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PERINATAL AND NEONATAL MORTALITY IN RURAL PUNJAB

A Community based Case-Control Study

Rohina Joshi

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ABSTRACT

Introduction : The study aimed at identifying social and biomedical risk factors attributable to perinatal and neonatal mortality (PN, NNM) in rural Punjab.

Methodology : A community based, individually matched case control study consisted of 100 cases of stillbirths and neonatal deaths and 300 controls. Odds ratio (OR) and 95% confidence interval (CL) estimated by conditional logistic regression were used to approximate relative risk. The estimates were adjusted for confounding variables.

Results : Households with a low socio-economic status (SES) had a 5 times higher risk of having PN or NNM when compared to higher SES households. (OR: 5.13, CI: 2.96-16.41). Higher level of parental education had a positive impact on the neonate's chance of survival. Lower maternal age and low birth order were beneficial for neonatal survival. History of abortion (OR: 2.2, CI: 1.26-3.96) and delivery conducted by an untrained birth attendant (OR: 4.67, CI: 1.55 – 14.07) were risks for PN and NNM. Preterm (OR: 3.73, CI: 2.13-6.4) and low birth weight babies (OR: 8.74, CI: 4.7-15.57) had a higher risk. A girl child had a 2 fold increased chance of dying in the first 28 days of life than a male child (OR: 1.84, CI: 1.37-3.45).

Conclusion : A neonate's chance of survival begins well before birth. A continuum of care beginning before birth should include regular antenatal care and safe delivery, followed by good newborn care practices. Economically and socially marginalized women need better ante, intra and post-natal care. The girl child needs special attention during the neonatal phase of her life. To save newborns in India, we need to change our focus to the time when most infants die – the perinatal and neonatal period. We also need to shift our attention from hospitals to the communities where deaths occur.

INTRODUCTION

According to the World Health Report 1996, nearly 5 million neonates die each year worldwide, 96% of which occur in developing countries. Neonatal mortality varies from 5 per 1000 live births in developed countries to 53 per 1000 live births in the least developed countries.[1,2] The perinatal and neonatal period, in spite of its shortness, is considered as the most critical phase of life.[3,5] It reflects the general health and the various socio-biological features of mothers and infants.[6,7] Perinatal mortality rate gives a good indication of the extent of pregnancy wastage as well as the quality and quantity of health care available to the mother and the new born.

With the decline of infant mortality rate to low levels in many developed countries, perinatal mortality has assumed greater significance as a yardstick of obstetric and pediatric care before and around the time of birth. Although perinatal period occupies less than 0.5 % of the average life span there are more deaths in this period than during the next 30 - 40 years of life in many developing countries.[8]

Since immunization, oral rehydration solution and control of acute respiratory infections have reduced post neonatal deaths[9]; the neonatal component now constitutes approximately 61% of infant mortality.[2] Therefore, as infant mortality rate goes down, the contribution of neonatal mortality to IMR goes up. This has been the experience of most countries worldwide.[10] As perinatal mortality is high in developing countries, deaths during this period have become a more important public health concern.[11] Also, the neonatal component of infant mortality has not shown any substantial decline in developing countries.[12] The aim of this paper is to identify various determinants (social and biomedical) of perinatal and neonatal mortality.

The National family health survey (NFHS) - 1 reported the infant mortality rate of India in 1992 - 93 to be 79 per 100 live births, in 1996 - 97 the IMR was reported to be 68 per 1000 live births. With the decline of Infant mortality to lower numbers, perinatal and neonatal mortality has assumed greater importance. Neonatal mortality has gradually increased as a percentage of total infant mortality, because of a faster decline in post neonatal mortality rate.[41] In India, 55 – 60% of infant deaths occur within the neonatal period. Neonatal mortality in the year 1995 was 50 per 1000 live births[13]. Perinatal and neonatal mortality rates serve as the most sensitive indicators of a country's health status. These mortality rates serve as a yardstick to measure the quality of obstetrical and neonatal services in the

country. A study done in Punjab in the year 1996, reported the perinatal mortality to be 37.5 per thousand live births.[36] The 1997 Sample Registration System (SRS) of India reported the Perinatal Mortality in Punjab to be 32.5 per thousand live births.

Although a lot of efforts have been made to improve child mortality, especially in the post neonatal phase, little attention has been given to the determinants of perinatal and neonatal mortality. This has been achieved by increasing immunization coverage, introducing oral rehydration solution and control of acute respiratory infections.

Most of the studies done in India are hospital-based studies relying on the hospital data for reporting. The studies reviewed were either cross sectional surveys or hospital based studies. There have been very few community based case control studies on perinatal and neonatal mortality linking both, biomedical and social determinants to these indices. Since, majority of the deliveries in rural India, continue to occur at home, risk factors operational in such circumstances have not been studied adequately. In such circumstances, it was vital to do a community based study to understand and analyze the factors that lead to perinatal and neonatal mortality It was in this perspective that I conducted a community based case control study, in an endeavor to study the determinants of perinatal and neonatal mortality.

Causes

Perinatal Mortality is defined as the number of stillbirths and the first week deaths per thousand total births. It includes both late fetal deaths and early neonatal deaths. Although the Perinatal Mortality Rate is expressed in terms of the number of perinatal deaths per thousand total births, most available information on perinatal mortality is in terms of the Perinatal Mortality Ratio, expressed in terms of the number of perinatal deaths per thousand live births. Neonatal deaths are defined as those that occur during the neonatal period commencing at birth and ending at 28 days completed after birth.[13]

The causes of both perinatal and neonatal mortality are multi-factorial. The predictor variables for perinatal mortality are :

1. *Antenatal Causes* : Maternal diseases like hypertension, cardiovascular diseases, diabetes, tuberculosis; Pelvic Diseases e.g. uterine myomas, endometriosis; Endocrine disorders, Blood incompatibilities, malnutrition, congenital defects, advance maternal age.

2. *Intranatal Causes* like Birth injuries, Asphyxia, Prolonged effort time, Obstetric

complications.

3. *Postnatal Causes* : Prematurity, Respiratory distress syndrome, Respiratory and alimentary disorders, Congenital anomalies.

The established causes of neonatal mortality are : Low birth weight, Birth injuries and difficult labor, Congenital anomalies, Hemolytic diseases of the new born, Conditions of the placenta and the cord, Diarrheal diseases, Acute respiratory infection, Tetanus.[13]

Apart from these medical causes stated above, there has been mention of social factors that lead to perinatal and neonatal mortality. It has been well documented that NNM and PNM increase as we go down the social ladder. More than half a century ago, an inverse relation between social class and stillbirth rates was reported.[14] This association between low socioeconomic level and mortality has been noted in several international studies.[15,17]Women's literacy and level of education has repeatedly shown influence on the chances of infant and child survival.[18, 19]

Risk factors

The infant mortality rate in Nicaragua, rapidly declined from 120 per 1000 live births in 1966 to 64 per 1000 live births in 1986. This decline in mortality rates was attributed to improved availability of health care services, better education facilities, especially for women and food supplementation programmes. Infants living in a poor household had higher susceptibility to die than infants from a non-poor household. Maternal education played a protective role only in poor households. [20,21] A similar study conducted to assess trends in fertility and infant mortality rates in Leon, Nicaragua, observed that the decline in infant mortality rate was due to health interventions, specially targeted to poorer groups of women and their infants.[22]

A number of maternal factors have been shown to be attributable to perinatal mortality in developed countries. For instance, high maternal age, primi-parity, high parity, smoking, low socio economic status, being a single mother, and early perinatal loss have been identified as risk factors for perinatal mortality.[23,28] A study in 1955 observed the influence of social class and geographical location on stillbirths and neonatal mortality in England and Wales[23].

Research done on the effect of the place of delivery on neonatal mortality in Brazil concluded that children who were not born in a hospital had 1.9 times increased risk of neonatal death. Mothers who delivered at home were of low socio economic status and a lower education level.[29] The study of Campbell et al showed similar results in England and Wales.[30]

Closer home, in Bangladesh, it has been observed that low birth weight (<2500 grams) approximately doubles the neonatal mortality in periurban settings. In the study, very low birth weight infants (<2000grams) formed only 7% of the LBW babies, but contributed towards 30% of the mortality. Apart from this finding, it was also observed that pre-term LBW infants were five times as likely to die as term LBW infants.[31]

In developing and developed countries alike, the birth weight of the infant is the single most important determinant of its chances for survival. Low birth weight infants (<2.5 kgs or 5.5 pounds) at birth, experience higher mortality from all causes.[32] Age of the mother at pregnancy was yet another determinant of perinatal and neonatal mortality. Children born to mothers at either a very young or very old reproductive age group were found less likely to survive. Teenage mothers are often biologically, socially, emotionally and economically ill prepared for child bearing. A short birth interval too is a health risk. Children born to mothers with a short inter pregnancy interval are at a greater risk of dying, in both rural and urban areas.[33]

Indian Scenario

In India, during the past three decades, death and birth rates have declined considerably.[34] This decline is more pronounced in some states like Kerala and Tamil Nadu than the others like Orissa and Bihar due to various biomedical and social determinants.

A community based cross sectional study done in Tamil Nadu, reported the still birth rate to be 13.5 per 1000 live births and neonatal mortality to be 35.3 per 1000 live births. Girls had excess neonatal mortality; this was pronounced among girls born to multiparous women with no living sons.[35] This is contradictory to the medical belief that Neonatal mortality is greater in boys than in girls because newborn boys are biologically more fragile than girls.[13,32]

The perinatal mortality in rural Punjab was estimated to be 34.57 per 1000 live births. Prematurity and a short birth interval were found to be statistically significant.[36] In a hospital-based study stretched over a two-year period in Himachal Pradesh, it was observed that the NNMR was 34.5 per 1000 live births.[37]The causative factors identified were, low birth weight, preterm birth and infection[11, 38]. In a study done on perinatal mortality in Pondicherry, the perinatal mortality rate, neonatal mortality rate, stillbirth rate and early neonatal death rate were 11, 10 and 16 times, respectively higher in preterms compared to term deliveries.[39]

According to the SRS data, the neonatal mortality rate in the year 1997 in rural Punjab is 31.8 per thousand live births while the perinatal mortality rate is 35.4 per thousand live births. In the Neonatal Morbidity and Mortality report of the National Neonatal-perinatal database, it was reported that the mortality rates were considerably higher than those reported in the SRS data. [40]

Conceptual framework for the paper

Proximate determinants

Biomedical determinants and Social determinants were taken as the proximate determinants of perinatal and neonatal mortality.

1. ***Social determinants*** :
   Apart from these medical reasons, there are certain social factors that determine mortality. Household factors like socioeconomic status of the family, caste, educational status of parents, occupation, etc, determine PN and NNM. Maternal factors like marital status, place of delivery; perinatal and Neonatal factors e.g., sex of the baby contribute towards PN and NNM.

2. ***Biomedical determinants*** :
   The biomedical determinants of PN and NNM are those medical factors that determine the outcome of the pregnancy. They include maternal factors like age, parity, antenatal care, bad obstetric history, and pregnancy related complications. Perinatal and Neonatal factors like birth weight, gestational age, infection, and congenital malformations also constitute biomedical determinants.

Methodology

Study design

The study design adopted is a community based individually matched case control study. The cases consisted of stillbirths and neonates who died in the last 3 years: 1st January 1999 – 31st December 2001. The controls consisted of those children who survived the neonatal period.

Study area

The study was conducted in 7 villages located in district Ludhiana, Punjab. Four villages belonging to the field practice area of Christian Medical College and three from Dayanand Medical College, Ludhiana were studied. These medical colleges maintain family folders for the whole village and have base line data on the adopted villages. They contain cards for individual family members of the household. The health workers conduct house visits once in every three months. All the vital events are registered in family folders.

Case Definition

Cases comprised of perinatal and late neonatal deaths. The definition adopted in this study is from the eighth revision of the International Classification of disease, which states that the perinatal mortality lasts from 28th week of gestation to the 7th day after birth. Neonatal deaths were defined as those that occurred during the neonatal period commencing at birth and ending at 28 days completed after birth. Three controls were matched for each case, based upon the time of birth of the case and village. Controls were randomly selected from all the births of the month.

Sample Size

For a confidence interval of 95%, power of 80%, keeping the risk factor (pre-term births) at 15% and odds ratio at 2.5, the number of cases calculated was found to be 79 and controls 237 giving a total sample size of 316. In this study I have included 100 cases and 300 controls, thereby giving a total sample size of 400. Sample size was calculated with the help of Epi info version 6.

Research Tools

The research tool adopted in this study was a semi-structured questionnaire (In annexure). This questionnaire was pre-tested in December 2001.

Data Collection Strategy

Identification of cases and controls : Cases and Controls were identified with the help of registers in the field practice areas. Case definitions were adhered to. All the neonatal and perinatal deaths, which took place in the time frame of three years (in 7 villages), were taken as cases. The investigator took the help of a health guide in locating the families.

Interview : Mothers were interviewed based on a questionnaire.

Cross checking of data : Data was crossed checked with the family folder records of each pregnancy to prevent recall bias.

Time Frame : The study began on 1st January and ended on February 20th, 2002.

Data Analysis

Data was entered everyday in Microsoft Excel version 4. The entire data was analyzed using softwares SPSS for windows and Epi info version 6. Initially, unmatched analysis was done using crude Odds ratio, 95% confidence interval, chi-square value and significance testing. Later, a matched analysis was done using Mantel Haenszel's chi-square, odds ratio and 95% confidence interval for minimum likelihood estimate. For multivariate analysis, Conditional logistic regression was done using Epi info 2000 for windows.

Socio Demographic Characteristics

Household Characteristics :

Out of the 400 households studied, 257 (64.25%) were joint families and the remaining 143 (35.75%) were nuclear families. The average family size was six. 13 (3.3%) of the households resided in kucha houses, 121 (30.3%) in mixed houses while 266 (66.4%) resided in pucca houses. Majority of the population were Sikhs (80.3%) and Hindus (19.3%); Muslims and Christians formed the minority in these villages. Families were classified as Scheduled Caste and Tribe, Backward Caste and Forward Caste. 190 (47.5%) families belonged to the scheduled caste/tribe, 40 (10%) to the backward caste and 170 (42.5%) comprised of the forward caste. 75% of the households were landless. 12.75% possessed 1–5 acres of land, and 2.75% possessed more than 10 acres of land.

Characteristics of the parents :

54 (13.5%) fathers and 95 (23.5%) mothers were uneducated. 17.5% and 22.5% had primary education and 55% and 42.2% had secondary education. 13.75% and 12.25% had education more than class 10. (For break-up into cases and controls refer to table 1)

The occupations of the fathers were classified as Professionals and self employed, Salaried, Skilled labourers and unskilled labourers. 28.75% of the fathers were professionals or self employed, 21.25 comprised the salaried class, 11.0% formed the skilled labourer class and 39% formed the unskilled labourers.

Results

Table 1. Sample Characteristics

Variable		Cases	Controls	Total
Total		100 (100)*	300 (100)	400 (100)
Family Type	Joint Family	67 (67)	190 (63.33)	257 (64.25)
	Nuclear Family	33 (33)	110 (36.37)	143 (35.75)
Religion	Sikh	83 (83)	238 (79.33)	321(80.25)
	Hindu	17 (17)	60 (20)	77 (19.25)
	Muslim	0	1 (0.3)	1 (0.25)
	Christian	0	1 (0.3)	1 (0.25)
Type of House	Kucha	5 (5)	8 (2.67)	13 (3.25)
	Mixed	38 (38)	83 (27.67)	121 (30.25)
	Pucca	57 (57)	209 (69.67)	266 (66.5)
Father's Education	Uneducated	24 (24)	30 (10)	54 (13.5)
	Class 1-5	26 (26)	45 (15)	71 (17.75)
	Class 5-10	28 (28)	77 (25.67)	105 (26.25)
	> 10	22 (22)	148 (49.33)	170 (42.5)
Mother's Education	Uneducated	39 (39)	56 (18.67)	95 (23.75)
	Class 1-5	23 (23)	65 (21.67)	88 (22)
	Class 5 -10	33 (33)	135 (45)	168 (42)
	>10	5 (5)	44 (14.67)	49 (12.25)
Caste	SC / ST	75 (75)	115 (51.67)	190 (47.5)
	Backward Class	3 (3)	37 (12.33)	40 (10)
	Forward Class	22 (22)	148 (49.33)	170 (42.5)
Occupation Groups	Professionals	18 (18)	97 (32.33)	115 (28.75)
	Salaried	16 (16)	69 (23)	85 (21.25)
	Skilled Labour	8 (8)	36 (12)	44 (11)

	Unskilled Labour	58 (58)	98 (32.67)	156 (39)
Land Ownership	None	83 (83)	217 (72.33)	300 (75)
	> 1 Acre	0	10 (3.33)	10 (2.5)
	1-5 Acres	11 (11)	40 (13.33)	51 (12.75)
	5-10 Acres	6 (6)	22 (7.33)	28 (7)
	> 10 Acres	0	11 (3.67)	11 (2.75)

* Figures in parenthesis are percentages

More than 50% of the mothers were between 20 and 25 years of age (Table 2). 5.75% of them were above the age of 30 years. All the mothers were registered during their antenatal period. 45% of them got registered on their own during the 1st trimester, 46.3% during the 2nd trimester and 8% during their 3rd trimester of pregnancy. The average number of visits made by the mothers to a qualified doctor for antenatal care was 4.34. 10.8% of the mothers never visited a doctor during their antenatal period; 24.5% visited a doctor less than 3 times, 46.7% visited a doctor 3 to 6 times, and 18% of them frequented a doctor more than 6 times during their pregnancy.

Intake of drugs during pregnancy : 13% of the mothers self reported to have consumed folic acid tablets from the first trimester of their pregnancy. 92% of the women self reported to have consumed iron and folic acid tables during their antenatal period. 30.75% of the women said to have had calcium tablets during pregnancy. The tetanus toxoid immunization coverage was found to be 100%.

Investigations undertaken : 33.3% of the women had Ultrasonographic tests done; of which 28.89% reported to get the sex of the fetus checked. None of the women had an X ray during pregnancy.

Obstetrical History : 34.8% of the women were primi-parous, while 65.2% were multi-gravida. 53% of the women had some form of complication during pregnancy (discharge per vaginum, anemia, pregnancy induced hypertension, gestational diabetes mellitus, antepartum hemorrhage or other complications) 10.3% of the women had undergone one or more abortions previously. 12.8% of the women had lost a child prior to the birth of this index child.

Table 2. Maternal Characteristics

Variable		Cases	Controls	Total
Total		100 (100)	300 (100)	400 (100)
Age at pregnancy	Less than 20 years	21 (21)	37 (12.33)	58 (14.5)
	21 – 25 years	55 (55)	143 (47.67)	198 (49.5)
	25 – 30 years	15 (15)	106 (35.33)	121 (30.25)
	More than 30 years	9 (9)	14 (46.67)	23 (5.75)
Antenatal registration	Registered	100 (100)	300 (300)	400 (400)
Time of Registration	1st Trimester	49 (49)	134 (46.67)	183 (45.75)
	2nd Trimester	39 (39)	146 (48.67)	185 (46.25)
	3rd Trimester	12 (12)	20 (6.67)	32 (8)
Number of doctor visits	0	21 (21)	22 (7.3)	43 (10.75)
	1 – 3	29 (29)	69 (23)	98 (24.5)
	3 – 6	43 (43)	144 (48)	187 (46.75)
	> 6	7 (7)	65 (21.67)	72 (18)
Iron and Folic Acid intake	Yes	86 (86)	282 (94)	368 (92)
	No	14 (14)	18 (6)	32 (8)
Folic Acid intake	Yes	5 (5)	47 (15.67)	52 (13)
	No	95 (95)	253 (84.33)	348 (87)
Ultrasonography	Yes	22 (22)	113 (37.67)	135 (33.75)
	No	78 (78)	187 (62.33)	265 (66.25)
Sex of the index child	Males	50 (50)	193 (64.33)	243 (60.75)
	Females	50 (50)	107 (35.67)	157 (39.25)
Birth Order	First BO	33 (33)	106 (35.33)	139 (34.75)
	2 – 3 BO	45 (45)	165 (55)	210 (52.5)
	> 3 BO	22 (22)	29 (9.67)	51 (12.75)
Complications during pregnancy		73 (73)	139 (46.33)	212 (53)
Anaemia		58 (73.4)*	99 (35.6)	157 (44)
Pregnancy Induced Hypertension		15 (19)*	33 (11.9)	48 (13.4)
Gestational Diabetes Mellitus		1 (1.5)**	10 (3.9)	11 (3.5)

Antepartum Haemorrhage	5 (5)	8 (2.67)	13 (3.25)

* Total Number = 357 Cases = 79 Controls = 278
** Total Number = 312 Cases = 58 Controls = 254

Majority of the births (61.8%) took place at home with the assistance of a trained or untrained birth attendant (Table 3). There was one spontaneous delivery where in the woman gave birth to her child prematurely. 90% of the deliveries were normal or assisted with the help of vacuum or forceps. 60.8% of the index cases were males, while 39.2% were female children. 2.5% of the all the index cases had some form of malpresentation. 28.5% of all the index cases were preterm births i.e. births which occurred before 37 completed weeks while, 71.5% were term births. 30.36% of the neonates born had a birth weight of less than 2500 grams.

Of all the cases, 45% were neonatal deaths while 55% comprised of stillbirths or intra-uterine deaths. Early neonatal deaths (deaths in the first week of life) contributed to 77.78% of all the neonatal deaths. Out of the 45 neonatal deaths, 44.44% were attributable to asphyxia, 11.11% to meconium aspiration, 8.89% to malformations (esophageal atresia, hydrocephalus, meningomylocele), 17.78% to pneumonia, 4.44% to jaundice, 13.33 to other causes (hypothermia, aspirations). Out of the 55 stillbirths, 5 (9.09%) had some form of congenital malformation (anancephaly, meningomylocele). In all, malformations (neural tube defects) contributed to 12% of all the deaths. Other causes of stillbirths included prolonged labour, cephalo-pelvic disproportion leading to obstructed labour.

Table 3. Characteristics of the index case

Variable		Cases	Controls	Total
Total		100 (100)	300 (100)	400 (100)
Place of Delivery	Hospital	27 (27)	126 (8.67)	153 (38.25)
	Home	73 (73)	174 (58)	247 (61.75)
Delivery Conducted by	Doctor	26 (26)	122 (40.67)	148 (37)
	Nurse/ANM/TBA	24 (24)	152 (50.67)	176 (44)
	Untrained Dai	49 (49)	26 (8.67)	75 (18.75)
	Spontaneous Delivery	1 (1)	0	1 (0.25)

Type of Delivery	Normal Delivery	93 (93)	258 (86)	351 (87.75)
	Caesarian - section	7 (7)	33 (11)	40 (10)
	Instrument assisted	0	9 (3)	9 (2.25)
Birth weight	< 2500 Grams	55 (64.7)*	61 (20.54)*	116 (30.36)*
	> 2500 Grams	30 (35.29)*	236 (79.46)*	266 (69.64)*
Gestational age	< 37 completed weeks	49 (49)	65 (21.67)	114 (28.5)
	> 37 weeks	51 (51)	235 (78.33)	286 (71.5)

Neonatal deaths	Total	45
	Early Neonatal Deaths	35
	Late Neonatal Deaths	10

Cause of Neonatal Deaths	Asphyxia	44.44%
	Meconium Aspiration	11.11%
	Malformation	08.89%
	Pneumonia	17.78%
	Jaundice	04.44%
	Others: Prematurity, Aspiration, Hypothermia	13.33%
Still Births		55
Cause of Still Births	Neural Tube defects	09.09%

* Total birth weights taken = 382 ; Cases = 85 ; Controls = 297

Risk Factor Analysis

Social Determinants

Caste : Compared to the forward caste, the scheduled caste/ tribe and backward caste had an increased risk of stillbirth and neonatal mortality, among the study population. The odds of having a neonatal or perinatal death in the scheduled caste/ tribe and backward caste were 3.41 times higher than in the forward caste. (95% confidence interval: 2.14-6.90)

Socio-economic-status : A socioeconomic index was created by adding 10 components: caste (Schedule caste/Tribe, Backward Caste, Forward Caste), 7 assets (TV, Fridge, Phone, Two wheeler, car, housing (kucha, pucca, mixed) and land owned) and literacy of the parents. Assets were given a score of one each. SC/ST was given a score of 1, backward caste 2, and forward caste a score of 3. Similarly, kucha, mixed and pucca houses were given a score of 1, 2 and 3 respectively. All these components were added and a comprehensive scoring pattern was formed with a minimum of 2 and maximum score of 15 where a larger score indicated a higher socioeconomic status. The entire study population was classified as tertiles and calculations were made keeping the highest SES group as the comparison group. Group 1 consisted of those households who had a score of 2–6, group 2 had a score of 7–9 and group 3 comprised of those households who scored more than 9. The difference in mortality across the social and economic status was observed to be statistically significant (Table 4). Households in the lowest SES group had 5.13 times higher chances of having a NN or PN death as compared to those in the highest SES group.

Table 4. Socioeconomic differentials in PN and NNM

SES Group	Unmatched OR	Matched OR	95% CL for Matched OR
Lowest	9.16	5.13	2.96-16.41
Middle	3.65	2.78	1.35-6.13
Highest	1.00		

***Literacy* :**

The father and mother's literacy had impact on the survival of the perinate/ neonate. The odds of having a neonatal death is 3.44 times in a family wherein the father is illiterate than in a family where the father is literate. (95% CL: 1.67–7.72) Similarly, mother's literacy has an effect on the survival of the infant. The odds of having a death in a family where the mother was illiterate was 4.04 times than in a family where the mother was literate. (95% CL: 2.40–7.42)

***Education* :**

Perinatal and neonatal mortality declined with increasing educational level of the father. In the table given below (table 5), level of the father's education was taken as a risk factor. Group 1 comprised of those who have had education less than class 6, group 2 consisted of those who had studied from class 6–10 and group 3 consisted of those who had studied higher than class 10. The calculations are based on tertiles.

Table 5. Effect of father's education on PN and NNM

Father's Education	Unmatched OR	Matched OR	95% CL for Matched OR
< Class 6	13.88	7.47	2.32-22.31
Class 6-10	3.67	2.75	1.36-5.53
> Class 10	1.00		

Similarly, mother's education was classified into 3 groups based on tertiles. Group 1 comprised of those who had studied till class 5; group 2, those who had studied from class 5–8 and group 3 comprised of those who had attained higher education than class 8. Mothers with an educational level less than class 5 had a 3.05 times increased risk of having a PN/NNM as compared to those with a higher level of education.

Occupation : The type of occupation held by the father was analyzed as a possible factor determining PN and NNM. Occupations were classified into 4 broad categories.

Here, the occupational group of unskilled labourers was taken as constant for calculating odds ratio. Every occupational group had a protective effect towards perinates and neonates compared to unskilled labourers (Table 6).

Table 6. Effect of father's occupation on PN and NNM

Occupation Groups	Unmatched OR	Matched OR	95% CL for Matched OR
Professionals / Self employed	0.25	0.33	0.14-0.64

Salaried	0.28	0.33	0.14-0.81
Skilled labourers	0.19	0.30	0.09-0.88
Unskilled labourers	1.00		

Housing and household size : Housing of families was classified as kucha, mixed and pucca. The difference in the type of housing did not seem to have any significant effect on the mortality. However, families who lived in a mixed house had 1.9 times higher chance of having a PN/ NNM as compared to those who lived in a pucca house. (95% CL: 1.06–3.60) (Table 7). Families were classified according to the household size as having less than 5 members, 5–7 members and more than 7 members, based on tertiles. Families with less than 5 members in the household had higher odds of PN and NNM than families who had more than 7 members in the household. (OR: 1.83, 95% CL: 1.01–3.85)

Sex of the Index Child : Perinatal and neonatal mortality was found to be much higher among the girl child as compared to boys. Girls had a 1.84 fold increase in mortality. (95% CI: 0.29–0.73)

Type of family, religion of the household, amount of land owned did not have any effect on perinatal and neonatal mortality.

Table 7. Social determinants for PN and NNM

Variable		Unmatched OR	Matched OR	95% CL for Matched OR
Caste	SC/ST/ BC	4.48	3.41	2.14-6.90
	Forward	1.00	1.00	
SES	Low	1.00	1.00	
	Middle	3.65	2.78	1.35-6.13
	High	9.16	5.13	2.96-16.41
Father's Literacy		5.50	3.44	1.67-7.70
Mother's Literacy		6.47	4.04	2.32-7.70
Father's education	< Class 6	13.88	7.47	2.32-22.31
	Class 6-10	3.67	2.75	1.3-5.86
	> Class 10	1.00	1.00	
Mother's education	< Class 5	5.06	3.05	1.21-8.47
	Class 5-8	4.01	2.38	1.05-7.49

	> Class 8	1.00	1.00	
Occupation	Professionals	0.25	0.33	0.14-0.64
	Salaried	0.28	0.33	0.14-0.80
	Skilled	0.19	0.30	0.09-0.88
	Unskilled	1.00	1.00	
Housing	Kucha	3.50	1.90	0.37–11.56
	Mixed	2.13	1.90	1.06–3.6
	Pucca	1.00	1.00	
Household Size	< 5	2.17	1.80	1.01–3.85
	5 - 7	1.30	1.20	0.50–2.90
	> 7	1.00	1.00	

Biomedical determinants

Age at pregnancy : Women were divided into 3 age groups based on tertiles (Table 8). Group 1 had women less than 23 years of age; group 2 had women between the ages 23–26 and group 3 had women above the age of 26 years. Maternal age above 26 years was observed to be a risk factor with the odds of 2.01 as compared maternal age less than 23 years. (95% CL: 1.07–3.94)

Birth Order : Birth order was grouped as first birth order, birth order of 2–3 and a birth order higher than 3. No significant difference was observed between groups 1 and 2. However, there was a difference between groups 1 and 3. Being born as the first child into a family seemed to have a protective effect on PN and NNM as compared to a birth order higher than 3. (OR: 0.4, 95% CL: 0.18–0.96)

Intake of iron and folic acid tablets : Not consuming iron and folic acid tablets during pregnancy was found to be a risk factor for stillbirths and neonatal mortality. The women who did not take iron and folic acid tablets during the course of their pregnancy had a 2.85 times higher risk of perinatal and neonatal mortality as compared to those who consumed these tablets during pregnancy. (95% CL: 1.15–6.38). Similarly, not taking folic acid during the first trimester had a detrimental effect on PN and NNM with odds ratio of 5.18. (95% CL: 1.59–15.80) Intake of other drugs like calcium, multi vitamin tablets, etc, did not have any effect towards the outcome of pregnancy. (P value: 0.401)

History of Abortions : The risk of stillbirth and neonatal mortality increased 2.17 times if there was a previous history of abortion. (P value: 0.005, 95% CL: 1.26–3.96.)

Complications during pregnancy : Complications included anemia, discharge per vaginum (more than 24 hours), pregnancy induced hypertension, gestational diabetes mellitus, antepartum hemorrhage and other conditions. It was observed that mothers with a complication during pregnancy had a 3.13 times higher chance of having a PN/ NNM as compared to those mothers who had an event free pregnancy. (95% CL: 1.88–5.55) Having hemoglobin more than 10 had a protective effect in pregnancy. (Matched OR: 0.35; 95% CL: 0.27–0.82)

Place of the delivery : Deliveries that took place at home had a 2.17 fold increased risk as compared to those deliveries, which took place in a hospital. (95% CL: 1.21-3.7)

Delivery conducted by : This was classified on the basis of who conducted the delivery, irrespective of the place of delivery. Group 1 consisted of those deliveries, which were conducted by doctors; group 2: deliveries conducted by a trained birth attendant and group 3 comprised of those deliveries taken by untrained dais. Calculations were made taking group 3 as constant. Refer (Table 9) for results.

Table 8. Biomedical determinants for PN and NNM

Variable		Unmatched OR	Matched OR	95% CL for Matched OR
Age at pregnancy	< 23 years	1.00	1.00	
	23 to 26 years	1.91	1.64	0.84 – 3.38
	> 26 years	2.54	2.01	1.07-3.99
Intake of Iron and Folic Acid		3.80	2.60	1.20-6.90
Intake of Folic Acid		5.20	4.50	1.60-15.8
Abortions		2.60	2.20	1.26-3.96
Complications During Pregnancy		3.71	3.20	1.90-5.51
Birth Order	1	1.00	1.00	
	2 - 3	4.70	2.51	1.04-5.50
	> 3	4.40	2.70	1.30-6.30
Delivery taken by	Doctor	0.04	0.10	0.04-0.28
	TBA	0.01	0.05	0.01-0.14

	Dai (untrained)	1.00	1.00	
Place of Delivery	Home	2.30	2.20	1.30-3.70
	Hospital	1.00	1.00	
Gestational Age	< 37 weeks	4.95	3.73	2.13-6.4
	> 37 weeks	1.00	1.00	
Birth Weight	< 2500 gms	13.54	8.74	4.7-15.57
	> 2500 gms	1.00	1.00	

Table 9. Differentials in PN and NNM by who conducted the delivery

Group	Unmatched OR	Matched OR	95% CL for Matched OR
Doctors	0.04	0.10	0.01-0.28
Trained Birth Attendants	0.01	0.05	0.01-0.14
Untrained attendants	1.00	1.00	

Gestational age : Births were classified based on gestational age. Preterm births were defined as those, which had not completed 37 weeks, while term births were those that had completed 37 weeks of gestation. Preterm birth was found to be a risk factor for PM/ NNM with an OR of 3.73 (95% CL: 2.13-6.4) (Table 10).

Birth weight : All the births were categorized according to the birth weight. Group 1 comprised of those with a birth weight of less than 2500 grams (low birth weights) and more than 2500 grams. Low births were found to be at a higher risk of dying as compared to those with a birth weight of more than 2500 grams.

Table 10. Effect of Gestational age and Birth weight on PN and NNM

Variable	Unmatched OR	Matched OR	95% CL for Matched OR
Preterms	4.95	3.73	2.13 – 6.40
Low Birth Weights	8.59	6.38	3.49 – 12.32

There was no significant increase in stillbirths and neonatal deaths based upon the

consumption of other drugs, number of visits to a doctor, time of registration or Ultrasonography.

Multivariate Analysis

Conditional multivariate logistic regression was done relating case-control status on variables namely, socio- economic status of the family, maternal age, birth order, by whom the delivery was conducted, birth weight, iron and folic acid consumption by the mother during the antenatal period and gestational age of the children. There was a significant association between socioeconomic status and stillbirths/ neonatal mortality when adjusted for all the other variables. In this study population, stillbirths and neonatal mortality was about 9 times higher in the lowest SES as compared to the highest SES (Table 11). Maternal age of less than 23 years was found to be protective as compared to maternal age more than 23 years of age. Gestational age and birth weight of the child had an association with PN and NNM. The PN and NNM was 4.27 times higher in neonates with a birth weight of less than 2500 grams as compared to those who a birth weight higher than 2500 grams, when adjusted for other variables. Preterm children too, had a 3.82 times higher chance of PN/ NNM compared to term births, when adjusted for other variables. The person who conducted the delivery had an impact on the outcome of pregnancy. Delivery conducted by an untrained birth attendant had a 4.67 times higher mortality as compared to one conducted by a doctor. Birth order of the child, when adjusted for other variables, was not found to be a significant risk factor that determined perinatal and neonatal mortality.

Table 11. Risk factor analysis for PN and NNM

Variable	Matched OR	95% CL for Matched OR
Age at Pregnancy		
Less than 23 yrs	1.00	
23 – 26 yrs	1.72	0.87 - 4.22
More than 26 yrs	6.49	1.79 - 23.81
Birth Weight		
Low Birth Weights	4.27	9.01 - 20.20
More than 2500 grams	1.00	

Delivery Conducted By		
Doctor	1.00	
Trained Birth Attendant	1.80	0.70 - 4.61
Untrained Attendant	4.67	1.55 - 14.07
Iron and Folic Acid		
Iron & Folic acid consumed	1.00	
Iron and Folic acid not consumed	1.26	0.28 - 5.77
Gestation		
Preterms Births	3.81	1.59 - 9.09
Term Births B		
Birth Order		
1	1.00	
2-3	0.70	0.27-1.78
>3	2.53	0.59-10.92
Socio Economic Status		
Lowest SES	8.85	2.70-29.4
Middle SES	4.17	1.39-12.5
Highest SES	1.00	

Discussion

The results indicate that several factors are significantly associated with increased risk of stillbirths and neonatal deaths. Low socio economic status and caste of the household, lower level of education of the parents, low birth weight, preterm births, higher birth order, history of abortions and child deaths, non-consumption of iron and folic acid tablets during the antenatal period, complications during pregnancy, all appeared to increase the risk of perinatal and neonatal mortality.

A strong inverse association between socioeconomic status and the probability that a perinate/ neonate would not survive the first 28 days of life was observed. The study suggested a 9-fold increase in the risk of stillbirths and neonatal mortality for households with the lowest SES compared with the highest. Low SES is a well-established risk factor

for perinatal and neonatal mortality.[14, 20, 26, 27, 42] Numerous studies have been done world wide to prove this association, however, none could explain why social differences increase perinatal and neonatal mortality.

Children born to illiterate were found to have a four fold higher chance of dying as compared to children born to literate mothers. A higher level of paternal and maternal education was found to be protective towards the health of the neonate. Though many studies have shown results wherein mother's education played a crucial role in determining the pregnancy outcome[20, 22, 28,] not many studies have shown the effect of father's education and occupation. In the present study, a higher level of education of the father and an occupation with a steady source of income was found to protect against perinatal and neonatal mortality. This can be explained by the fact that unskilled labourers work as daily wagers, and hence do not have job security and a steady source of income. Obstetric care cost is an important barrier for many economically deprived families to seek health interventions. A more detailed study on how social factors affect mortality could help to elucidate the mechanism by which risk is increased.

The female child was found to have a higher risk of mortality as compared to the male child in the perinatal and neonatal period. This is contradictory to the medical belief that the male child is more susceptible to mortality in the first year of life.[13, 32] This gender bias is consistent with the findings of National Family Health Survey–II, wherein they found higher mortality levels for the female child when compared to the male child in Punjab. This finding is further validated by the gender differentials in child mortality as established by Das Gupta in her study.[48]

Biomedical factors like lower birth order, regular consumption of iron and folic acid tablets, delivery conducted by a trained personnel and delivery taken in a hospital were found to be protective. Literature on place of delivery as a risk factor for perinatal and neonatal mortality is consistent with the findings of this study.[29] Delivery taken at home by an untrained birth attendant had a 9 times increased risk of perinatal and neonatal mortality as compared to one taken by a doctor. Historically, skilled care at delivery has been associated with lower neonatal death rates.[43] Skilled attendants at birth are defined as "people with midwifery skills (e.g., doctors, midwives and nurses) who have been trained to proficiency in the skills to manage normal deliveries, and diagnose and manage or refer complicated cases." This finding emphasizes that skilled assistance in delivery is a must[44].

Low birth weight and preterm births were associated with an increased risk of perinatal and neonatal mortality, which is in accordance to previous findings.[31, 36, 45] One way to prevent mortality in preterms is to ensure that the delivery takes place in a hospital equipped to handle preterm births. Low birth weight is one of the principal contributors to neonatal

morbidity and mortality worldwide. Newborns who get off to an unhealthy start, especially low birth weight and preterm babies, are particularly vulnerable to illness and death during their first year. Like preterm babies, low birth weight babies need special care, particularly with regard to warmth, feeding, hygiene practices, and prompt recognition of the warning signs of infection.

Though consumption of iron and folic acid tablets was found to be protective in univariate analysis, when adjusted for other variables, it lost its protective effect. However, the number of stillbirths and neonatal deaths associated with lethal malformations especially neural tube defects accounted for a substantial portion of mortality (12%) in this study. This could be associated with low folic acid consumption during the first trimester. Several observational studies and 2 randomized controlled trials have reported that more than 50% neural tube defects can be prevented if women consume a folic acid-containing supplement before and during the first trimester of pregnancy.[46, 47]

Previous histories of abortions or child death were found to be risk factors for adverse pregnancy outcome. This finding is consistent with other studies conducted on parity specific perinatal mortality.[24, 36]

In developing countries, where 96% of the global burden of neonatal deaths occurs, neonatal care is practically non-existent.[9] In a country like India, wherein a lot of deliveries take place at home, there is a pertinent need for a package dealing in home based neonatal care. Interventions such as essential newborn care are available, however, correctly implementing them could result in a rapid reduction in perinatal and neonatal mortality rates. Emergency obstetric care and essential newborn care, the two golden principles highlighted in the National Health Policy, 1983, need to be strengthened and reemphasized upon. A model project for neonatal care and management of sepsis has been developed in Gadchiroli District of Maharashtra. The goal to reduce NNM and PNM is achievable, but much is left to be desired. Perinates and neonates are a vulnerable group, if cared for, can bring down the infant mortality tremendously. Simple measures like health education, proper antenatal care, institutional delivery and home based neonatal care can go a long way to improve the present scenario.

Conclusion

The causes attributable to perinatal and neonatal mortality comprised of various social and medical factors. Socially and economically marginalized households were at a higher risk of having a perinatal/ neonatal death. A higher educational level of the parents and an

occupation with a steady source of income was found to be protective for the survival of the neonate. Among the various biomedical factors, higher maternal age, previous history of abortions and child deaths in the family, untrained birth attendant, preterms and low birth weights had a higher chance of mortality.

Since this study was conducted in field practice areas of medical colleges, all the households were registered; hence no household was missed during the selection of cases and controls. Since all the antenatal events were noted in family folders, the problem of recall bias was taken care of. It is difficult to extrapolate this result to the villages of Punjab who would not have medical care to such a level as present in this area. However, if this is the state of health care in areas with medical facilities, it is frightening to imagine the level of health care in remote villages.

A neonate's chance of survival begins well before birth, with the socio-economic status of the family, health and nutritional status of the mother and type of delivery. Therefore, a continuum of care beginning before birth should include regular antenatal care and safe delivery, followed by good newborn care practices. In India, more than 60% of infants are born at home. Hence, more knowledge is needed at the community level regarding obstetric care and care for the neonate. Programs are urgently needed for re-education and training of health workers to improve their skills in managing delivery, identification and management of malpresentation and prolonged labor. Most of these neonatal deaths can be prevented with cost-effective solutions that do not depend on highly technical training or sophisticated equipment.

Saving newborn lives requires a paradigm shift. We need to change our focus to the time when most infants die — the perinatal and neonatal period.

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