Vol. 10, No. 1, March 1995

The Influence of Socio-biological Factors on Perinatal Mortality in a Rural Area of Bangladesh (Demographers' Notebook)

By Golam Mostafa

** The authors of this paper are Golam Mostafa, International Centre for Diarrhoeal Disease Research, Bangladesh, GPO Box 128, Dhaka 1000, Bangladesh; Andrew Foster, University of Pennsylvania; and Vincent Fauveau, UNFPA Country Director for Cambodia, who at the time of co-authoring this paper was with the London School of Hygiene and Tropical Medicine.*

Reduction of perinatal mortality in developing countries is highly dependent on the management of pregnancy and delivery. The identification of important risk factors could help to direct attention to mothers who need special care, thereby leading to a more efficient health programme to improve their survival. Several previous studies (James, 1968; Saksena, 1980; Zimmer, 1984; Bakketeig and Hoffman, 1979; Misra and others, 1973; Forbes, 1985; Serour, 1981; Stanley, 1981; and Fortney, 1982) of perinatal mortality that have been carried out in different countries suffer from a number of difficulties. Most of the studies have been limited to univariate or bivariate analysis and thus have provided little scope for assessing the net effect of a particular risk factor on perinatal mortality when the effects of other factors are taken into account. Those studies that utilized multivariate techniques considered only a few of the possible risk factors. The studies suggest, however, that survival of the perinatal period is influenced by a number of characteristics of the woman and her reproductive history. Infants born to women in the mid-range of the reproductive years were found to have better perinatal survival chances than those of either younger or older mothers (Srivastava and others, 1969; Misra and others, 1973; Saksena, 1980; Forbes, 1985; Bakketeig, 1979; Stanley and others, 1983; Kiely and others, 1986). In contrast, Baird (1962) found that age did not influence perinatal mortality after controlling for social class in a developed country. Other studies have found that survival chances improved with socio-economic status as measured by such indicators as parental education and parental occupation (Saksena and others, 1980; Forbes and others, 1985; Stanley, 1980; Erhardt and others, 1973; Ross, 1964; Serour and others, 1981; Adelstein and others, 1980). Nulliparity also has been found to increase risk significantly (Kiely and others, 1986) as has both short (e.g. less than two years) and long (more than five years) intervals between pregnancy outcomes (Fedrick and others, 1973; Zimmer, 1979). Similarly previous fetal wastage has been strongly associated with perinatal mortality.

It is rare, however, to have data of high quality on all of these risk factors from an area in which infant mortality is known to be quite high and to be able to analyze this information in a multivariate context. The present study considers data on all pregnancies that ended in a stillbirth or live birth in a rural area of Bangladesh during the years 1982 to 1984. It considers the relationships of both biological and socio-economic factors to perinatal mortality.

Methodology

The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) has been operating a Demographic Surveillance System (DSS) in Matlab thana (district), rural Bangladesh, since 1966. The DSS combines periodic censuses of the study population with continuous registration of vital events and migration. Vital events are reported by 110 female community health workers who visit each household once every two weeks. In half the area, a Maternal and Child Health and Family Planning Programme (MCH-FP) is conducted by the Centre; the remaining villages serve as a comparison area. The recording of vital events on standard registration forms is the responsibility of male health assistants who, accompanied by the community health workers, visit each household every 5-6 weeks to obtain detailed information about any event that took place since their previous visit. Details of the data collection system have been reported in an earlier publication (Cholera Research Laboratory, 1978).

During the study period, the surveillance area consisted of 149 villages with a total population of about 190,000, each of whom was identified by a unique registration number. Gestational age was determined by the field workers at the time the birth was reported, using the mother's menstrual history. If gestation was seven months or more and the pregnancy ended in a non-live birth, the outcome was classified as a stillbirth. The field workers distinguished between live and non-live births by asking the mother and other persons attending the birth about signs of life such as breathing or muscular movements. They also asked mothers about their previous pregnancy history; this information was used to define pregnancy order and past pregnancy wastage. The interval between the pregnancy of interest (index pregnancy) and the previous one was determined by searching DSS pregnancy termination records for nine previous years and selecting the most recent prior birth. Maternal and paternal education (number of years of formal schooling) and paternal occupation, all of which factors were considered measures of socio-economic status, were obtained from the census conducted in the study area in 1982. Women who had migrated into the area after the 1982 census were excluded from the study because no information on education, occupation, or previous pregnancy interval was available.

The 22,122 pregnancies that were registered in 1982-1984 were considered in the present study: of these pregnancies, there were 785 stillbirths and 21,337 live births; further, 817 neonates died during the first week of life (0 to 6 days). The perinatal mortality rate was defined as the number of stillbirths plus early- neonatal deaths per thousand total births (live births plus stillbirths).

The analysis was carried out in two stages: first, perinatal mortality rates were calculated according to univariate characteristics of the parents and of the birth. Second, multivariate logistic regression was employed to estimate the net effects of these factors on perinatal mortality. Confidence interval and odds ratio were calculated using Mieltinens test-based interval (Kleinbaum, 1982).

Results

Table 1 presents perinatal mortality rates and odds ratios according to each variable considered in our analysis. None of the socio-economic or areal measures showed a statistically significant association with perinatal mortality when analyzed individually, whereas all pregnancy history variables and maternal age did. The significance of these associations was measured by calculating the odds ratio for each category of a particular variable, relative to a designated reference category, where the odds are defined as the perinatal mortality rate divided by the survival rate for infants born to women with a particular characteristic1. An odds ratio greater than one indicates a higher mortality risk than the reference category, while a value less than one indicates a lower risk. Statistical tests can show if the difference between the observed odds ratio and one (the value expected if the odds are the same in both categories) is significant. In addition, the 95 per cent confidence interval for the ratio is given in the last column of table 1.

Table 1: Perinatal mortality rates (per 1000 LB) by different socio-biological factors, Matlab, 1982-1984 (Univariate)

Factors	Number of		Rate	Odds ratio	95% confidence interval of odds ratio
	Live births	Perinatal deaths			
Mother's education (years)[a]					
None	13,826	1,106	79.9	.94	.79-1.13
1-5	5,059	346	68.4	.80	.71-1.06
6+	1,825	150	82.1	1.00	-
Father's education (years)					
None	9,078	693	76.3	1.05	.92-1.18
1-5	5,390	405	75.1	1.03	.90-1.18
6+	6,901	504	73.0	1.00	-
Father's occupation[b]					
Lower	6,851	497	72.5	1.03	.88-1.24
Middle	8,118	627	77.2	1.11	.95-1.30
Higher	3,484	244	70.0	1.00	-
Areaa					
MCH-FP	9,875	728	73.8	1.00	-
Comparison	10,833	817	75.4	1.02	.92-1.14
Age of mother					
<20	2,079	236	112.5	1.73 * *	1.49-2.01
20-34	16,514	1,137	68.9	1.00	-
35+	2,758	229	83.0	1.22 * *	1.05-1.42
Parity					
0	4,587	509	110.9	1.88 * *	1.67-2.12
1-4	12,029	748	62.2	1.00	-
5+	4,753	345	72.5	1.19 *	1.04-1.36
Previous fetal wastage					
None	17,485	1,203	68.8	1.00	-
1	3,033	253	83.4	1.23 *	1.07-1.42
2+	851	146	171.6	2.84 * *	2.35-3.44

Pregnancy interval status[c]					
<24 months	3,907	340	87.0	1.54 * *	1.35-1.78
24-59	10,883	631	57.9	1.00	-
60+	2,188	170	77.7	1.37 * *	1.14-1.64

Notes: * * P<0.001; * P<0.01;

a Total number of cases are different owing to mission data.
b Lower = daily labour, unemployed, agriculture labour etc.;
Middle = skilled labour, small business, etc.; and Higher = service, established business, agriculture owner etc.
c First pregnancy were excluded.

The mortality odds do not vary significantly by category of maternal or paternal education, by paternal occupation, or by area of residence. They do, however, differ according to age of the mother and her pregnancy history. A reversed J-shaped relationship is observed: young women (under 20) have infants who are at high risk of perinatal mortality relative to those whose mothers are 19-34 years at the time of the birth. The risk to infants of women over 35 years of age is also elevated, but not nearly as much as for young mothers.

A J-shaped relationship of similar magnitude is found by parity: first births are much more risky in terms of perinatal survival than birth orders 2-5, and birth orders 6+ again have somewhat elevated mortality rates. Similar results are found for previous pregnancy intervals. Children born within two years of the end of a previous pregnancy have especially high mortality odds compared with those born 2-5 years after a previous pregnancy, while those born after a long interval (60+ months) also experience higher mortality. Finally, the more previous fetal losses a women has experienced, the greater will be the risk of perinatal mortality in her subsequent pregnancies.

To examine the relationship between each of these variables and perinatal mortality while controlling for the effects of the others, logistic regression models were estimated. Three groups of factors were considered: socio-economic and areal variables; age and parity; and the more detailed pregnancy history variables, previous pregnancy interval and previous fetal losses2. Model I shown in table 2 includes only the first group. Although one coefficient is statistically significant, the model taken as a whole represents no improvement in predictive power over the model that uses only the constant term to predict survival status at the end of the perinatal period3. The second group of variables (representing age and parity) improves the prediction of survival considerably. Model III shows that previous pregnancy interval and fetal loss also are significantly related to perinatal mortality; the only non-significant term is for the variable that represents no previous pregnancy. All three groups of variables are included in Model IV, which confirms the earlier results: the coefficients for the first group of variables are not significant individually and the model, taken as a whole, is not an improvement over our final model, Model III.

The net effect of each variable in the model is represented by the value of the coefficients. A positive value indicates a higher mortality risk. Since all coefficients (except the constant term) are positive, the lowest mortality risks are found in infants of reference group mothers: those aged 20-34, who have already had a live birth and have never experienced fetal loss, and whose child is born 2-5 years after the previous pregnancy termination.

Table 2: Multivariate logistic regression coefficients of perinatal mortality on different factors, Matlab, 1982-1984.

Factor	Reference category	Model			
		I	II	III	IV
Constant		-2.483 * * *	-2.759 * * *	-2.958 * * *	-2.999 * * *
Mother's education (years)					
None	6+	-0.984			-0.010
1-5		-0.200			-0.136
Father's education (years)					
None	6+	0.031			0.041
1-5		0.030			0.033
Father's occupation					
Low	High	-0.055			-0.031
Middle		0.047			0.061
Area					
Comparison	MCH-FP	0.020			0.061

Age of mother (years)					
<20	20-34		0.174	0.208 * *	0.209 * *
35+			0.304 * * *	0.184 * *	0.167 * *
Parity					
0	1+		0.552 * * *	0.500 *	0.505 *
Pregnancy interval (months)					
None	24-59			0.195	0.204
<24				0.242 *	0.243 * * *
60+				0.268 *	0.291 *
Previous fetal wastage					
1	None			0.263 *	0.263 *
2+				1.020 * * *	1.020 * * *
Likelihood ratio statistic		11,494.5	11,390.4	11,270.8	11,262.4
Degrees of freedom		22,146	22,150	22,145	22,139

Notes: * p<.01, * * p<.05, * * * p<.001

For them the log odds of mortality is given by the constant term and the odds by exp(-2.958) = .052. The estimated proportion surviving the perinatal period is, then, .052/(1+.052) = .049. The odds for infants of mothers in a particular category relative to the reference group (the odds ratio), is given by exp(b), where b is the estimated coefficient for that variable. For example, the relative odds for infants of young mothers (relative to the reference group) is given by exp(.208) = 1.23. The estimated odds for this category are given by exp(constant=b) =exp(-2.958 +208) =.063 and the estimated mortality rate by .063/(1+.063) =.060. The relative risk is simply this rate divided by that for the reference category, or 1.22.

Thus perinatal mortality for infants of the youngest mothers is 22 per cent higher than for those who are a few years older, but have all other characteristics the same. If the young mother is also primiparous, the odds of dying increase further (to exp(-2.958+.208+.500) = .105) as do the relative odds (to 2.03).

Both the relative odds and the relative risk are shown in table 3 for groups of women that differ from the reference group on only one of the factors included in the model. As can be seen, these values are almost identical when the risk of dying is quite small4.

The results indicate that women hoping to deliver their first live birth and women who have experienced difficulty in the past, as measured by two or more fetal losses, have especially high risks of perinatal mortality.

Discussion

The findings of this study are generally consistent with those of the studies established previously, although some differences are observed. The main contrast is the lack of association with any measure of socio-economic status. It may be that in a rural area of a developing country there is, uniformly, little access to maternity care during pregnancy for the mother and during delivery and thereafter for both mother and newborn that might improve perinatal survival chances. It may also be that there are few differences in fertility patterns by social class. If, for example, young mothers were drawn disproportionately from among the poorer and less educated groups, a spurious univariate association between social class and perinatal mortality would be engendered because of a true association between maternal age and perinatal survival.

Our study has confirmed that survival of the perinatal period is separately related to both maternal age and primiparity. Once maternal age is taken into account, high parity shows no evidence of decreasing survival chances. Of note are the sizable negative effects of short inter-pregnancy intervals and of previous experience with fetal loss.

Table 3: Predicted mortality rate, relative odds and relative risks of perinatal mortality for groups of women that differ from the reference category on a single characteristic *

Group	Predicted perinatal mortality	Relative odds	Relative risk
Reference group * *	49.4	1.00	1.00
Age of mother (years)			
<20	60.1	1.23	1.22

35+	58.7	1.20	1.19
Parity			
0	78.9	1.65	1.60
Pregnancy interval (months)			
None *	59.4	1.22	1.20
<24	62.0	1.27	1.26
60+	63.6	1.31	1.29
Previous fetal wastage			
1	63.2	1.30	1.28
2+	125.9	2.77	2.55

Notes: * Predicted from Model III, table 2.
* * Reference group: women aged 20-34, parous, pregnancy interval 24-59 months, no previous fetal wastage.

These results suggest that, to reduce perinatal mortality, programmes targeted at primiparous women, at those who had had fetal losses and to both younger and older mothers should be considered. Serious attention should be given to the types of antenatal and delivery care that may be feasible in the context of rural developing countries. It can also be recommended that efforts to increase fertility control practices that lengthen the inter- pregnancy interval to more than 24 months would be effective in reducing individual experience with perinatal mortality.

Footnotes

1. For example, age is divided into three categories, with women 19-34 years selected as the reference group. The survival odds are:

Oddsref = 68.9/931.1, Odds35+= 83.0/917.0.

The odds ratio for the oldest age group is, then, odds35+/oddsref= 1.22.

2. In preliminary analyses, the coefficient of the variable representing high parity (equal to or greater than 5) was never significant when age was included in the model. Parity is, therefore, treated as a dichotomous variable here.

3. Logistic regression models that are nested (in that all variables included in the model with fewer variables also appear in the larger model) can be compared using their likelihood ratio statistics. The difference between the two statistics has a chi- square distribution with degrees of freedom equal to the difference in the degrees of freedom for each model. In this case, the difference in likelihood ratio statistics is 11501.4 -- 11494.5 = 6.9, with degrees of freedom = 22153 -- 22146 = 7, which is not significantly different from zero. Therefore, this group of variables does not improve our explanatory power.

4. If the probability of dying, p, is very small, the odds ratio p/(1-p) is nearly identical to p itself. Therefore, the relative odds and relative risk will be nearly identical.

References

Adelstein, A.M., I.M.M. Davis and J.A.C. Weatherall (1980). "Perinatal and infant mortality: social and biological factors, 1975-77". In: Studies on Medical and Population Subjects (London: Her Majesty's Stationery Office).

Baird, A. (1962). "The contribution of operative obstetrics to prevention of perinatal death", Journal of Obstetrics and Gynaecology of the British Commonwealth, 70:204.

Bakketeig, L.S. and H.J. Hofman (1979). "Perinatal mortality by birth order within cohort based on sibship size", British Medical Journal, (6192):693-696.

Cholera Research Laboratory (1978). "Demographic Surveillance System: methods and procedures", Scientific Report, 1(9), Dhaka, Cholera Research Laboratory.

Erhardt, C.L. and H.C. Chase (1973). "Ethnic group, education of the mother and birth weight", American Journal of Public Health, Supp. 63:19-23.

Fedrick, J. and P. Adelstein (1973). "Influence of pregnancy spacing on outcome of pregnancy", British Medical Journal, 4:753.

Forbes, J.F. and R.M. Pikering (1985). "Influence of maternal age, parity and social class on perinatal mortality in Scotland: 1960-82", Journal of Biosocial Science, 17(3):339-349.

James, W. H. (1976). "Birth order, maternal age and birth interval in epidemiology", International Journal of Epidemiology, 5(2):131-132.

Kiely, J.L., N. Paneth and M. Russer (1986). "An assessment of the effects of maternal age and parity on different components of perinatal mortality", American Journal of Epidemiology, 123(3):444-453.

Kleinbaum, David G., Lawrence L. Kupper and Hal Morgenstern (1982). Epidemiologic Research (Belmont, California: Wadsworth Publishing).

Misra, P.K., P.C. Bajpai, T.K. Tripathi, R. Gupta and Kutty (1973). "Perinatal mortality: a hospital study", Indian Paediatrics, 210:545-551.

Ross, R.A. (1964). "Some important factors in perinatal mortality statistics in a rural state", American Journal of Obstetrics and Gynacology, 88:342-346.

Saksena, D.N. and J.N. Srivastava (1980). "Biosocial correlates of perinatal mortality: experiences of an Indian hospital", Journal of Biosocial Science, 12:69-81.

Serour, G.I., N.M. Younis, F. Hefnawi, M. El-Bahy, H.F. Dagistany and M. Nawar (1981). "Perinatal mortality in an Egyptian maternity hospital", International Journal of Gynaecology and Obstetrics, 19(6):447-451.

Srivastava, J.R., K.K. Saluja, K. Bai Sunada and K.C. Samuel (1969). "Studies on perinatal mortality in medical college hospitals, Kanpur", Indian Paediatrics, 6:374-381.

Stanley, J.F. and M.S.T. Hobbs (1983). "Perinatal outcome in western Australia, 1968 to 1985", Medical Journal of Australia, April, 413-416.

Swenson, I. and Paul A. Harper (1979). "High risk maternal factors related to fetal wastage in rural Bangladesh", Journal of Bisocial Science, 11(4):465-471.

World Health Organization (1978). Social and biological effects on perinatal mortality (Budapast: Statistical Publicity House).

Yudkin, P.L. and M.A. Brass (1983). "A new approach to assessing the effect of birth order on the outcome of pregnancy", Journal of Biosocial Science, 15(3):307-316.

Zimmer, B.G. (1979). "Consequences of the number and spacing of pregnancies on outcome, and of pregnancy outcome on spacing", Social Biology, 26(2):161-177.
