0-4 with data from the Philippines, Indonesia, and Pakistan.

(SES) determinants. Nevertheless, in rural Bangladesh, where poverty is pervasive and access to health services is typically inadequate, there is reason to question whether the inverse relationship between social and economic status and infant mortality can be demonstrated. The null effect of SES could arise because living conditions are generally so poor that proximate determinants of mortality are invariant across social classes: Breast feeding is universal and prolonged, complications of delivery affect all classes because hospital delivery is rare, infectious disease morbidity is high among all classes and ambulatory health care is inadequate, sanitation is generally poor, and dietary imbalances apply to a large proportion of rural women and their children. This hypothesis of null SES effects on infant mortality contrasts with the determinants of child survival: after weaning the differential allocation of food favours male offspring which elevates risks of nutritional and infectious disease morbidity among females. This situation is exacerbated by the practice of favouring males in the provision of medical care so that elevated mortality risks occur to female children, particularly if maternal education attainment is low or if household economic status is low. In infancy the hypothesis of null SES effects is nevertheless plausible because infants are protected from environmental risks by breast feeding.

In the present analysis the relationship of infant mortality with SES is examined with baseline data from the maternal and Child Health Family Planning Extension Project of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B). This project has, as its primary focus, a test of the transferability of health services from the successful ICDDR, B field experiment in Matlab thana to the public sector programme of the Ministry of Health and Population Control in other sector programme of the Ministry of Health and Population Control in other areas of Bangladesh. Although research in this project is focused on service operations, the project has a longitudinal demographic data sample registration system (SRS) for assessing project mortality and fertility impact. The rural areas of North Bengal served by this project have no previous history of special health project activities.

The present analysis is derived from the mortality experience of a cohort of 1926 births monitored over the period October 1, 1982 to December 31,1983. First, we briefly review the literature on determinants of infant mortality. Next, we discuss the data for the analysis and its limitations, followed by a discussion of the statistical model. Finally, we discuss results for neonates and infants and review the implications of findings for future research.

4. The prolonged pattern of breast feeding in rural Bangladesh has been documented by Huffman *et al.* (1980). A useful review of the nutrition situation in rural Bangladesh is in Huffman and Huque (1983), and careful longitudinal studies of nutritional status, infectious disease morbidity and mortality risks in Matlab are in Black *et al.* (1982a and 1982b) and in Chowdhury and Chen (1977). Bairagi (1980) analyzed data from Noakhali which showed that the nutritional status of children aged 12-36 months is explained by family income, maternal education, sex of child, and birth order. The effect of maternal illiteracy was more pronounced among low income households.

5. Studies of rural South Asia show that child mortality SES differentials are pronounced (see, D'Souza and Bhuiya 1982) but that infant mortality differentials are less apparent (see, Chowdhury, 1982 and Ruzicka and Chowdhury 1978). The effect of SES is conditional upon the sex of the child (see, D'Souza and Chen 1980; Bairagi *elal..* 1982) presumably because scare resources are more readily available to male offspring (Chen *et al.* 1981).

6. The Matlab experiment in maternal and child health and family planning has been descrioed by Bhatia *et al.* (1980) and the extension of the experiment to the public sector is described in Phillips, *et al.* (1983).

7. The Sample Registration System (SRS) is described by Phillips and Mozumder (1984) and tabulations of first year results are reported in Mozumder and Phillips (1984).

The Demographic and SES **Determinants of Infant Survival**

Studies of infant mortality consistently demonstrate the importance of maternal age and parity. First births are at high risk, particularly among young mothers. Risks to infants increase directly with parity and with age of mother and increase inversely with the birth intervals. Parity effects are, therefore, pronounced even if the age of mother is controlled. More important than parity and age is prior child mortality experience of mothers, since the conditions that confer risks to infants are selective to particular mothers and households and recur with each birth.

While there is much agreement about the importance of maternal education at least one study has shown that maternal education had no apparent effect. Authors note that neonatal mortality is more strongly affected by biological factors such as age and parity than post neonatal mortality, and that maternal education, household economic status, and behavioural variables have more pronounced effects in the post neonatal period. Environmental factors, such as proximity to cows and buffalos, have been shown to affect neonatal mortality through the transmission of the microganism that causes tetanus neonatorum.

While SES affects utilization of health services, the accessibility of health care services has been shown to explain variation in child survival. Attempts to examine SES effects on infant survival in Bangladesh typically employ individual indicators such as land, floor space, or possession of boats. Since such indicators are obviously flawed as measures of status, their weak effect on mortality may arise more from measurement problems than from an absence of an SES-mortality relationship.

The literature on infant mortality, in summary, stresses the importance of demographic correlates, and has demonstrated significant effects of access to health care, exposure to the risk of tetanus, and cultural factors, such as sex preference, which disadvantages female relative to male offspring during times of economic and nutritional adversity. Little has been published on economic status effects in Bangladesh, perhaps because direct measurement of wealth is not possible in a rural traditional economy and indirect scaling methods have

8. See, for example, Martin *el al.* (1983), Simmons *et al.* (1982), Frenzen and Hogan (1982). Data from rural Bangladesh show an elevated risks of neonatal mortality among women under 20 and a curvivdlinear relationship for post neonatal mortality with age of mother. See, for example, Stoeckel and Chowdhury (1972).

9. See, for example, Simmons, *et al.* (1982a). Several studies have documented the curvilinear pattern of risks with age and parity. See, for example, Frenzen and Hogan (1982), Stoekel and Chowdhury (1972).

10. Smucker, *et al.* (1980), Simmons *et al.* (1982), Frenzen and Hogan (1982).

11. Caldwell (1979), Ruzicka and Kanitkar, (1972), Martin *et al.* (1983) and Simmons, *et al.* (1982) show that the effect of maternal education on infant survival is conditional on the sex of the infant. When neither parent is educated, females are less likely to survive.

12. Frenzen and Hogan (1980) showed that maternal education has no effect on infant survival and Smucker *et al.* (1980) showed that maternal education had no effect on the survival of neonates in rural India. Chowdhury (1982) using Matlab data, showed that maternal education had no effect on the survival of neonates and weak effects on post neonatal survival.

13. See, Simmons, *et al.* (1982), Smucker *et al.* (1980).

14. See, Smucker, *el al,* (1980). Tetanus neonatorum is known to be a major cause of neonatal deaths in Matlab (Rahman, *et al.* 1982a and 1982b).

15. Smucker *et al.* (1980), Frenzen and Hogan (1982).

not been well developed in Bangladesh research centres. Moreover, most of the available research on mortality emanates from Matlab, a locality with a history of special health service inputs where the implications of socio-demographic research on infant mortality for policy is increasingly questioned. The MCH-FP Extention Project research addresses this need for research on the determinants of infant and child survival in areas where special services have yet to be developed.

The Data

Study areas and the dependent variables. Infant mortality in rural Bangladesh is known to be high by international standards. Available data are typically derived from special project areas, and estimates from national surveys are typically higher than rates available from local studies. The Extension Project baseline data are somewhat exceptional in that regard, although there is considerable variation across project areas. This is shown by the mortality data in Table 1. The Bangladesh Fertility Survey (BFS) infant mortality rate

TABLE 1 : NEONATAL, POST NEONATAL, AND INFANT MORTALITY RATES FOR BANGLADESH, MATLAB AND THE FOUR THANAS OF THE MCH-FP EXTENSION PROJECT

Mortality Rate '	MCH-FP Extension Thana"				Extension (All)	Matlab (Camilla)	Bangladesh 1975
	Sirajgonj (Pabna)	Gopalpur (Tangail)	Abhoynagar (Jessore)	Fultala (Khulna)			
Neonatal	75.5	96.6	63.1	58.8	73.5	68.1	81.7
Post neonatal	75.5	33.6	55.0	80.9	63.9	50.2	62.5
Infant	151.0	130.2	118.1	139.7	137.4	118.3	144.2
(Number of births)	(795)	(238)	(491)	(136)	0660)	(4143)	(6511)
Crude Death	19.7	12.9	10.7	16.2	15.5	15.9	d
Person years of observation	17968.1	5103.0	13425.9	3884.2	0381.1	b	d

[a]These rates apply to the four quarters of the October 1, 1982 to September 30, 1983 period
[b]Composition areas only, 1982 (preliminary).
[c]*Source:* Bangladesh Fertility Survey, 1975. See Rutstein (1983).
[d]Not available.

compiled for 1975-76 is only slightly higher than the current rates for Extension Project areas (144.2 versus 137.4 respectively). Most national estimates are substantially higher than infant mortality in Matlab where villagers benefits from the special services .of the ICDDR, B Diarrhocal Disease Hospital in Mallab and where infant mortality has declined in recent years. The BFS followed a major famine by a year and infant mortality rates estimated from

16. See, Rustcin (1983).

BFS data may be higher than current levels in Bangladesh. The current level of infant and child mortality in Bangladesh is unknown.

The data from the four study thanas of the Extension Project are derived from a sample of households in two pairs of thanas selected by the Ministry of Health and Population Control in 1982. Study in intervention areas are Abhoynagar of Jessore District and Sirajgonj of Pabna District. Comparison area households were sampled from the unions of Fultala in Khulna District and Gopalpur in Tangail District. The comparison sample areas are contiguous to the intervention sample areas and are comparable ecologically, economically, and demographically to service areas. The two pairs of thanas in the Extension Project nevertheless differ markedly from one another: the Jessore-Khulna area, near the West Bengal border, is a rural area with some 30 percent of households heads employed as traders, businessman and labourers in jute and textile mills. The Pabna-Tangail sample area economies are most predominantly agricultural with some 10 percent of the household heads classified as traders, businessmen, or mill workers.

Ecological characteristics of the areas also differ markedly. Unlike Matlab or Pabna-Tangail, the Jessore-Khulna sample areas are rarely subject to flooding. In Sirajgonj, however, some 30 percent of the sample population reside on temporary sandbars known as 'char' land that is subject to annual flooding by the Jamuna river. Relative to other riverine areas of Bangladesh, the Sirajgonj chars are vast and their movement from season to season is unpredictable, necessitating an annual resettling of a substantial Proportion of the population. The relative poverty, isolation, and environmental adversity faced by the Sirajgonj char population may account/or the relative high mortality in that thana. Similarly, the lower mortality in Abhoynagar may reflect the relative security from flooding and the prosperity of the area, since communication, health facilities, and levels of development are known to be relatively advanced in that locality. Thus the areal variations in the aggregate mortality data presented in Table 1 are consistent with the view that economic development varies inversely with infant mortality risks in rural Bangladesh.

17. The comparison area in Matlab comprised 79 villages with a population of approximately 94,000 where demographic monitoring is known to be accurate and complete. Extension areas have not yet been provided with intensive MCH and family planning services, Matlab treatment areas, where infant mortality declined owing to project interventions, are excluded from Table 1. Extension area rates are based on a calendar year of observation from October, 1982 to September 1983. Regpression models estimated below are based on 15 months of observation extending through DecemberSl, 1983.

18. The Sample Registration System (SRS) is a stratified two stage cluster sample designed to permit comparison of treatments provided with different combination of services. The overall fraction is slightly less than five percent and 7282 household, each with an equal probability of selection. The SRS is a comprehensive data base consisting of several types of crosslinked data. Data on reproductive attitudes of women is linked to socio-economic information elicited from their husbands; which, in turn, is stored with longitudinal records on the observation of children. This comprehensive baseline data permits analysis of the covariates of subsequent demographic events. Li the first calendar year of the SRS 40,3 81.1 person years of observation were compiled. Each round is accompanied by a regimen of field and machine edits to ensure linkage and timely tabulation and analysis (see, Phillips and Mozumder 1984). 19. See, Phillips, *et al.* (1983) and Phillips and Mozumder (1984). In February, 1984 Pabna District was divided into several Districts with six thanas of Sirajgonj subdivision becoming a separate district. Thanas, now referred to as 'upazila' or subSistrict, typically have from 200,000 to 300,000 population with a government headquarters, a police station, and a health complex.

Independent variables. The independent variables for the analysis with means and standard deviations are reported in Table 2. Two variables are categorical, sex of child and maternal desire for additional children, while other variables are continuous. Maternal variables are age, parity, and child survival status immediately prior to the delivery. The present analysis is preliminary and restricted to a limited range of variables owing to storage limitations of the micro computer used for the analysis.[20]

To incorporate a wide range of economic indicators while working within the constraints of the available computers* we scale SES into two factors. While discussion of the SES scaling procedure is beyond the scope of this paper, a synopsis of the economic status estimation procedure is appropriate.

While maternal education and other variables in Table 2 can be readily assessed in the field, household economic status is difficult to measure because direct measures such as income, assets, and investments are meaningless in the context of rural Bangladesh. Thus, while SES is widely discussed as a correlate of child survival, empirical investigation of its relationship with infant mortality in Bangladesh has been limited to tabulations of proxies for economic status wherein effects of maternal education are not controlled. Without multidimensional scales for economic status such analyses are difficult to interpret. The literature thus provides little insight into the relative magnitude of the maternal education versus household economic status on infant mortality.

TABLE 2 : MEANS AND STANDARD DEVIATIONS OF INDEPENDENT VARIABLES

Independent variable	*Mean*	*Standard deviation*
Sex of child[a]	0.52	0.50
Mother's age	25.00	6.69
Mother's children bom alive	2.98	2.57
Mother's children dead	0.79	1.15
Maternal education[b]	1.06	2.21
Household economic status, I[c]	0.02	1.01
Household economic status, II[c]	0.01	0.99
Number of Cows or Buffalos	1.78	2.19
Maternal Desire for additional child[d]	0.45	0.50

[a]Dummy variables: 1 = Sons, 0 = Daughters.
[b]*77.4* percent have no education. [c]Factor scores
are in a standard score metric.
[d]Dummy variable: 1 = Do not want more children, 0 = Want more, do not know, up to God.

20. The ICDDR, B main frame computer is an MB System 34 and its peripheral systems will soon include IBM PCs. A multivariate analysis package for these limited systems was developed at the ICDDR, B and applied to the present analysis (see, Leon and Phillips 1983). The logistic regression package uses the method of Walker and Duncan (1967) and the application of the procedure to censored logically equivalent to the method proposed by Phillips (1982).

To derive a more sensitive measure of economic status than any single indicator we use factor analytic scaling of a set of indicators of household wealth in rural Bangladesh. The selected indicators are household head's occupation and whether a second occupation is pursued, cultivatable land owned, dwelling unit floor area, roof material and wall material, number of modern objects owned on a prespecified list of items, number of cows and goats, and whether latrines are present. We exclude maternal education from the scale since it enters the analysis as a separate variable. Data correspond to a three month period prior to launching theSES.

The correlation matrix and factor loadings for the SES scales appears in Appendix A. The estimation of factors failed to identify a single factor for economic status: two orthogonal factors were derived which are equivalent in their capacity to explain the common variance among economic indicators. Although overall variance explained by the factors, 43 percent, is disappointing, the scales are nevertheless more plausible indicators of the concept of economic status than any single indicator. The first factor is more heavily weighted by variables that distinguish agriculturally derived wealth from other sources of income: occupation, land holding, and animals. The second factor is distinguished by acquired assets and behavioural variables: latrines, things owned, and wall materials. Maternal education correlates more highly with factor 2 than with factor 1.

The Model

In the SRS birth cohort for the October 1982 to December 1983 period, a mean of only 6.7 months is observed. To adjust for this censoring of observations we employ the logistic response model for monthly probabilities of surviving through infancy given by

$$\underset{\sim}{q} = [1 + \exp - (\underset{\sim}{1}\ \underset{\sim}{T}\ \underset{\sim}{X})\ ((\beta_0\ \underset{\sim}{\beta}\ \underset{\sim}{\gamma})']^{-1} \tag{1}$$

where

$\underset{\sim}{q} = q_1, q_2, \ldots, q_N$ for N infant months of observation,

$T =$ An N x 2 matrix of time variables where in T has a column denoting ordinal time and a column for a dummy variable defining whether a given infant month is a neonate,

$\underset{\sim}{X} =$ An N x K matrix of characteristics of infant that are fixed over time,

$\underset{\sim}{\beta_0} =$ A scalar,

$\underset{\sim}{\beta} =$ A 2 x 1 vector of time coefficients, and

$\underset{\sim}{\gamma} =$ A K x 1 vector of main effects.

The vectors of unknown coefficients $\underset{\sim}{\beta}, \underset{\sim}{\gamma}$ and $\underset{\sim}{\delta}$, are estimated by maximum likelihood.

21. Factor analysis was first proposed by Pearson (1901) and later refined by Retelling (1933). Factor extraction and rotation in the present analysis follow procedures specified by Gorsuch (1974). Procedures are documented, in detail, in Leon and Phillips (1983). The factor analysis of MCH-FP Extension data is described by Hossain and Phillips (1984).

Several studies have used log linear models for analysis of censored survival data with covariates while permitting estimation of time dependent covariate effects.[22] The specification (1) represents an application of the proportional hazards model proposed by Cox in that the ji define the underlying; risk of mortality and y the net effects of covariates. The model can be readily expanded to assess time conditional effects by including a matrix *U* among independent variables with elements comprising products of columns of J and X and a coefficient vector 6 assessing effects unique to particular periods of infancy. This time conditional model is appropriate owing to the unique conditions affecting neonates, but cannot be estimated on computers available in Bangladesh.

Owing to this constraint we estimate a sep'rate model for neonates. Since neonatal data are uncensored and attrition within the neonatal period can be assumed to be exponential the model becomes:

$$q = [1 + \exp - (\underset{\sim}{1}\ \underset{\sim}{X})\ (\beta_0\ \underset{\sim}{\beta})']^{-1} \quad (2)$$

for neonates.

Adjustment for censoring in the estimation of (1) is achieved by entering each infant month into the analysis as a unit of observation with elements of the likelihood function weighted for fractions of months of observation corresponding to infant months in which censoring occurs. To illustrate this, consider the likelihood for the sample if a data matrix Z substituted the matrices in (1) so that equation (1) becomes *F(Z)*. Suppose the data with *n* infant months of observation is to be ordered so that the first *S* observations correspond to survival and the remaining correspond to death. Then

$$\mathcal{L} = F(\underset{\sim}{Z}_1) \cdot F(\underset{\sim}{Z}_2), \ldots, F(\underset{\sim}{Z}_s) \cdot (1 - F(\underset{\sim}{Z}_{s+1}), \ldots, (1 - F(\underset{\sim}{Z}_n)) \quad (3)$$

if each observation corresponds to a full month of risk. Equation (2) can be reduced by collapsing each set of elements with identical *Zj* into a single term with an exponent equal to the number of identical elements. Similarly, if the*Jth* element is censored, the exponent for *F(Zj)* is the fraction of a month that is observed.

22. The Cox (1972) proportional hazard model is a means of regressing characteristics of a risk set on survivorship when data are censored. The time 'proportion hazard' is applied because effects are assumed to be independent of time. In the study of infant mortality, the covariates of neonatal and post neonatal mortality may differ and the porportional hazards assumption is inappropriate. Therefore, a time conditional extension of the Cox model is appropriate (see, for example, Mautel and Hankey, 1978; Holf ord 1980; Phillips 1982). An application of log linear models to the study of infant and child mortality is given in Trussell and Hammerslough (1983).

23. Actual estimation of (1) on the ICDDR, B IBM S-34 computer proved to be computationally intractable owing to the fact that the data matrix has 12512 rows. By introducing the simplifying as sumption of a constant hazard in the post neonatal period, the continuous time vector could be eliminated from (1), so that T is a vector of dummies denoting neonates, and the X matrix is collapised with exponents tor elements in (2) corresponding to post neonatal months of exposure to risk. Based on the specification in (1) we have estimated a discriminant function analysis (see, Truett *et al.* 1967) with continuous time included and found that a similar analysis using the constant attrition assumption and a post-neonatal collapsed data matrix produced nearly identical results. Moreover the coefficients and standard errors estimated by the discriminant function method are similar to the more rigorous results of a logistic regression estimated on the constant post-neonatal attrition assumption. We conclude from this that the simplifying assumption of a constant hazard among neonates has no effect on the Y in this analysis. Since mortality typically changes in the post neonatal period, however, the estimation of (1) is recommended over our simplified model if computer equipment is available which is designed for decimal arithmetic. Microcomputers such as the IBM PC-XT are better suited to solving this problem than the ICDDR, B's IBM S-34 which is designed for commercial applications.

Results

Neonatal mortality. Table 3 reports the results from the analysis of neonatal mortality. All coefficients, except the effect of previous mortality, are non-significant. The likelihood

TABLE 3 : A MULTIPLE LOGISTIC REGRESSION ANALYSIS OF NEONATAL MORTALITY IN THE FOUR THANAS OF THE MCH-FP EXTENSION PROJECT, OCTOBER, 1982 - DECEMBER, 1983

Variable	*Animals excluded*			*Animals included*		
	Coefficient	*SE*	*t*	*Coefficient*	*SE*	*t*
Constant	-1.905	0.593	-3.21*	-1.786	0.599	-2.98*
l)Sex of infant	-0.288	0.189	-1.52	-0.293	0.189	-1.55
2) Maternal Age	-0.000[s]	0.028	-0.01	+0.000[C]	0.280	+0.02
3) Maternal Education	-0.011	0.050	-0.22	-0.019	0.050	-0.37
4) Children born that are now dead	+ 0.371	0.119	+3.12**	+0.367	0.119	+3.08"
5) Children ever born	-0.131	0.099	-1.33	-0.128	0.099	-1.30
6) Maternal Desire for more. Children"	-0.368	0.247	-1.49	-0.386	0.248	-1.56
7) Household Economic Status: Factorl	-0.084	0.091	-0.92	+0.045	0.142	+0.32
8)Househdd Economic Status: Factor II	+0.005	0.106	+0.05	+0.053	0.113	+0.47
9) Cows and Buffalo	-	-	-	-0.087	0.074	-1.17
Likeihood ratio statistic: d.f.	22.215**[d] 8			23.592**[d] 9		

[a]0.000376. [b]1 = mother no more children, 0 = otherwise. [c]0.000668. [d]n= 1724. * $p < .05$. ** $p < .01$

chi square shows that the model as a whole improves upon chances in the prediction of neonatal mortality, but only the siblings who died variable contributes to prediction. The cow-buffalo variable, introduced to test effects demonstrated by Smucker and her colleagues (1980) with Indian data was not significant in the present analysis. The findings in table show that neonatal rates, which are exceedingly high in the study population, are nevertheless not associated with social status as measured by education of mother or with the economic status scales. The insignificant-effect of maternal education is consistent with the findings reported in a recent analysis of Matlab data (see, Chowdhury 1981 and 1982).

The implication of the significant effect of siblings who died can be demonstrated by substituting coefficients and variable means into equation (3) and computing a predicted adjusted mean mortality rate for neonates who have one sibling who died versus none who died, controlling for other effects. The adjusted mean mortality rate for neonates with one sibling who died is 72.0 per 1000 live births versus 50.8 among neonates with all siblings surviving. There is thus clear evidence that risks to neonates recur with delivery, perhaps because birth practices associated with high risk recur over successive deliveries.

TABLE 4 : A MULTIPLE LOGISTIC REGRESSION ANALYSIS OF POST NEONATAL AND INFANT MORTALITY IN THE FOUR THANAS OF THE MCH-FP EXTENSION PROJECT, OCTOBER, 1982 - DECEMBER, 1983

Variable	*Post neonatal*			*Infant mortality*		
	Coefficient	*SE*	*/*	*Coefficient*	*SE*	*/*
Constant	-3.677	0.828	-4.44"	*-4.132*	0.490	-8.43"
1) Sex of infant	+0.125	0.241	+0.52	-0.131	0.148	-0.88
2) Maternal Age	-0.084	0.040	-2.10*	-0.03C	0.023	-1.32
3) Metemal Education	-0.013	-0.070	-0.18	-0.012	0.040	-0.29
4) Children bom that are now dead	+0.178	0.145	+1.22	+0.297	0.091	+3.24"
5) Children ever bom	+0.177	0.126	+1.41	-0.016	0.077	-0.21
6) Maternal Desire for more children	-0.335	0.303	-1.10	-0.359	0.191	-1.88
7) Household Economic Status: > Factor I	-0.088	0.119	-0.74	-0.082	0.072	-1.14
8) Household Economic Status: Factor H	-0.075	0.144	-0.52	-0.023	0.085	-0.27
9) Neonatal dummy	-	-	-	+2.46	0.152	+16.19"
likelihold ratio statistic: d. f.	13.658 8			297.849 9		
n (per months)	10788			12512		

*. $p < .05$. **. $p < .01$.

Post neonatal mortality. Table 4 presents the results of a multivariate analysis of post neonatal mortality. Results show that neither maternal education nor socio-economic status predict post neonatal mortality. The post neonates of young mothers are at higher risk of mortality than infants of older mothers. Other variables, such as children ever bom, children dead among children ever bom, and maternal desire for more children have no effect. Owing to the strong effect of children dead among children ever bom among neonates, this variable predicts infant mortality despite its weak effect among post neonates.

Conclusion

Recent work on Matlab has demonstrated the pronounced effect of social and economic status among children under five (D'Souza and Bhuiya 1982). Sex differentials in the allocation of familial resources explain this finding (D'Souza and Chen 1979). These authors nevertheless posit that such effects will be weak among infants owing to the protection that breast feeding affords infants. Matlab research on SES determinants of infant mortality lend support to this hypothesis (Chowdhury 1982). The present research on populations in North Bengal is consistent with this finding from Matlab. We have used multidimensional scaling to refine estimates of economic status, since weak SES effects in Matlab research could arise from use of proxies for economic status. Refined estimates of status nevertheless produce results confirming findings from Matlab. This suggests that conditions affecting proximate determinants of infant mortality are invariant across social classes owing to generally poor living conditions and the nearly universal practice of breast feeding.

This research has produced no evidence that neonatal or post neonatal mortality differ significantly by sex of infant, or that maternal reproductive motives prior to delivery have any effect on infant survival.

That age is a factor explaining post neonatal mortality when parity effects are controlled, suggests that infant mortality would be reduced if the very early mean age of first birth were to rise. Delayed age of marriage, advanced as a social policy for reducing fertility, thus has implications for infant survival as well.

Most significant in our findings is the pronounced effect of prior child deaths on the neonatal mortality, such as tetanus, may recur with successive deliveries because public health programmes fail to respond to the needs of high risk households. While it may not be feasible to deli ver tetanus vaccination and antenatal care to all women in their homes, it is plausible that significant gains in child survival could be achieved if special outreach programmes were directed to mothers who have a history of mortality among ever born children.

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APPENDIX - A

Correlation matrix for indicators of economic status, factor loadings and factor coefficients for 7282 sample household in the four thanas of the MCH-FP Extension Projec is given in Tables A-1, A-2 and A-3, respectively.

TABLE Al : CORRELATION MATRIX FOR INDICATORS OF HOUSEHOLD ECONOMIC STATUS AMONG 1882 SAMPLE HOUSEHOLDS OF THE MCH-FP EXTENSION PROJECT

	Variables										
	OCCU1	OCCU2	CLTLND	DAREA	WALLM	ROOFM	OWNTHG	COWS	GOATS	MALLAT	femlat
OCCUI[a]	1.00										
OCCU2[b]	-0.59	1.00									
CLTLND[C]	-0.12	0.25	1.00								
DAREA[d]	-0.04	0.22	0.23	1.00							
WALLM[e]	-0.01	0.15	0.20	0.27	1.00						
ROOFM[f]	-0.04	0.20	0.17	0.11	0.06	1.00					
OWNTHG[g]	0.01	0.32	0.32	0.35	0.32	0.20	1.00				
cows[h]	-0.23	0.45	0.38	0.26	0.18	0.26	0.40	1.00			
goats[i]	-0.06	0.17	0.13	0.16	0.10	0.03	0.20	0.30	1.00		
MALLAT[j]	0.09	0.11	0.13	0.21	0.26	0.02	0.39	0.07	0.05	1.00	
FEMLAT[k]	0.02	0.19	0.14	0.16	0.18	0.14	0.38	0.15	0.05	0.55	1.00

a = occupation of household head having medium level of income (OCCL'l).
b = Occupation of household head having high level of income (OCCU2).
c = Cultivable land owned (CLTLND).
d = Area of dwelling unit (DAREA).
e = Wall material of dwelling unit (WALLM).
f = Roof material of dwelling unit (ROOFM).
g = The number of things owned among a prescpecified list of common household durables indicating possession of household items (OWNTHG). h = Number of cows owned (COWS) j = Number of goats owned (GOATS), j = Possession of a male latrine (MALLAT). k= Possassion of a female latrine (FEMLAT).

TABLE A2 : FACTOR LOADINGS, EIGENVALUES AND COMMUNITIES FOR THE FACTOR ANALYSIS OF THE VARIABLES RELATED IN THE FOUR THANAS OF THE MCH-FP EXTENSION PROJECT

Variables Name	*Factor Loading (Rotated Matrix)*	
	1	2
OCCU1	-0.69	0.32
OCCU2	0.81	0.06
CLTLND	0.48	0.30
DAREA	0.32	0.45
WALLM	0.18	0.51
ROOFM	0.35	0.15
OWNTHG	0.37	0.68
COWS	0.72	0.22
GOATS	0.36	0.14
MALLAT	-0.07	0.78
FEMLAT	0.05	0.71
Communalities	21.97	21.11
Cumulative Communali ties	21.97	43.08
Eigenvalues[3]	3.071	1.668

[a]To maintain a limited number of factors we arbitrarily restrict the rotation to two factors. A third factor was estimated with an eigenvalue exceeding 1.0 (£3 = 1.104).

TABLE A3 : DESCRIPTIVE STATISTICS FACTOR COEFFICIENT FOR A FACTOR ANALYSIS OF VARIABLES RELATED TO SES

Variables	*Descriptive Statistics*		*Factor Coefficient for*	
	Mean	*Standard Deviation*	*Factor I*	*Factor 2*
OCCU1	0.28	0.45	-0.35	0.24
OCCU2	0.47	0.50	0.36	-0.08
CLTLND	1.39	3.48	0.18	0.07
DAREA	219.21	210.24	0.08	0.17
WALLM	0.27	0.45	0.01	0.22
ROOFM	0.43	0.50	0.14	0.02
OWNTHG	1.69	1.71	0.08	0.27
COWS	1.38	1.90	0.30	0.00
GOATS	0.59	1.33	0.14	0.02
MALLAT	0.26	0.44	-0.14	0.38
FEMLAT	0.47	0.50	-0.07	0.33