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## **Non-Biological Correlates of Early Neonatal Deaths: Evidences from Five Selected States of India**

### **Introduction**

TN the study of determinants of mortality at younger ages researchers have so far been rarely interested in the mortality during first seven days of life. Rather, a massive amount of researches have been done on levels, trends and factors of infant mortality, child mortality or even perinatal mortality of which 'early neonatal mortality' is an important part. Any Government intervention in health related areas has the basic target of reducing three components of child mortality, viz., late neonatal mortality (1 to 4 weeks), post neonatal mortality (1 to 11 months) and early childhood mortality (1 to 4 years). Early neonatal mortality did not receive much attention, probably because of the notion that this component of child mortality is predominantly caused by biological and genetic factors, so that it can little be influenced by public health measures. The following evidences tell a different story.

In last two decades (1971-91) India has achieved a 64 point drop in infant mortality (144 to 80 per 1000 live birth) principally because of the definite decline in the proportion of late neonatal mortality and post neonatal mortality. This leads to an increase in the proportion of early neonatal deaths in neonatal deaths from 50 per cent to around 70 per cent during the same period. World scenario is not different from this. According to WHO, each year around 5 million infants die in the first month of life. Out of these, 3.4 million die in first week of life. In other

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words, 70 per cent of the infant deaths occurring during neonatal period take place in first week of life. No less than 98 per cent of these deaths occur in developing countries. So, if the experiences of developed and developing countries are considered, it can be seen that there is a wide gap between the incidence of early neonatal mortality in the two worlds. For sake of simplicity, if we hold that early neonatal mortality in developed countries are solely caused by biological and genetic factors, the differential in the incidence of early neonatal deaths between developed and developing countries can not be explained only by their biological and genetic differentials. Within a single country, wide difference between rural and urban areas signifies the same fact. These hint to the existence of other factors which would be alterable to favour.

Several studies, mostly on perinatal mortality rather than on early neonatal mortality, indicate that 75 per cent of the causes of perinatal deaths are amenable. Many scholars pointed out that inadequate care of mother during pregnancy and delivery, poor hygiene during delivery and inappropriate management of complications during pregnancy and delivery led to early end of life (*Shahetal.*, 1984; Pinnelli, 1986). They also revealed that low birth weight, neonatal infection, feeding problem in newborn were some of the main causes of early neonatal deaths. Some studies suggested that demographic characteristics of mother viz., age of mother at time of birth, parity, previous birth interval, survival status of previous child were also of much importance (Saksena, 1980; Pinnelli, 1986). In contrast, another study found that age did not influence perinatal mortality in developed countries. Socio-economic characteristics of parents were also seen to influence survival of infants in the first week of life.

One of the important studies conducted by Saksena and Srivastava in 1980 is on the 'Biosocial Correlates of Perinatal Mortality' using data from Dufferine Hospital, Lucknow. This study suggested that age of mother at birth, parity, period of gestation, birth weight and sex had impact on perinatal mortality. They found that perinatal mortality rate declined with increase in socio-economic condition of mother. Shah *et al.* (1984), suggested that survival of the newborn during first week of life was determined by the stresses of intrauterine life and the birth process as well as the adjustment to new environment, nutrition and infection.

Kikhela (1989) gave a conceptual framework and the technique of data collection for the study of perinatal mortality in Kinshasa, Zaire. This study also confirmed the earlier results. *Most'dfaetal.* (1989), using logistic regression technique estimated the net effect of risk factors on perinatal mortality. This study indicated that survival of infants in perinatal period was separately related to maternal age, parity and last birth interval. Pinnelli (1986), suggested that women's general health, gestation

and pediatric surveillance were the factors towards which efforts could be done for further improvement of infant survival.

Most of these studies were on perinatal mortality rather than on early neonatal mortality and those were mainly based on clinical data of high quality and reliability but suffered from selection bias. Very few studies have been done on perinatal or early neonatal mortality in an Indian context.

Against this backdrop, the present paper is an attempt to go a step further to unearth specific correlates of early neonatal deaths with the help of a conceived framework of the process using latest available survey data for rural area of Bihar, Uttar Pradesh, Orissa, Madhya Pradesh and West Bengal.

### **Source of Data and Limitations of the Study**

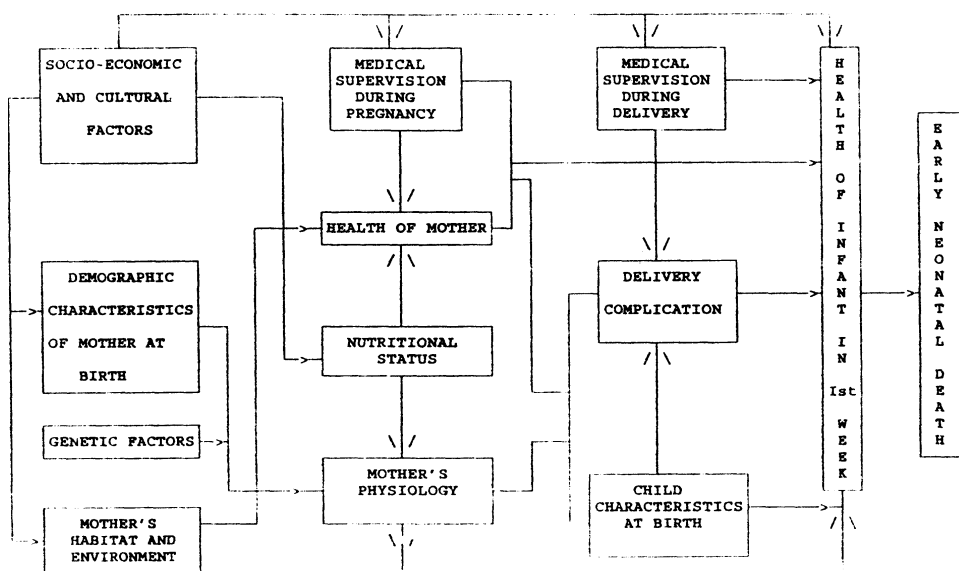
Data from NFHS (1992-93) is used for the study of determinants of early neonatal death as NFHS provides necessary information on variables related to the conceptual framework. Information on last birth (if occurred during 1988-92) only are used for analysis. To get sufficient number of sample required for analysis, data on the five states mentioned above are clubbed together. In all the above states, rural and urban set ups are so widely different in terms of health infrastructure and other facilities that a combined study can not give any clear picture. Further, urban sample size happens to be too small to get any meaningful result. So, the study is restricted to rural area only. The main argument behind selecting these five states is that in all these states neonatal death rates are above 50 per 1000 live births (NFHS, 1992-93). Further, rural areas of these states are not widely different in village characteristics, health infrastructure and other civil facilities.

Though NFHS is a large scale survey, some of the major areas like health and nutritional status of mother, morbidity of mother during pregnancy, health of the infant during first seven days of life, etc., are not covered. Data on birth weight, which is a major determinant of early neonatal deaths, is not complete, probably because most of the births in India take place outside institution. In place of birth weight, size of infant at birth is thus taken for analysis. Information on physical and medical infrastructure is available in NFHS village schedule, but of very poor quality and do not encourage to use it.

### **Methods**

To study the determinant of early neonatal mortality a conceptual framework is developed by modifying the framework coined by Kikhela (1989) to study perinatal mortality in Kinshasa, Zaire.

To construct the framework eleven hypothesis have been postulated (Table A). In this framework (Fig. 1) four broad categories of variables are considered.



**Fig. 1.** Conceptual Framework for Early Neonatal Death

The first category consists of variables which exist before conception. Socio-economic and cultural factors, habitat and environment, demographic factors of mother and genetic factors are included here. Second category includes variables existing during pregnancy. Medical supervision of pregnancy, health of mother during pregnancy and mother's nutritional status come under this heading. Physiological factors are also included in this. The third one includes those variables which are present during delivery. Variables related to medical supervision of delivery, delivery complications and child characteristics at birth constitute this category. In the fourth category only health of infant in the first week of life is considered.

The flowchart shows the sequences in which factors may affect incidence of early neonatal deaths directly or indirectly. In this framework, socio-economic determinants are the exogenous factors while incidence of early neonatal death is the dependable variables. The exogenous factors operate on incidence of early neonatal deaths through intermediate variables (category 1, 2, 3 and 4 variables).

A broad discussion on variables of each category and expected influences of these variables on outcome of pregnancy is given below.

TABLE-A: HYPOTHESES POSTULATED FOR THE CONSTRUCTION OF CONCEPTUAL FRAMEWORK

<i>S. No.</i>	<i>Dependent variable</i>	<i>Independent variable</i>
1.	Early neonatal deaths	1. Health of infant in first week of life
2.	Health of infant in first week of life	1. Medical supervision of delivery 2. Delivery complication 3. Child's characteristics at birth 4. Mother's physiology 5. Medical supervision of pregnancy 6. Health of mother during pregnancy 7. Socio-economic and cultural factors 8. Mother's habitat and environment
3.	Medical supervision of delivery	1. Socio-economic and cultural factors
4.	Delivery complication	1. Medical supervision of delivery 2. Medical supervision of pregnancy 3. Child's characteristics at birth 4. Health of mother during pregnancy 5. Mother's physiology
5.	Child's characteristics at birth	1. Medical supervision of pregnancy 2. Mother's physiology 3. Mother's health during pregnancy
6.	Medical supervision of pregnancy	1. Socio-economic and cultural factors
7.	Mother's health during pregnancy	1. Medical supervision of pregnancy 2. Nutritional status of mother 3. Mother's habitat and environment
8.	Nutrition status of mother	1. Socio-economic and cultural factors
9.	Mother's physiology	1. Mother's demographic factors 2. Nutritional status of mother 3. Genetic factors
10.	Mother's demographic factors	1. Socio-economic and cultural factors
11.	Mother's habitat and environment	1. Socio-economic and cultural factors

*Exogenous Variables*

Socio-economic and cultural determinants of early neonatal deaths can be grouped into two broad categories of variables:

1. Individual level variables: Education and occupation of parents, tradition/norms/ attitudes.
2. Community level variables: Physical and Medical Infrastructure.

*Individual level variables*

EDUCATION OF PARENTS. Education of parents, especially of father, usually correlates strongly with occupation and therefore with household income. Thus in many cases correlation between infant survival in the first week of life and the education level of parents largely occur because of operations on intermediate determinants through the income effects. Parent education may also influence attitude towards health and health related matters and income helps in materializing the utility of available health facilities. Above all an educated woman can take care of herself and her newborn better than an illiterate woman.

TRADITIONS/NORMS/ATTITUDES. Grouped under this category are factors that shape and modify health related practices at individual level according to the culture, tradition and norms. In traditional society, women get married at younger ages and consequently their age at first birth is low. At that age they are generally unaware of the consequences of motherhood at younger age. Even if they are aware, they may have little control over the allocation of household resources for themselves. Decisions in these areas are generally reserved for the elders who may adhere to conventional and obsolete practices.

*Community level variables*

PHYSICAL INFRASTRUCTURE. Rail, roads, electricity, water, sewage influence health, particularly through their impact on relative price of staples as well as of health related goods, services and information. Lack of transport facilities might prevent pregnant women visiting health service centers or hinder immediate referral in case of emergencies and acute complications during delivery. So lack of physical infrastructure may increase the risk of experiencing early neonatal deaths.

**MEDICAL INFRASTRUCTURE.** Availability of health services in a community is the basic need. Women can go for medical supervision only when such facilities are available within their reach.

### *Intermediate Variables*

Intermediate variables are inter-related with each other.

Environment and Habitat of mother has lot of bearing on her health and ultimately on the of survival of infant in the first week of life. Below are some major ways in which living condition and surroundings influence survival of early neonatals.

*Source of drinking water:* Both quality and quantity of drinking as well as non-drinking water supply are important determinants of exposure to disease. So, it affects early neonatal death through health of mother during pregnancy and also through the health of the newborn.

*Housing:* Size and quality of house are important factors. Poor ventilation and crowded sleeping condition have adverse effect on health of mother and the newborn. Availability of toilet and sewage facilities also influences early neonatal deaths.

Demographic characteristics of mother, such as, age of mother, parity, previous birth interval and outcome of previous pregnancy influence her physiology which in turn affects child's characteristics at birth as well as complication during delivery. Generally, risk of delivery complication and premature birth is high among younger and older women as compared to women in age group 20-29 years. This is mainly because the reproductive organs of women aged below 20 years is not fully developed to bear the stress of pregnancy. Any acute complication during delivery and premature births may lead to early neonatal deaths. Low parity and small birth interval enhance the risk of death of baby during the first week of life.

Nutritional status of mother during pregnancy is another very important intermediate variable through which socio-economic and cultural factors affect early neonatal deaths. Availability of minimum food supply of sufficient variety to ensure adequate amount of all nutrients is very important for women during pregnancy and lactation. During pregnancy body needs more energy for the growth and maintenance of the fetus, the placenta and maternal tissue. So it directly affects mother's physiology. Sanitary condition of food is also important in preventing

disease transition. So, nutritional status influence health of fetus through the health of mother during pregnancy.

Delivery Complication is influenced by medical supervision during pregnancy and delivery and also by mother's physiology. If delivery takes place at clinic or hospital, attended by doctor or trained person, any complication can properly be managed, that can prevent deaths in early neonatal period because birth injury is one of the major causes of early neonatal deaths. Proper medical supervision during pregnancy (popularly known as ante-natal care) reduces chance of acute delivery complication.

Apart from the above mentioned factors, there are genetic factors which can not be ignored in the study of early neonatal deaths. These factors can little be changed by any social or administrative measure.

Due to nonavailability of data, four sets of variables, health of mother during pregnancy and that of the newborn, nutritional status of mother during pregnancy, mother's physiological and genetic factors are dropped from the final analysis. So the present framework is remoulded (Fig. 2). Physical and medical infrastructural variables are also excluded due to similar reasons.

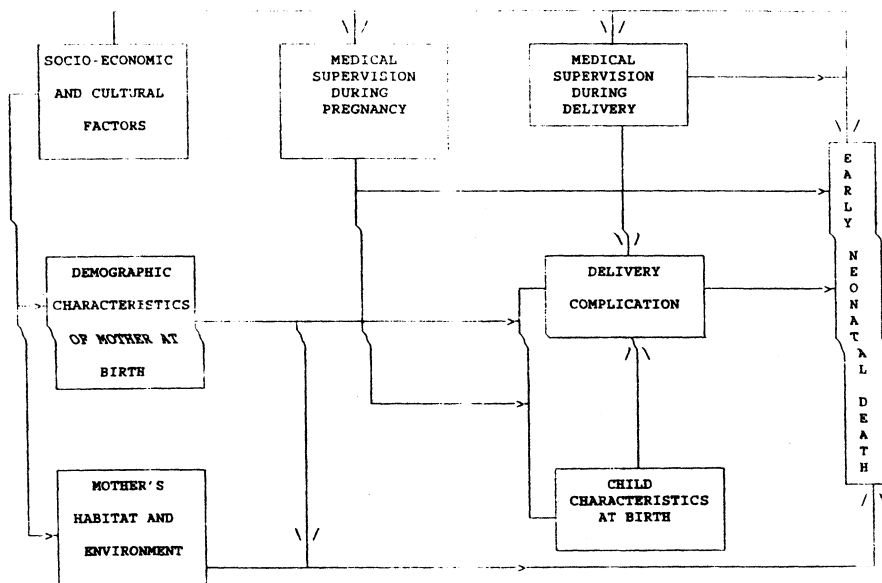


Fig. 2. Conceptual Framework for Early Neonatal Death

The relationships of each independent variable with the outcome variable are examined by using bivariate and multivariate analysis techniques. In bivariate analysis, effect of each independent variables on the dependent variable is obtained without controlling for other variables. So the effect of other variables get intermingled leading to no definite conclusion about the relationships. A multivariate analysis would help establishing the inter-relationship of important factors more accurately, keeping control on all other explanatory variables. As the outcome variable is naturally dichotomous (0—Death, 1—Nodeath), application of logistic regression happens to be an automatic choice.

In logistic regression the net effect of each category of a categorized variable on the dependent variable, with respect to reference category is represented by the value of odd ratio (Exp ( $B$ )). Odd ratio of reference category is 1, so an odd value greater than 1 indicates a higher chance of survival of infants in the first week of life for that category with respect to the reference category.

### Results and Discussions

Table 1 presents early neonatal mortality rate (ENMR) for the three periods 1983-84, 1987-88 and 1991-92 for all five states under study, separately for rural and urban areas. Early Neonatal Mortality Rate (ENMR) is estimated from still birth rate (SBR) and perinatal mortality rate (PNMR) using formula proposed by Lahiri (1993). This method is elaborated in the Appendix.

TABLE 1: ENMR AND PERCENTAGE OF EARLY NEONATAL DEATHS IN NEONATAL DEATHS FOR BIHAR, W.B., ORISSA, M.P. AND U.P.

<i>States</i>	<i>Rural</i>			<i>Urban</i>		
	<i>1983-84</i>	<i>1987-88</i>	<i>1991-92</i>	<i>1983-84</i>	<i>1987-88</i>	<i>1991-92</i>
Bihar	41.1 (65)	36.0 (61)	32.0 (70)	27.1 (60)	21.0 (55)	18 (69)
West Bengal	37.0 (66)	29.1 (63)	30.2 (67)	21.2 (75)	15.2 (65)	14.2 (66)
Orissa	51.5 (61)	49.0 (61)	49.0 (64)	28.9 (67)	23.1 (60)	32.1 (70)
Madhya Pradesh	53.1 (64)	44.8 (62)	47.9 (69)	30.2 (65)	28.0 (64)	28.8 (64)
Uttar Pradesh	66.0 (63)	44.3 (58)	41.2 (65)	37.0 (65)	25.4 (61)	30.9 (69)

*Note:* ( ) - Percentage of early neonatal deaths in neonatal deaths.

*Source:* Sample Registration System, India (1982-93).

This table is used only to show the magnitude of problem posed by early neonatal deaths and not the levels and trends of ENMR. The table reveals that ENMR for Bihar and W.B. are comparable at 32 and 30 per 1000 live birth (L.B.) respectively in 1991-92 but it is very high in Orissa and M.P., U.P. is in between these two groups. Similar is the situation in urban area. Though ENMR has declined over the years in all five states, percentage of early neonatal deaths in neonatal deaths has increased and in most of the cases it is above 60, implying that among the infants who died in first month of life, 60 percent died in the first week of life. Another important issue is the wide gap between urban and rural areas. This may be because of the difference in health and physical infrastructure and also in social set up. This wide urban-rural gap also hints the implication of socio-economic factors on the incidence of early neonatal deaths.

### *Bivariate Analysis*

To study the impact of each variable on the incidence of early neonatal deaths, bivariate analysis is carried out without having control over other variables.

### *Socio-economic and cultural factors*

(a) CASTE AND RELIGION OF MOTHER: Out of 17184 births in rural area, 24 per cent were born to SC/ST mothers and remaining to the mothers belonging to other castes. But, ENMR among SC/ST is 33 (Table 2) while in other castes it is only 26. This variation in early neonatal death over caste group is statistically significant. A probable reason may be the low socio-economic condition of SC/ST people in these states. Literacy and standard of living among them are miserably low. Table 2 also shows that religion does not have significant influence on incidence of early neonatal deaths. ENMR is 27 and 31 for Hindus and non-Hindus respectively.

(b) EDUCATION OF PARENTS: In rural areas of the selected states overall literacy is very low. Out of total births taken for study, 79.5 per cent were born to illiterate mothers (Table 2). Risk of experiencing early neonatal death is higher (29) to the illiterate mothers than literate mothers (21). The negative association of early neonatal death with education of mother is statistically significant. Similar is the situation with father's education, though it is not significantly associated. This is probably because educated parents are more aware about health care and utilize medical facilities better than uneducated parents. This is in conformity with other studies, those of by Saksena *et al.* (1980) and Mostafa (1989).

(c) OCCUPATION OF PARENTS: In rural areas, as it is clear from Table 2, 77.3 per cent of women under study are not working, 14.8 per cent are engaged in primary sector and remaining 7.9 per cent in services. The incidence of early neonatal deaths in rural areas do not vary with occupation of mother which contradicts the general finding that early neonatal death decreases with occupation. This may be because of the fact that in rural areas mostly women of low socio-economic background work outside home. They are mostly engaged in agriculture, construction work and low paid jobs. This may be responsible for the increase in their chance of experiencing early neonatal deaths. Father's occupation does not seem to have any impact on early neonatal deaths.

*Environment and habitat of mother.* In rural areas, 73.6 per cent women live in *kachha* house and just 7 per cent in *pucca* house, 92 per cent women do not have any toilet facility. Early neonatal deaths are significantly associated with source of drinking water and toilet facility. When type of house, water and toilet facility are taken separately, early neonatal deaths among those living in *kachha* house is 29 while among those who are living in *pucca* house is 22 (Table 2). Women who have access to only surface water (pond, river, etc.) for drinking purpose are more likely to experience early neonatal deaths (32) than those having tap/handpump (28) or well (26). Similarly no toilet facility has adverse effect on health of mother and the newborn. Early neonatal death is 28 among those having no toilet facility while it is 17 among those having facility.

*Demographic factors of mother.* Table 2 also shows that association between demographic characteristics of mother and early neonatal death is highly significant. Analysis of data shows that 24 per cent of the total births are to the mothers below 20 years. Early neonatal death exhibits an inverted J-shaped relationship with maternal age at birth. Deaths in the first week of life is higher for infants born to younger (< 20 years) or older (30+) mothers. ENMR for mothers below age 20 years is 39 while for mothers in middle age group (20-29 years) is 22. The difference is statistically significant with high chi-square value. The probable reason may be that a woman of age below 20 years may not be mature enough to bear the stresses of becoming pregnant. This may lead to higher delivery complication and may have adverse effect on the health of infant. Likelihood of giving birth to deformed child among women of age 30+ is high.

Early neonatal death evidences an inverted J-shaped relationship also with parity of mother. Death rate in the first week of life is seen to be high (48) for first order births. It is low for 2-3 order infants and then starts increasing for higher

TABLE 2: EARLY NEONATAL MORTALITY RATE BY SOCIO-ECONOMIC AND DEMOGRAPHIC FACTORS OF MOTHER

<i>Factors</i>	<i>Early</i>	<i>Neonatal Death</i>	<i>Live Birth</i>	<i>ENMR<sup>4</sup></i>
<b>SOCIO-ECONOMIC AND CULTURAL FACTORS</b>				
a. Caste of mother*				
(i) SC/ST		139	4193	33
(ii) Other		334	12991	26
b. Religion of mother				
(i) Hindu		393	14469	27
(ii) Non-Hindu		78	2519	31
c. Education of mother*				
(i) Illiterate		400	13659	29
(ii) Literate		73	3525	21
e. Occupation of mother				
(i) Not working		364	13260	27
(ii) Primary sector		66	2536	26
(iii) Service		40	1347	30
f. Occupation of father				
(i) Primary sector		211	7551	28
(ii) Service		262	9535	27
g. Mass-media exposure				
(i) Exposed		139	5047	28
(ii) Not exposed		334	12124	28
<b>MOTHER'S HABITAT</b>				
a. Type of house				
(i) Kachha		367	12608	29
(ii) Semi pucca		78	3313	24
(iii) Pucca		26	1201	22
b. Drinking water facility*				
(i) Tap/Handpurnp		312	11068	28
(ii) Well		139	5433	26
(iii) Surface water		22	683	32
c. Toilet facility				
(i) No		449	15796	28
(ii) Yes		24	1388	17
<b>DEMOGRAPHIC FACTORS OF MOTHER</b>				
a. Age of mother at birth*				
(i) < 20		161	4107	39
(ii) 20-29		213	9576	22
(iii) > 29		99	3500	28
b. Parity*				
(i) 1		181	3810	48
(ii) 2-3		126	6439	20
(iii) 4-6		112	5050	22
(iv) 6+		54	1885	29

<sup>4</sup>ENMR calculated here is not a conventional one. This rate is based on only the last birth occurred during 1988-92.

## EARLY NEONATAL MORTALITY RATE BY MEDICAL SUPERVISION AND CHILD CHARACTERISTICS

<i>Factors</i>	<i>Early Neonatal Death</i>	<i>Live Birth</i>	<i>ENMR<sup>t</sup></i>
c. Previous birth interval*			
(i) < 12	58	899	65
(ii) 12-24	117	3923	30
(iii) 24-48	190	8707	22
(iv) > 48	108	3655	29
MEDICAL SUPERVISION OF PREGNANCY			
a. Tetanus*			
(i) Yes	176	8318	21
(ii) No	295	8866	33
b. Antenatal care			
(i) Yes	180	8040	23
(ii) No	293	9144	33
MEDICAL SUPERVISION OF DELIVERY			
a. Place of delivery*			
(i) Hospital	81	1682	48
(ii) Home	392	15502	25
b. Delivery assistant*			
(i) Doctor	57	1379	43
(ii) Trained attendant	33	2400	14
(iii) T.B.A.	163	6090	27
(iv) Others	220	7316	31
DELIVERY COMPLICATION*			
(i) Yes	106	1786	60
(ii) No	367	15398	24
CHILD CHARACTERISTICS AT BIRTH			
a. Size of child*			
(i) Normal	188	11350	17
(ii) Abnormal	285	5834	49
b. Gestation period*			
(i) On time	342	16210	21
(ii) Premature	131	634	208
c. Sex			
(i) Male	245	8962	27
(ii) Female	228	8222	28

Note: \* - significant at  $p < 0.05$ .

order births (Table 2). Delivery complication may be a pertinent reason. ENMR is comparatively higher among those women whose previous birth interval are either too short (< 12 months) or too long (> 4 years). So, this again shows an inverted J-shaped distribution of early neonatal death in relation to previous birth interval.

*Medical supervision during pregnancy.* Most of the earlier studies based on clinical data suggested that tetanus was one of the major causes of early neonatal deaths. According to WHO (1994), 14 per cent of the early neonatal deaths are caused by Neonatal Tetanus, even then only 50 per cent of the women under present study went for ANC and tetanus injection. This study also shows that ENMR is higher (33) for those who have not taken tetanus injection than for those who have taken (21). Similar is the situation with antenatal care. Thus, early neonatal death is negatively associated with medical supervision during pregnancy and the association is statistically significant (Table 2).

*Medical supervision of delivery.* Medical supervision during delivery includes both place of delivery and delivery assistance. In rural areas, 90 per cent of the deliveries take place at home, mostly assisted by untrained birth attendant or relatives. Table 2 shows that risk of early neonatal death is higher (48) when delivery takes place in hospital as compared to home delivery (25). This is probably because in rural areas only serious cases are taken to hospitals. Due to similar reason ENMR is 43 when birth is attended by doctor, but very low (14) when delivery is assisted by trained person other than doctor. These two variables are significantly associated with death in the first week of life.

*Delivery complication.* Most of the medical studies on perinatal mortality and early neonatal mortality have suggested that early neonatal deaths are significantly associated with delivery complication. Present study has also confirmed this fact. Out of 17184 women under study, 10.4 per cent reported to have complication at the time of last birth (Table 2). ENMR among those women having complication is 60 while among those having no complication is 24.

*Child characteristics at birth.* Number of studies have established that low birth weight is a major cause of early neonatal deaths (Pinnelli, 1986; Parmar, 1989; Barren, 1974; Singh, 1988; Srivastava, 1992; WHO, 1994), through it is not known, whether low birth weight *per se* leads to infant death in the first week of life or it does so through some other factors. But in rural India most of the children are not weighed at the time of birth. Hence size of infant at birth is taken as a proxy

variable in the present study. Table 2 also reveals that out of total births, 34 per cent are either small or large in size at the time of birth. Risk of death in the first week of life is quite higher (49 per 1000 L.B.) for those who are either small or large in size at the time of birth, compared to normal size babies (17).

Data shows that 3.7 per cent of total births are premature. ENMR is extremely high (208) for such births. Table 2 reveals that there is no variation in early neonatal death by sex of the child, though it is believed that male babies are more prone to death during early stage of life.

### *Multivariate Analysis*

To substantiate the above results, binary logit regression analysis has been done with dichotomous dependent variable 'early neonatal death' (0—death 1—no death) in three stages. In each subsequent stage some variables have been added in sequence of their occurrence in the conceptual framework. Model-1 shown in Table 3 includes only socio-economic, habitat and demographic factors of mother. At the second stage, medical supervision during pregnancy and delivery are included (Model-2). In final model, delivery complication and child characteristics are added (Model-3). For the explanatory variables which are polytomous by nature, for them dummy variables have been created. For individual variables and its categories, reference groups are indicated in the table.

In the first model, among socio-economic variables, caste and education of mother show significant bearing on the dependent variable. These two variables may have direct and indirect effect on the incidence of early neonatal deaths. Infants born to literate mothers have 48 per cent higher chance of survival than those born to illiterate mothers. The risk of early neonatal death is 28 per cent lower for those who are born to mothers of higher caste as compared to those born to SC/ST mothers, when all other variables included in the model are kept constant. This may be because of the differences in cultural practices in care given to mother and infant. Previous birth interval and parity, with their high significant level turn out to be highly important variables influencing infant survival in the first week of life at this stage of analysis. The interaction between age and parity of mother is also highly significant. The related Exp(B) value of the interaction, 0.9842, indicates that risk of experiencing early neonatal death is high for women with low age and high parity or with high age and low parity. Age of mother, seems to affect infant survival through its interaction with parity only as it does not show any individual effect on outcome. As previous birth interval increases from less than 2 years to 2-4 years, risk of dying in first week of life also decreases while at higher birth interval chance of

Variables	Reference Category	Exp.(B)		
		Model-1	Model-2	Model-3
1. Caste of mother Other caste	SC/ST	1,2553*	1.2601*	1.1798
2. Religion Non-Hindu	Hindu	0.8913	0.8502	0.8291
3. Education of mother Literate	Illiterate	1.5652**	1,5302**	1.5749**
4. Occupation of father Service	Primary	1.0881	1,0400	1.0095
5. Mass-Media exposer Exposed	Non-exposed	0,8830	0.8511	0.8706
6. Type of house Semi-pucca Kachha	Pucca	0.6701 0.7888	0.8911 0.7177	0.9195 0.8116
7. Toilet Facility Yes	No	0.9931	0.9898	0.9886
8. Age of mother at birth Parity	continuous	1.0171	1.0213	1.0002
9. Mother's age*	continuous	1.8503**	1.7759**	1.6196**
10. Parity	continuous	0.9844**	0.9868**	0.9888**
11. Birth interval 24-48 > 48	< 24	1.7523** 1.4931**	1.7527** 1.5489**	1.6479** 1.4559**
12. Tetanus Injection Yes	No		1.7372**	1.6175**
13. Place of delivery Home	Hospital/clinic		2.5223**	1.4689*
14. Delivery complication No	Yes			1.8559**
15. Size of infant at birth Normal	Small/large			2.1529**
16. Gestation period On time	Premataure			8.1496**
17. Sex Female	Male			1.0227

Note: 1. Significant at: \* -  $p < 0.05$  \*\* -  $p < 0.001$

2. Dependent variable: Early Neonatal death: 0 - death 1 - no death.

death again increases. For high birth interval (> 4 years) survival chance decline probably because of the fact that in a population where contraceptive prevalence is very low high birth interval is possible in case of pregnancy loss only and this have negative effect on survival of infant in the first week of life. Value of  $\text{Exp}(f_i)$  reveals that incidence of early neonatal death is higher for initial parity when all other variables are kept controlled. A probable reason is that, generally women experience more complications at their first parity. The variables related to mother's habitat and environment show no significant direct effect here. As on some other very important variables of this group viz. occupancy in the house and the environment around it, data are not available, testing the effects of this group remains limited.

Model-2 reveals that the variables which are significant at first stage turn out to be significant at the second stage also when variables related to medical supervision of pregnancy and delivery, viz. tetanus injection and place of delivery are added to the model. All these new entries show significant relationship with early neonatal death. Risk of experiencing early neonatal death is 82 per cent lower for those who have taken tetanus injection and iron folic tablets than those who have not taken. Model-2 shows that home delivery is around 2.5 times safer than institutional delivery when variation in other related factors are fixed. This may be because of the fact that in rural areas only complicated cases are taken to hospitals where the cases can obviously be better managed. Approaching hospital at the last moment increases the risk of death of the newborn, specially in absence of proper transport facility. So, it seems that place of delivery influence incidence of early neonatal deaths mainly through delivery complication, though this may have some net direct effect also.

In Model-3, delivery complication and child characteristics at birth are included for analysis. Caste is the only variable which has not been significant at this stage among those which were significant in earlier model. However, it is expected that caste influences incidence of early neonatal deaths through education and occupation of parents. Interestingly enough, this analysis shows that caste has some influence through child characteristics. This may be because of 'genetic' differences between scheduled tribe and other castes people. With the addition of variables related to delivery complication and child characteristics, values of  $\text{Exp}(B)$  for place of delivery has declined. The decline in  $\text{Exp}(B)$  for place of delivery from 2.5 to 1.5 evidences that most of the effect of 'place of delivery' at the second stage has probably been absorbed by 'delivery complication'. Even after having a control over the latter variable, home delivery seems to be safer place of delivery than hospital. If the degree of complications could be measured and would be included in the study, the result could have been explained better. Final model reveals that delivery complication, duration of gestation and size of infant at birth have significant direct

impact on the incidence of early neonatal deaths. Probability of survival is 8 times higher for the infants who are born on time than premature babies. Normal size infants have 2 times higher chance of survival than those who are of either small or large size. So, this model reveals that all the variables that have been significant at this stage have some direct effect on early neonatal deaths or through other variables which are not taken for analysis, e.g., health of newborn.

## Conclusions

Due to lack of data on 'health of the newborn', though the analysis could not single out ultimate net effect of each variable on the outcome, it has been successful to some extent in separating out most of the important factors, which hold tremendous policy implication for the Government. The study shows that caste and education of mother have significant effect on the survival of infant in the first week of life. All the variables related to pregnancy and delivery, mother's demographic factors and child characteristics have shown significant impact on outcome of pregnancy. In logistic regression also these variables turn out to be significant. By using logistic regression, successively adding group of variables at different stages, the sequences of effects of different variables in the conceptual framework are established.

The results of the study can help realizing that with the improvement in socio-economic condition, loss of human resource in the first week of life can be reduced to a great extent. In India, Government intervention is the only resort to rural people in health related problems. Enhancing child survival at very early ages was sorted out to be one of the most effective measures to reduce fertility. Government thus, started to provide basic MCH services at root level. The specific aim of MCH services was to provide proper health care services to the expectant and nursing mothers along with their newborn. From 1975, with the introduction of ICDS project as supplement to MCH services, whole attention got its renewed direction towards children only. Starting from IEC programme to actual services, interventions are largely made for children rather than for their mothers. The present study reminds once again that child survival, even in the first week of life, is largely influenced by the factors related to antenatal mothers. The study suggests that mothers demand equal medical care and attention during pregnancy as their children for reducing early neonatal deaths. Probably, the factors influencing health and nutritional status of mothers are much more important than anything. Though, very recently 'reproductive health package' is introduced in MCH services, still there is a need to develop and operate schemes to identify needy expectant mothers and provide every bit of care they require to deliver a healthy baby. Under the present medical infrastructure,

a great amount of success can be achieved by strong mass-media coverage on areas related to child bearing and available MCH services. The present study also unfolds the need of collecting reliable data related to health and nutritional status of mothers and also on health of the newborn for at least first 30 days of life to pinpoint the specific factors related to early neonatal deaths.

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**Appendix**

Early neonatal mortality can be estimated directly by using Perinatal Mortality Rate and Still Birth Rate as perinatal period includes period from 28 week of pregnancy to first week of life.

Perinatal Mortality Rate (PNMR), Still Birth Rate (SBR) and Neonatal Mortality Rate (NMR) are given by

$$\text{PNMR} = \frac{D_s^z + D_{en}^z}{B^z + D_s^z} * 1000 \quad (1)$$

$$\text{SBR} = \frac{D_s^z}{B^z + D_s^z} * 1000 \quad (2)$$

$$\text{NMR} = \frac{D_n^z}{B^z} * 1000 \quad (3)$$

where,

$D_s^z$  : No. of still births in a calendar year z

$D_{en}^z$  : No. of deaths in the first week of life in that calendar year

$B^z$  : No of live births in the same calendar year

Early Neonatal Mortality Rate (ENMR) can be defined as

$$\text{ENMR} = \frac{\text{No. of infant deaths in first week of life in a calendar year}}{\text{No. of live births in that year}} \quad (4)$$

By substituting (1) and (2) in above equation, we get

$$\text{ENMR} = \frac{\text{PMR} - \text{SBR}}{1000 - \text{SBR}} * 1000 \quad (5)$$

Thus, percentage of Early Neonatal Deaths in Neonatal Deaths is

$$\frac{\text{ENMR}}{\text{NMR}} * 100 \quad (6)$$

But before estimating ENMR there point moving average of PNMR and SBR is taken to remove any random fluctuation, particularly with rates.

*Source:* (Lahiri, 1993)