TRENDS AND DETERMINANTS OF EARLY NEONATAL MORTALITY IN INDIA

Dissertation submitted to Jawaharlal Nehru University
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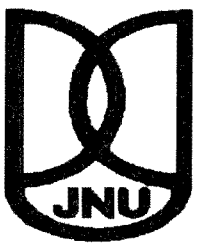
the award of the degree of

MASTER OF PHILOSOPHY

BINOD BIHARI JENA



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DECLARATION

This is to certify that the dissertation entitled **"TRENDS AND DETERMINANTS OF EARLY NEONATAL MORTALITY IN INDIA"** is my bonafide work for the degree of **MASTER OF PHILOSOPHY** and may be placed before the examiners for evaluation.

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FORWARDED BY

We recommend that the dissertation be placed before the examiners for evaluation.

July 19, 2011

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DEDICATED TO

MY PARENTS AND TEACHERS

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ABBREVIATIONS

ENMR	Early Neonatal Mortality Rate
LNMR	Late Neonatal Mortality Rate
IMR	Infant Mortality Rate
NMR	Neonatal Mortality Rate
PNMR	Post neonatal Mortality Rate
PMR	Peri-natal Mortality Rate
NFHS	National Family Health Survey
SBR	Still Birth Rate
SRS	Sample Registration System
EAG	Empowered Action Group
MDG	Millennium Development Goals
CI	Concentration Index
RCH	Reproductive and Child Health
CSSM	Child Survival and Safe Motherhood
ICDS	Integrated Child Development Scheme
ANM	Auxiliary Nurse Mid-wife
MoHFW	Ministry of Health and Family Welfare
IIPS	International Institute for Population Sciences
DHS	Demographic and Health Survey
ANC	Ante Natal Care
BMI	Body Mass Index
OR	Odds Ratio

CHAPTER 1

INTRODUCTION

CHAPTER-1
INTRODUCTION

Mortality is one of the basic components of population change and its study is essential for demographic and public health administration. In demographic transition theory, first decline in mortality which is an important cause of fertility decline in the later stages. The world's overall mortality level which is measured by Crude Death Rate (CDR) has already declined to a lowest level and there is hardly any difference between developed (10) and developing (8) countries (PRB, 2010). But there exists huge differences with respect to other age specific mortality rate indicators such as, Under-five Mortality Rate (U5MR), Infant Mortality Rate (IMR) and its components. Among these mortality indicators IMR is sensitive index as seventy percent of under-five deaths occur within first year of life. Infant mortality rate (IMR) is considered as one of the most important indicators of the health status of a community. As per WHO (1991), it was accepted as a global indicator of the state of public health and environmental sanitation of a community and its importance becomes more as it affects the desired family size. It is also one of the components of United Nations Human Development Index. In 2009, 5.75 million children across the world died before their first birthday. Most of these children lived in developing countries and died from a disease or a combination of diseases that could easily have been prevented or treated (UNICEF, 2010).

The reduction of under-five and infant mortality rate by two-thirds between 1990 and 2015 are two important targets of the Millennium Development Goal-4 of child survival (MDG, 2000). Therefore, the two indicators of child mortality become common while measuring progress in child wellbeing in any country. However, the rate of decline in under-five mortality is still grossly insufficient to reach the MDG goal by 2015, particularly in Sub-Saharan Africa and South Asia. It is alarming that among the 64 countries with high mortality rates (40 per 1,000 or more), only 9 are on track to meet MDG-4 (UNICEF, 2010). So, the reduction in infant and child mortality remains a primary concern for most developing countries. While strategies such as immunization, oral rehydration and control of acute respiratory infections have contributed to the decline of deaths among children above one month of age, but, the reduction in neonatal deaths (deaths under four weeks of age) has not been significant. As a result, there is a shifting of mortality to neonatal period which is a serious concern in developing countries and the MDG-4 requires major reductions in neonatal mortality (Lawn, 2005).

1.1: Significance of Early Neonatal Mortality in Neonatal, Infant and Under-five Mortality.

Every year an estimated 4 million babies die in the first 4 weeks of life (the neonatal period); 3 million of these deaths occur in the early neonatal period (WHO 2005, cited in Lawn 2005). "Almost all (99%) neonatal deaths arise in low-income and middle-income countries and remaining 1% of deaths in rich countries. The highest numbers of neonatal deaths are in south-central Asian countries and highest rates are generally in Sub-Saharan Africa" (Lawn, 2005). In proportion, 38 percent (2000 A.D.) of the under-five deaths occur in neonatal period i.e. in first 28 days of life and still it is increasing. "The remaining 62 percent of deaths occur almost over a period of 1800 days. Thus, the average daily mortality rate during the neonatal period is close to 30-fold higher than the post neonatal period. But even within the neonatal period there is considerable variation in the daily risk of deaths with very high risk in the first 24 hours of life after birth" (Lawn, 2005). Globally for the year 2000, three-quarters of the neonatal deaths happen in the first week of life (WHO, 2005) and remaining one-quarter in the late neonatal period (from 2nd week to 4^{th} week). Thus, the average daily mortality rate in the early neonatal period is 9 times higher than in the late neonatal period. The Millennium Development Goal for child survival cannot be met without substantial reductions in neonatal mortality particularly emphasizing the early neonatal deaths (Lawn, 2005).

In India IMR continued to remain high as compared to all developed countries and many of the developing countries. It has declined from 139 in 1972 to 53 in 2008 indicating a reduction of 62 percent. This decline in IMR was mainly because of the substantial reduction of deaths during the post neo-natal and late neonatal period. During this period post-neonatal mortality and late neonatal mortality has declined to 74 percent and 78 percent respectively whereas the early neonatal mortality has been reduced only 23 percent. Currently more than two-thirds (66%) of infant deaths comprised of neonates most of who die within the first week of life i.e. in the early neonatal period (SRS, 2009). The share of early neonatal deaths has been increasing over the years and in the year 2008 it has reached to 77 percent of all neonatal deaths and 51 percent of infant deaths and 39 percent of under-five mortality. In the year 2000, 27 percent of the global neonatal deaths were from India (WHO, 2005). Hence, it is important to focus the crucial first 7 days of life in order to reduce infant mortality rate to the targeted level that will meet India's Millennium Development Goal-4 for child survival.

1.2: Early Neonatal Mortality in International Perspective

Table 1.1 presents the global scenario of early neonatal mortality by world regions and sub-regions of each continent. This is the first global estimates of early neonatal mortality rate for the year 2000 by World Health Organization (WHO, 2006). The table also shows the percentage share of early neonatal mortality to neonatal mortality of some continents and regions. For the year 2000, the world average early neonatal mortality rate was 23 per thousand of live births and its share in neonatal mortality was 75 percent. The early neonatal mortality rate in least developed regions (31) was 8 times more that of the more developed regions (4) and for less developed regions it was 25. The share of early neonatal mortality in neonatal mortality was more in developed regions (79) than less developed regions (75). Of the continents, both North America (4) and Europe (4) were at the lowest level and Africa (31) was at highest followed by Asia (24), Oceania (19), Latin America and Caribbean (12). Even within the same continent there are great variations among sub-regions. In two sub-regions of Africa namely Northern Africa (16) and Southern Africa (17) the rate was low whereas it was high in other three sub-regions such as Western Africa (37), Middle Africa (35) and Eastern Africa (31). In Asia, Eastern Asia (16) was the lowest and South Central Asia was at highest level (32). There were little variations among different sub-regions of both Europe and Latin America and Caribbean, but in Oceania there were great variations. The rate was lowest in Australia/New Zealand (3) and highest in Melanesia (21).

Table 1.2 shows the levels of early neonatal mortality rate among different countries of the world in descending order of magnitude for the year 2000 which is the latest data that are available. Among the countries, Mauritania which is a North African country had the highest rate of early neonatal mortality (52), followed by Liberia (48), Iraq (46), Afghanistan (45), Sierra Leone (42) and Pakistan (38). From the bottom line, Japan and Singapore each had 1, Germany, France and Norway each had 2, UK had 3 and USA had 4 deaths per thousand of live births. In India, the rate was 33, but in most of its neighboring countries the rate was very less. It was 18 in Bhutan, 16 in China, 14 in Indonesia, 9 in Srilanka and 4 in Malaysia.

Table 1.1: Global Estimates of Early Neonatal Mortality Rate by Regions, 2000

Region and Sub Region	Early Neonatal Mortality Rate
World	**23 (75)**
More Developed Regions*	**4 (79)**
Less Developed Regions	**25 (75)**
Least Developed Regions	**31**
AFRICA	**31 (75)**
Eastern Africa	31
Middle Africa	35
Northern Africa	16
Southern Africa	17
Western Africa	37
ASIA*	**24 (75)**
Eastern Asia *	16
South-central Asia	32
South-eastern Asia	15
Western Asia	21
EUROPE	**4**
Eastern Europe	7
Northern Europe	3
Southern Europe	3
Western Europe	2
LATIN AMERICA AND CARIBBEAN	**12 (77)**
Caribbean	14
Central America	11
South America	11
NORTHERN AMERICA	**4**
OCEANIA*	**19 (73)**
Australia/New Zealand	3
Melanesia	21
Micronesia	6
Polynesia	9

Source: Neonatal and Perinatal Mortality: Country, Regional and Global Estimates, WHO, 2006
Note: Figures in bracket are percentage share of ENMR to NMR *: Australia/New Zealand and Japan have been excluded from the regional estimates but are included in the total for developed countries.

Table 1.2: Estimates of Early Neonatal Mortality Rate by Country in the World, 2000

Country	Early Neonatal Mortality Rate
Mauritania	52
Liberia	48
Iraq	46
Afghanistan	45
Sierra Leone	42
Pakistan	38
Ethiopia	38
India	33
Nepal	29
Kazakhstan	29
Bangladesh	27
Bhutan	18
China	16
South Africa	15
Indonesia	14
Brazil	12
Sri Lanka	9
Russia Federation	7
Costa Rica	6
Malaysia	4
Kuwait	4
USA	4
Israel	3
Canada	3
UK	3
Denmark	3
France	2
Norway	2
Germany	2
Singapore	1
Japan	1

Source: Neonatal and Perinatal Mortality: Country, Regional and Global Estimates, WHO, 2006

1.3: Early Neonatal Mortality in Indian Perspective

In India, the Sample Registration System (SRS) provides the annual estimates of early neonatal mortality rate for bigger states (states having population of ten million or above) on a regular basis only from 1995 onwards. Before that the early neonatal mortality rate is calculated from perinatal mortality and still birth rate. For the year 1972, the all India average early neonatal mortality rate was 35 per thousand of live births and for the year 2008 which is the latest data available, the early neonatal mortality rate was 27 per thousand of live births. During the last three and half decades the rate of decline is very slow. The average annual percentage reduction of early neonatal mortality rate was the least (0.6% per annum) compared with late neonatal mortality rate (2.2%) and post neonatal mortality rate (2.0%). Table 1.3 shows a comparative view of the percentage reduction in IMR and its components.

Table 1.4 shows the situation of early neonatal mortality rate in India and its bigger states for the year 2008 which is the latest data available. The average early neonatal mortality rate for India as a whole was 27 per thousand of live births as available and there is variation among bigger states. Among the states Madhya Pradesh had the highest rate of 38, followed by Chhattisgarh (36), Orissa (34) and Uttar Pradesh (33). On the other hand, Kerala had the lowest (5), followed by Tamil Nadu (15), Delhi (15), Maharashtra (19) and Karnataka (20). Comparing the North and South Indian states, it is evident that the rate was higher in Northern states (Uttar Pradesh, Madhya Pradesh, Bihar, Chhattisgarh and Rajasthan) than the Southern states (Kerala, Tamil Nadu, Karnataka, Andhra Pradesh). Northern and Southern division is clear from the Map 1.1. There were also large variations between urban and rural areas in almost all the states.

Table 1.3 : Percentage Reduction of IMR and Its Components in India during 1972-2008

IMR and its Components	Year		% Reduction During 1972-2008	Average Annual Reduction
	1972	2008		
Infant Mortality Rate	139	53	62	1.7
Post Neonatal Mortality Rate	68	18	74	2.0
Neonatal mortality Rate	72	35	51	1.4
Late Neonatal Mortality Rate	37	8	78	2.2
Early Neonatal Mortality Rate	35	27	23	0.6

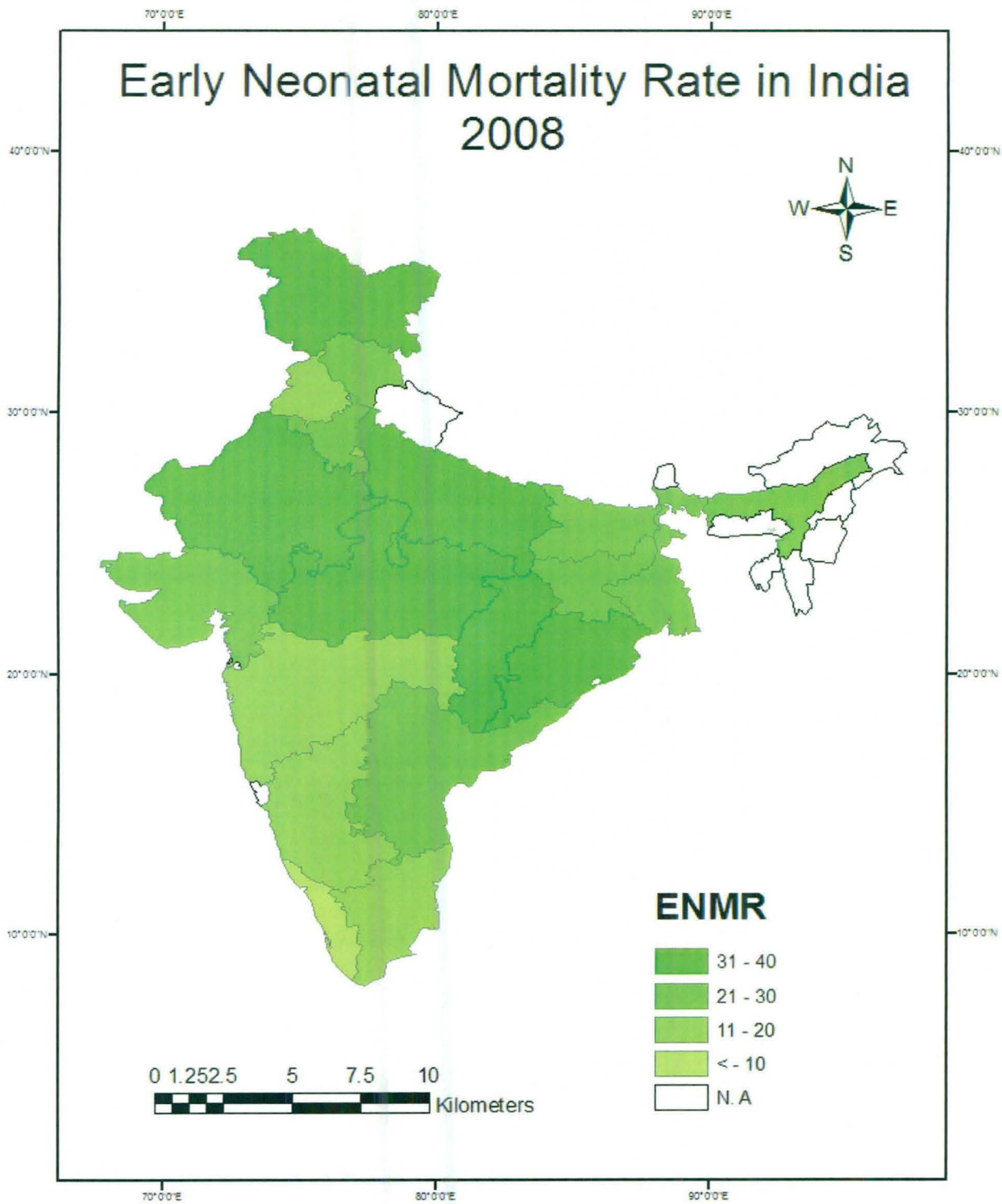
Source: Sample Registration System, Registrar General of India, 1972-2008

Table 1.4: Early Neonatal Mortality Rate in India and its Bigger States, 2008

India and Bigger State	Early Neonatal Mortality Rate
India	**27**
Madhya Pradesh	38
Chhattisgarh	36
Orissa	34
Uttar Pradesh	33
Rajasthan	33
Jammu & Kashmir	33
Gujarat	30
Assam	27
Bihar	27
Himachal Pradesh	27
Andhra Pradesh	26
Jharkhand	24
Haryana	24
West Bengal	21
Punjab	20
Karnataka	20
Maharashtra	19
Delhi	15
Tamil Nadu	15
Kerala	5

Source: Sample Registration System: Registrar General of India, 2009

Map 1.1



Source: SRS, Registrar General of India, 2009

1.4: An Overview of Child Health Programs in India

The government of India has launched several programmes on child and maternal health since first-five plan in order to reduce the high rate of child and maternal mortality. During the fifth five year plan (1974-79), there was an integration of family planning services with maternal and child health services and nutrition services which were introduced as a part of the Minimum Needs Program. The primary objective of the program was to provide basic health services to vulnerable groups of pregnant women, lactating mothers and preschool children. Then in the year 1976 the Department of Women and Child Development within the Ministry of Human Resource Development initiated the Integrated Child Development Services (ICDS). Under this program, anganwadi centers provide health, nutrition, and education services to the children from birth to six years of age and a nutritional and health services to pregnant and breastfeeding mothers (NFHS-3, IIPS, 2005-06).

In 1977 the family planning was changed into Family welfare programme with Maternal and Child Health becoming an integral part with the vision that reduction in birth rate has a direct relationship with reduction in infant and child mortality. Then in 1978 the diarrhoeal disease control programme was started in the country to prevent death due to dehydration caused by diarrheal diseases among children below 5 years of age. Under the RCH programme ORS is supplied in the kits to all sub-centres in the country every year to prevent diarrhoeal diseases. The 1983 National Health Policy envisioned significant reduction in infant mortality rates; neonatal mortality rate and child mortality rate by 2000 and all the child health programmes are directed towards achieving these goals (MoHFW, 1997).

The Universal Immunization Programme was introduced in the country in a phased manner in 1985, which covered the whole of India by 1990 to immunise infants against six preventable diseases, namely, diphtheria, pertusis, childhood tuberculosis, poliomyelitis, measles and neonatal tetanus reduces infant mortality to a considerable amount. This Universal Immunization Programme (UIP) becomes a part of the Child Survival and Safe Motherhood (CSSM) Programme in 1992 and Reproductive and Child Health (RCH) Programme in 1997. The Acute Respiratory Infection (ARI) Control Programme was started in India in 1990. It sought to introduce scientific protocols for case management of pneumonia with co-trimoxazole. The Child Survival and Safe Motherhood Programme jointly funded by World Bank and UNICEF were started in 1992-93 for implementation up to

1997-98. The Program was implemented in a phased manner covering all the districts of the country by the year 1996-97. The objectives of the programmes were to improve the health status of infants, child and maternal morbidity and mortality. The Programme yielded notable success in improving the health status of pregnant women, infants and children and also making an effect on infant mortality rate and maternal mortality ratio and incidence of vaccine preventable diseases (MoHFW, 1997).

The Government of India during 1997-98 launched the RCH Program by integrating Child Survival and Safe Motherhood (CSSM) Program with other reproductive and child health (RCH) services in order to improve the health status of women and children and fulfill the unmet need for family welfare services in the country, especially the poor and under served by reducing infant, child and maternal mortality and morbidity. During the Reproductive and Child Health (RCH)-I Program, an essential newborn care package was also incorporated for training at all levels. The second phase of RCH program i.e. RCH–II has been commenced from 1st April, 2005 and the main objective of the program is to bring about a change in mainly three critical health indicators i.e. reducing total fertility rate, infant mortality rate and maternal mortality rate with a view to realizing the outcomes envisioned in the Millennium Development Goals, the National Population Policy 2000, and the Tenth Plan Document, the National Health Policy 2002 and Vision 2020 India. Millennium Development Goals have set the target to reduce under-five mortality rate and infant mortality rate by two-thirds, between 1990 and 2015. Under the goal of improving maternal health, it has set the target to reduce the maternal mortality ratio between 1990 and 2015 and universal access to reproductive health such as contraceptive prevalence rate, adolescent birth rate, antenatal care coverage and unmet need for family planning (MDG, 2000).

The National Rural Health Mission which was launched in 2005 for a period of seven years, also includes RCH-II, disease control programmes and integration with nutrition, water and sanitation in an effort to provide universal access to equitable, affordable, and quality health care services such as women's health, child health with an aims to reduce child and maternal mortality, prevention and control of communicable and non-communicable diseases, including locally endemic diseases, promotion of healthy life styles as well as to stabilize population growth. Under the NRHM, the Integrated Management of Neonatal and Childhood Illness (IMNCI) program was also implemented to address high neonatal death rates, along with stagnating IMR and under-five mortality. The program aims to improve

child survival by extending the intervention services in homes, communities and health care system. It will focus specifically the management of acute respiratory infections (ARI), diarrhea, measles, malaria and malnutrition, which are the main causes of childhood deaths in India. Further for the first time under NRHM a new programme called 'Navjat Sishu Suraksha Karyakram' was launched on September 15, 2009 to focus the management of newborns in order to reduce neonatal mortality. The programme aims to train health care providers on basic newborn care and resuscitation technique and to create newborn care units at district level hospitals, stabilization units at CHC level and newborn corners at PHC level to provide specialized care to newborns, skill development of ASHAs and skilled birth attendants to ensure home-based newborn and child care (MoHFW, GOI, 2009). All these programs have been able to reduce under-five mortality, infant mortality, post neonatal and late neonatal motility to a considerable amount but not much in first week's deaths which now needs special attention and should be addressed by launching more newborn care programs with strengthening the existing one.

1.5: Statement of the Problem

In order to achieve the Millennium Development Goal-4 of child survival, India needs to reduce its under-five mortality rate by two-thirds, between 1990 and 2015. But according to 2010 MDG evaluation report it is not possible for India to achieve the goal because both under-five and infant mortality rate continued to remain high as the rate of reduction is very slow. The report particularly emphasizes the need for the reduction in early neonatal deaths since it constitutes more than 51 percent of total number of infant deaths in 2008 (WNTA, 2010). From the preliminary analysis it is evident that in India during the last three and half decades the reduction in the post neonatal (74%) and late neonatal mortality rate (78%) was much higher than early neonatal mortality rate (23%). In absolute terms the late neonatal mortality rate has reached to a lowest level (8 per thousand of live births) whereas the early neonatal mortality is still at a high level (27 per thousand of live births). Currently a large portion (66%) of infant deaths occurred in neonatal period and again majority of neonatal deaths (77%) comes from early neonatal period (SRS, 2009). Therefore, a faster rate of reduction in infant mortality rate can only be possible through a higher rate of reduction in early neonatal mortality rate.

Earlier studies show that the reduction of early neonatal deaths remains challenging "because it is predominantly caused by biological and genetic factors and it can be little influenced by public health measures" (Achyut et al., 1997). Other studies show that along with biological factors, socio-economic, cultural, environmental, demographic factors and factors related to pregnancy and delivery significantly impact on the survival newborns during early neonatal period. According to recent studies the major causes of death during this period are severe infections, asphyxia and trauma, problems related to low birth weight (such as hypothermia, respiratory and feeding problems) and malformations and most of these problems occur due to inadequate care during the antenatal period and during labor (Lawn et al., 2005 and UNICEF, 2006). In India where most the births taken place in home, deaths occur in home that can be prevented through cost effective feasible interventions of essential home-based newborn care practices such birth preparedness, hygienic delivery, umbilical cord care, initiating breastfeeding within one hour of birth, thermal care including skin to skin care, and immediately wiping and keeping the baby warm. In addition to these, providing necessary information on birth preparedness, recognitions of danger sign, educating pregnant women and caretakers about antenatal care, safe delivery practices and home based neonatal care can reduce early neonatal mortality to a large extent (UNICEF, 2006; Kumar et al., 2008).

Hence, there is a need to examine how these factors along with socio-economic and environmental, demographic and biological and programmatic factors affect the survival of newborns during early neonatal period. Studies on socioeconomic inequalities in under-five and infant mortality show that the deaths are not proportionally distributed among poor and non-poor (Wagstaff, 2000; Hosseinpoor, 2006; Joe, 2008; Pradhan, 2010). So, in this context, there is also a need to examine the socio-economic inequalities in early neonatal mortality i.e., how the early neonatal deaths are distributed among the poor and non-poor and which factors contributes largely to these inequalities, so that effective health policies can be formulated to reduce these socio-economic inequalities in early neonatal mortality.

1.6: Objectives of the Study

1. To examine the levels and trends in early neonatal mortality rate.
2. To study the age patterns of mortality in early neonatal period.
3. To examine the factors affecting early neonatal mortality.
4. To study the socio-economic inequalities in early neonatal mortality.

1.7: Hypotheses

1. The chance of survival is higher for newborns whose mothers take full antenatal care compared with taking partially or not at all.
2. The rate of early neonatal mortality is lower for newborns where delivery kits/new blades are used.
3. The probability of dying is more in home deliveries than hospital deliveries.
4. The socio-economic inequality in early neonatal mortality in EAG region is higher than south and other region.
5. Mother's education is the largest contributor to inequality in early neonatal mortality.

1.8: Chapterization of the Study

This dissertation is divided into six chapters. First Chapter includes introduction, statement of the problem, objectives and hypotheses. The Second Chapter includes review of literature. Third Chapter contains conceptual framework, data sources, methodology, data quality and limitations. Fourth Chapter consists of levels and trends in early neonatal mortality rate. Fifth Chapter deals with the determinants and inequalities in early neonatal mortality and the Sixth Chapter contains conclusions and policy recommendations.

CHAPTER 2

REVIEW OF LITERATURE

CHAPTER-2
REVIEW OF LITERATURE

While reviewing the literature on early neonatal mortality it was found that few studies have been conducted exclusively on early neonatal mortality both nationally and internationally. But studies reported in the literature are largely hospital based which focused mainly the causes of early neonatal deaths. These deaths are influenced by biological factors rather than on socio-economic and other risk factors. In addition a large number of studies are on perinatal and neonatal mortality where early neonatal mortality is a part. The causes and determinants of perinatal and neonatal mortality are almost similar (WHO, 2006). In this literature review we focus on various determinants of early neonatal, neonatal and perinatal mortality. These determinants are categorised as demographic and biological, socio-economic and environmental and programmatic and newborn care. Some studies also highlight the causes of death and socio-economic inequality in child mortality.

Demographic and Biological Factors: A hospital based cohort study was undertaken in Caxias do Sul city hospital to study the causes and risk factors of early neonatal mortality. Results show that mother's previous birth history, maternal age > 35 years, gestational age, Apsagar score <7, male child and low birth weight were related to early neonatal deaths (Araujo et al., 2000). A study on determinants of perinatal mortality highlights that perinatal deaths are largely the result of poor maternal health (Korejo, 2007). A study conducted in Dufferin Hospital, Lucknow during the year 1976-77, found that the biological factors -the age of mother at birth, parity, period of gestation, birth weight and sex of the child are significantly associated with perinatal mortality (Saksena and Srivastav, 1980). Repeated study in the same hospital after a decade shows that age of mother, parity, period of gestation, birth weight and sex of the child were significantly correlated with early neonatal mortality (Srivastav, 1992). Children with previous birth interval of less than 18 months and 18-24 months have significantly lower chance of survival in neonatal period compared with children with more than 24-month birth interval. Genetic factors like still birth or spontaneous abortion are also found to be highly significant in explaining neonatal mortality (James and Subramanian, 2004). Mother's demographic factors and child characteristics such as parity, birth interval, size of infant at birth and gestation period have significant impact on the survival of infants in the first week of life (Achyut et al., 1997). Poor maternal health affects perinatal and neonatal mortality (Wassan et al., 2009). Lower maternal age and low birth order had a positive impact on neonate's chance of survival. Preterm and low birth

weight babies and female child have higher chance of dying during the neonatal period. A female child had two times more chance of dying than male child (Joshi, 2003). Twins and babies born to mothers under 15 years of age had greater risk of dying than singletons and babies born to mothers of age 25-29 years (Samms-Vaughan et al., 1990). Maternal malnutrition is indirectly associated with perinatal and neonatal mortality through pregnancy and delivery related complications leading to adverse outcomes of pregnancy. Factors such as preterm delivery and parity have significant association with perinatal and neonatal mortality (Bamji, 2008). The main risk factors of neonatal deaths are maternal anaemia, maternal malnutrition, poor antenatal care, multiparity (Kousar et al., 2010).

Birth weight is the most important determinant of perinatal and infant mortality and the lowest mortality rate in the first week of life are recorded among new born infants weighing 3.5 kg or more. The maternal age range 25-29 is optimal as regards birth weight, the younger mothers give birth to a greater proportion of low-birth weight babies and therefore the reduction of infant and neonatal mortality has centred upon the reduction of the births weight lower than 2500g (Saugstad, 1981). Low birth weight infants (<2500g) are 40 times more likely to die than infants with normal birth weight and infants with a very low birth weight (<1500g) are 200 times more likely to die. Low birth weight babies are at a much higher risk of being born with cerebral palsy, mental retardation, and other sensory and cognitive impairments, compared with infants of normal birth weight (AAP, 2002 cited in Golestan, 2008). Nearly one third of Indian neonates are low birth weight weighing less than 2500gm. Over 70 percent of perinatal deaths, 90 percent of neonatal deaths and 50 percent of infant deaths occur among low birth weight babies (Paul, 1988). The majority (75%) of early neonatal deaths and still births occurred in neonates weighing 1500g or more and the odds of still birth and early neonatal mortality increased among mothers who were single or who did not receive prenatal care, and among premature, low birth weight, or male infants (Engmann et al., 2009). Factors found to be significantly associated with neonatal deaths from univariate analysis are gestational age < 37 weeks, birth weight < 2000g, caesarean sections and sign of pregnancy complication. But from logistic regression gestational age < 37 weeks and caesarean section were the only factors remained significant predictors of neonatal mortality (Jehan et al., 2009). The main risk factors for sepsis are low birth weight and prematurity. Late-premature newborns present 10 times the risk of infection than full term babies (Melamed et al., 2009).

Maternal age below 20 years and above 40 years found to be associated with increased risk of neonatal deaths. Teenage pregnancies and pregnancies in women greater than 40 years and maternal pre-pregnancy BMI of less than 18.5 are associated with preterm delivery and low birth weight. Older women have a higher chance of antenatal complication which contributes to still births. Preterm birth, low birth weight, and gestational age are all recognised as contributors to still births and neonatal deaths. Preterm birth accounts for nearly half of the neonatal mortality in England (Getahun et al., 2007 cited in CEMACH: UK, 2009). History of prior still birth or premature birth, maternal weight less than 45 kg and moderate or severe clinical anaemia were significantly associated with still birth and early neonatal mortality (Mavalanker et al., 1991).

Birth weight and gestational age are associated with risk of early neonatal deaths non-linearly, quadratic and cubic respectively. Birth weight and female babies are the only variables that are negatively associated with neonatal deaths (Zadkarami, 2008). Children of older mothers run a significantly higher risk of foetal mortality, whereas babies of young mothers (including women in their early twenties) run a higher risk of infant mortality (Meulen, 2004). Some risk factors are related to the mother and child. Risk factors for the mother are age, marital status (especially single motherhood), pregnancy history, socioeconomic status, height, ethnic origin, smoking and drinking, fertility treatment, chronic disease and complications during pregnancy and childbirth. For the baby risk factors include pregnancy duration and weight at birth, multiple births, sex, position at birth and congenital abnormalities (Richardus et al., 1998).

Twins have four times higher risk of perinatal mortality than single births (Tas, 1990). Perinatal mortality rate was higher in adolescent age group and in elderly mothers. Premature birth and low birth weight babies are the important causes of perinatal deaths (Dali et al., 2003). Mother's nutritional status at the time of conception, early childbearing, too many closely spaced pregnancies causes to neonatal and still births (WHO, 2006). Low birth weight is one of the major determinants of neonatal survival and it accounted for two-thirds of neonatal deaths (Golestan et al., 2008). Adolescent childbearing causes many adverse outcomes including unwanted, repeated childbearing and increased risks of having low birth weight, preterm births and neonatal mortality (Lee et al., 2007 cited in Golestan, 2008). The demographic and nutritional markers that were significantly associated with perinatal mortality were young maternal age <=18 years and thinness of mother (Kusiako et al., 2000). Among the proximate determinants which directly impact on child survival are maternal

factors such as age, parity, birth interval and nutrient deficiency (Mosley and Chen, 1984). In a framework of perinatal mortality mother's demographic and maternal health and nutrition status affect on child's characteristics at birth and ultimately on perinatal survival (Kikhela, 1989).

Socio-economic and Environment Factors

A population based case control study in the city of Sao Paulo assessed the risk factors for early neonatal mortality. The results show that the risk factors were household head's education (less than 4 years of study), place of residency (slum), number of rooms (one room), mother's union status, presence of domestic violence (Schoeps, 2007). The socio-economic factors associated with early neonatal mortality from a community based study in Himachal Pradesh, India were Hindu religion, mothers belonging from scheduled caste and others, mothers having no education and primary education, living in kutcha and semi-pucca, households having buffaloes and cows, and having no health facility in the village(Aggarwal et al., 2003). Perinatal deaths are largely the result of low socio-economic status (Korejo, 2007). Socio-economic factors significantly associated with perinatal mortality were religion and occupation of father (saksena and Srivastav, 1980). The factors which significantly correlated with early neonatal mortality were religion, family income, father's occupation (Srivastav, 1992). The chance of neonatal death was higher for no educated mothers compared with high school and above educated mothers (James and Subramanian, 2004).

A study on non-biological correlates of early neonatal deaths in India shows that caste and education of mother have significant impact on the survival of newborns in the first week of life (Achyut et al., 1997). A community based case control study in rural Punjab shows that households with higher socioeconomic status and higher level of parental education had a positive impact on neonate's chance of survival. Household with low economic status had five times more chance of dying compared with higher economic status households (Joshi, 2003). The underlying socio-economic causes of neonatal mortality in an urban slum study were poor living conditions, illiteracy, ignorance and poverty (Fernandez et al., 2003). Poor socio-economic conditions play an important role indirectly on early neonatal mortality as it enables people to seek health care services during pregnancy, delivery and post natal care (Galjaart, 2007). Spontaneous preterm delivery and intrapartum related causes (hypertensive disorder) are the most common obstetric events (maternal complications) most likely to contribute to the risk of perinatal deaths in poor and disadvantages population, especially for

delivery occurring outside hospital or health care facilities and prematurity was the main cause of early neonatal deaths (Hany and Guillermo, 2006). Both socio-economic and demographic factors are associated with low birth weight babies (Lia and Sung, 2008). Lower socio-economic status has been shown to influence low birth weight through its various correlates (Hughes and Simpson, 1995). Essential newborn care (neonatal resuscitations, breast feeding, kangaroo care, small baby care and thermoregulation) training deceases early neonatal mortality and its impact are larger in infants without secondary education. The impact of training may be optimised without secondary health care workers who treat women with less formal education (Chomba et al., 2008). Mother's education, types of latrine and electricity have significant association with neonatal mortality (Chowdhury et al., 2010). Eighty four percent of neonatal deaths occurred in the first seven days, half with within first 48 hours. Preterm delivery was involved in three-quarters of neonatal deaths, but was associated with only one third of low birth weight neonates (Yasmin et al., 2001)

Non-white ethnicity has been associated with increased risk of still birth and neonatal death in UK, USA and in Europe. Ethnicity is likely to be associated with other risk factors such as deprivation and it increased the risk of still birth and neonatal deaths. Women with greater level of deprivation are more likely to have a pregnancy outcome of still birth or neonatal deaths. In Wales it was found that those in the most deprived quintile had a 53 percent increased risk of still birth and infant deaths compared with those in the least deprived quintile (Getahun et al., 2007 cited in CEMACH: UK, 2009). Socio-economic factors affect perinatal mortality largely operating through proximate determinants such as maternal nutritional status, antenatal care and complication during delivery (Mavalanker et al., 1991). Mother's education influences survival through changing feeding and care practices, leading to better health seeking behavior and changes the traditional familial relationships (Caldwell, 1979). Low maternal education is associated with increase in neonatal mortality rate (Golestan et al., 2008).

The environment into which a child is born also influences survival. It is important to know about risk factors such as the smoking of parents and unsafe water and sanitation as well as specific neonatal disease and injury factors, such as diarrhea, neonatal sepsis, pneumonia or neonatal jaundice (Kumar et al., 2007). In low income countries environmental risk factors accounts for about one–tenth of the total burden of disease (World Bank, 2001 cited in Mutunga, 2004). Among the 10 identified leading mortality risks in high-mortality

developing countries unsafe water, sanitation and hygiene ranked second, while indoor smoke from solid fuels ranked fourth. About 3 percent of these deaths (1.7 million) are attributable to environmental risk factors and child deaths account for about 90 percent of the total (WHO, 2002 cited in Mutunga, 2004). Women and children are more likely than men to be exposed to indoor air pollution from biomass fuels, because women spend many hours a day indoors near an open fire, often cooking with a child strapped on their backs (Mutunga, 2004). Household's socio-economic and environmental characteristics have significantly different impacts on mortality rates at different ages of the child. The model predicts that a significant number of under five years deaths can be averted by providing access to electricity, improving the education of women, providing sanitation facilities and reducing indoor air pollution (Klaauw and Wang, 2003 cited in Mutunga, 2004). Results from logistic regression show that source of drinking water and sanitation facilities were strong predictors of infant mortality (Malawi and Espo, 2002). Access to municipal water decreases the risk and sanitation is found to have a more pronounced impact on mortality than water (Hala, n. d. cited in Mutunga, 2004). Children's health is affected by environmental conditions and economic status of the household (Timaeus and Lush, 1995 cited in Mutunga, 2004).

Results from China's national survey for children show that use of unclean cooking fuels (wood and coal) significantly reduces the neonatal survival probability in rural areas, access to safe water or sanitation reduces child mortality risks by about 34% in rural areas and higher maternal education levels also reduce child mortality. Female education has strong health externalities where a child living in a neighborhood with more educated mothers has about 50 percent lower mortality risk. Access to safe water/sanitation, and immunization reduce diarrhea incidence in rural areas, while access to modern sanitation facilities (flush toilets) reduces diarrhea prevalence in urban areas, significant linkages between Acute Respiratory Infections incidence and use of unclean cooking fuels are also found (Jacoby and Wang 2003 cited in Mutunga, 2004). A framework which integrates both the social and medical research methods in the study of child survival shows that all the socio-economic factors influences child survival through a common set of proximate variables among which environmental contamination is one (Mosley and Chen, 1984). In a framework of perinatal mortality mother's socio-economic and environmental factors affects on perinatal survival (Kikhela, 1989).

Programmatic and Newborn Care Factors

One of the major causes of newborn deaths is birth asphyxia during which a baby can't take enough oxygen before, during and just after birth. A hospital based study was conducted to know the risk factors of birth asphyxia on neonates. Results show that lack of antenatal care, poor nutritional status, anaemia, ante partum haemorrhage and maternal toxaemia were associated with higher incidence of asphyxia. Hence, improving public health of women with growth and nutrition, early identification of high-risk cases with improved antenatal and perinatal care can decrease such high mortality (Majeed et al., 2007). In an intervention study there was a significant reduction in mortality in low birth weight babies after training the medical and nursing staff about newborn care (Mufti et al., 2006). The risk factors of early neonatal mortality were problems in pregnancy, inadequate or absent prenatal care, previous low birth weight baby, delivery problems and transportation to hospitals, low birth weight and duration of pregnancy. The study highlights the importance of prenatal care, improving access and quality of health services, special care should be given to mothers in recent union or single and living in slums, information on mothers with previous low birth weight babies, have a positive impact in the reduction of early neonatal mortality (Schoeps, 2007).

The predominant immediate cause of early neonatal deaths was birth asphyxia and the mean time for deaths due to this was 30 minutes and as a result hospital cannot be accessed in most of the cases. Hence, advanced training are needed for birth attendants and community volunteers for resuscitation of newborns, skills to administer the recommended antibiotics, community awareness about recognition of danger signs and transporting sick babies, maintain warm chain, equipping and orienting hospital staff for prompt management of neonatal complications, may reduce the early neonatal mortality further (Aggarwal et al., 2003). The determinants of perinatal deaths are lack of health awareness and inadequate care during antepartum, intrapartum and postpartum period (Korejo, 2007). Anemia was the most common risk factor in perinatal mortality. To improve perinatal mortality rate, early antenatal registration and minimum 3 antenatal visits should be aimed. Early referrals to better equipped facilities should be encouraged in potentially high risk patients. Advice should also be given on diet, rest, iron, folic acid and vitamin supplementation (Wassan et al., 2009). Reduction of prenatal mortality needs to locating biologically and socio-economically high risk pregnant women and providing special antenatal and postnatal care (Saksena and Sivastav, 1980). Early neonatal mortality which can be significantly reduced by providing expectant mothers with proper nourishment, antenatal medical care, taking adequate

precautions at the time of delivery and in handling and feeding the child during its first crucial week of life (Srivastava, 1992).

The main risk factors of still birth were lack of antenatal care, untrained birth attendants in abnormal labour, previous still births, abnormal presentation, lack of knowledge and skill among untrained birth attendants of resuscitating the newborn and maternal malnutrition (Shah et al., 1984a). Seventy percent of early neonatal deaths are amenable to interventions through primary health care if based on scientific principle and offered through female community health workers as well as simple techniques for care of the newborn (Shah et al., 1984b). Receiving two or more TT injection and sufficient IFA tablets were found to be negatively related but delivery under medical supervision showed a positive relationship with neonatal mortality. This contradictory result may be that most of the women go for hospital delivery due to some complications and the visited hospital would not been able to save the newborns (James and Subramanian, 2004). A randomised controlled study was conducted in Dhanusha district of Nepal to show the impact of antenatal supplementation with a multiple micronutrient in intervention group and a standard folic acid and iron tablets in control group on the birth weight and gestational age which were the crucial underlying factors of neonatal mortality. The result of the study shows that the impact of multiple micronutrient supplements associated with increased birth weight compared with standard iron and folic acid preparation but, the gestational age was not affected by the multiple supplementations. The mean birth weight was 2733 g in the control group and 2810 in the intervention group, indicating a mean difference of 77 g (95% CI 24-130, p=0.004) (Osrin et al., 2005).

The major causes of neonatal deaths can be prevented or treated with known, highly effective and widely practicable interventions such as improvements in prenatal care (skilled attendance, emergency obstetric care, and simple immediate care for new born babies), delivery and postnatal care (Bassani et al., 2010). Cost-effective interventions could avert an estimated 41-72 percent of neonates worldwide in settings with high neonatal mortality through outreach and family-community care, including health education to improve home-care practices, to create demand for skilled care, and to improve care seeking and utilising antenatal and postnatal care (Darmstadt et al., 2005). Inadequate antenatal care, inappropriate management of antenatal and intrapartum complications, poor hygiene during delivery and the first critical hours after birth and poor quality of newborn care add to the mortality figures. Ensuring their survival does not require expensive technology, but simple preventive measures, and prompt extra care such as newborn - resuscitation when necessary, immediate

breast feeding, warmth, cleanliness, hygienic conditions for delivery and cord care, prevention, early detection and management of major (Gunasekera and Gunasekera, 2000). The Home Based Newborn Care strategy says that even if preterm birth or low birth weight cannot be prevented today, newborn deaths can be reduced by either preventing or treating other morbidities, such as infections, asphyxia or hypothermia, which constitute the major component of the cause of death. Since hospital care is neither available nor acceptable to parents, newborn care should be provided at home by training health workers in the community (SEARCH, Maharashtra, n.d.).

History of abortion and delivery conducted by untrained birth attendants causes higher neonatal mortality (Joshi, 2003). The main factors contributes to neonatal mortality are home deliveries, late recognition of neonatal illness, delay in seeking medical help and inadequate treatment. Hence in order to reduce mortality measures should be focused on health education, antenatal care, promoting institutional deliveries and ensuring quality perinatal care (Fernandez et al., 2003). Lack of proper health care delivery system and inadequate or poorly trained health care service providers are the other major contributors to early neonatal mortality (Galjaart, 2007). Spontaneous preterm delivery and intrapartum related causes (hypertensive disorder) are the most common obstetric events (maternal complications) most likely to contribute to the risk of perinatal deaths in poor and disadvantages population, especially for delivery occurring outside hospital or health care facilities and prematurity was the main cause of early neonatal deaths (Hany and Guillermo, 2006). With the intervention on the home based neonatal care (HBNC) the neonatal mortality decreased from 62 to 25 in the intervention area which was contributed by the reduction of 24 points in early neonatal mortality rate and of 20 points in late neonatal mortality rate (Bang and Reddy, 2005).

Improved care of preterm or low infants can substantially improve survival of neonates. Early postnatal vitamin-A dosing, promotion of early and exclusive breast feeding, hypothermia prevention and management, including skin to skin care may also reduce mortality and morbidity in low birth weight or preterm neonates (William et al., 2006). A recent cluster randomised behavioural intervention study was conducted in some villages of Uttar Pradesh shows that care packages and behaviour education that encouraged improvement in birth preparedness, hygienic delivery, thermal care including skin to skin care, umbilical cord care and breast feeding resulted 54 percent reduction in neonatal deaths in the intervention group compared with control group (Kumar et al., 2008). Inadequate antenatal care (<2 antenatal visit), insufficient use of iron and vitamin supplements (<5 weeks), decrease in dietary intake

during the last trimester and vaginal bleeding during pregnancy were associated with increased risk of still birth and early neonatal deaths (Mavalanker et al., 1991). In order to prevent perinatal mortality regular antenatal care with identification of high risk group and management of complications along with improved neonatal care facilities will help to minimize the high perinatal mortality rate. Regular perinatal death audit is necessary to identify the common and preventable causes of perinatal mortality (Dali et al., 2003).

Neonatal deaths and stillbirths occur from poor maternal health, inadequate care during pregnancy, inappropriate management of complications during pregnancy and delivery, poor hygiene during delivery and the first critical hours after birth, and lack of newborn care such as inadequate cord care, letting the baby stay wet and cold, discarding colostrums and feeding other food (WHO, 2006). Neonatal hypothermia contributes to morbidity and mortality risk among newborns (WHO, 1997). In order to prevent perinatal and neonatal mortality interventions prior to birth needs expanding maternal immunization with tetanus toxoid, including malaria prophylaxis in routine antenatal care visits, and nutritional support for pregnant women to improve birth outcomes. In the early weeks of life, the lives of many neonates could be saved by wider use of resuscitation techniques for asphyxiated infants, proper management of neonatal sepsis and other infections, skin-to-skin Kangaroo Care for preterm infants, and immediate and exclusive breastfeeding for all children. Breastfeeding especially protects against late neonatal deaths that are primarily due to infections such as sepsis, pneumonia, meningitis, umbilical infection, and diarrhea (CHRP, 1999).

Causes of Early Neonatal Deaths

A hospital based cohort study in Brazil shows that the main causes of death were hyaline membrane disease, followed by congenital cardiopaties, extreme preterm and abruption placenta. Though the observed probability of early neonatal mortality was low, but some deaths might have been avoided if better prenatal care, delivery care and newborn care assistance had be provided (Araujo et al., 2000). The predominant underlying causes of early neonatal mortality in a community based survey in Himachal Pradesh were Prematurity (33%), birth asphyxia (24%), low birth weight and neonatal sepsis each at (13%) (Aggarwal et al., 2003). Prematurity and low birth weight was the most important single cause of death accounting for over half of the early neonatal deaths (Srivastava, 1992). Of the causes asphyxia was responsible for 53 percent of the still births followed by unexplained causes (17.8%), prematurity (15.6%), intrauterine growth retardation (4.4%), and congenital

anomaly (4.4%), and others (4.4%) (Shah et al.,1984a). The causes of early neonatal mortality were prematurity and related complications (35%), congenital malformation (23%), sepsis (19%), birth asphyxia (16%) and most of the deaths occurred among babies weighing less than 2500g (Mufti et al., 2006). The underlying causes of early neonatal deaths were low birth weight, feeding problem in newborn, fetal asphyxia during labour, injury, neonatal infections, congenital anomaly, other respiratory problem and others (Shah et al., 1984b).

A study conducted by Registered General of India on the causes of neonatal mortality shows that three causes of death such as prematurity and low birth weight, neonatal infections, and birth asphyxia and birth trauma accounted for 78 percent of all neonatal deaths (Bassani et al., 2010). In neonates the most important causes were preterm birth, birth asphyxia, sepsis and pneumonia (Black et al., 2010). A community based cohort study was done in rural Southern Nepal to find out number of deaths due to birth asphyxia and the risk factors of birth asphyxia. The findings show that birth asphyxia deaths accounted for 30 percent of neonatal mortality and the important risk factors were maternal infections, prematurity, and multiple births and low socio-economic status was also highly associated with birth asphyxia (Lee et al., 2008). The Jamaican Perinatal Survey identifies that 74 percent of neonatal mortality were due to prematurity and intrapatrum asphyxia (Samms-Vaughan et al., 1990). In an urban slum study the primary causes of neonatal mortality are sepsis, perinatal asphyxia and prematurity (Fernandez et al., 2003).

A hospital based study identifies the causes of neonatal deaths are sepsis, birth asphyxia, respiratory distress syndrome, and congenital anomalies (Kousar et al., 2010). Among the causes of death in the early neonatal period, the major causes are low birth-weight, birth asphyxia, bacterial infection and congenital malformation (Chavan, 1992). A study in rural Gadchiroli, Maharashtra, India shows that the primary cause of death were sepsis/pneumonias (52.5%), birth asphyxia (20%), prematurity (15%), hypothermia (2.5%) and other unknown (10%) (Bang, 2005). The main causes of neonatal deaths globally were estimated to be infections (sepsis/pneumonia, tetanus, and diarrhoea, 35%), preterm births (28%) and asphyxia (23%) (Lawn et al., 2006). Early neonatal deaths were strongly associated with birth asphyxia (Mavalanker et al., 1991). Causes of still birth and early neonatal deaths from 7993 pregnancies in six developing countries show that spontaneous preterm delivery and hypertensive disorders were the most common obstetric events leading to perinatal deaths (28.7% and 23.7 respectively). Premature was the main cause of early neonatal deaths (62%) (Ngoc, 2006). Immaturity was the most common cause of perinatal

deaths followed by foetal distress and congenital abnormality (Wassan et al., 2009). The main causes of neonatal mortality among low birth weight babies were respiratory distress (59%), asphyxia (20%), septicemia (12%) and congenital malformation (9%) (Golestan et al., 2008). The most common causes of perinatal mortality from a hospital based study in Tanzania were birth asphyxia (37%) and prematurity (29%). The majority of the perinatal deaths should be avoidable through improved quality of intrapartum care (Kidanto et al., 2006). The major causes of neonatal death are infectious diseases, birth injury, asphyxia and prematurity (CHRP, 1999).

Socio-economic Inequalities in Early neonatal Mortality

A study on health inequality in India using National Family Health Survey-3 data reveals that there exists income-related health inequalities across states but the inequality is concentrated among poor. Among the major states the socio-economic inequality in under-five mortality was greater in Maharashtra, Madhya Pradesh, Gujarat, Tamil Nadu and Punjab than Uttar Pradesh, Rajasthan and Bihar (Joe et al., 2008). Study on socio-economic inequalities in child mortality across nine developing countries shows that the inequalities in infant and under-five mortality favors the better-off and these inequalities vary between countries (Wagstaff, 2000). Result of the decomposition of socio-economic inequality in infant mortality in Iran shows that household's economic status is the largest contributor (36.2%) to inequality in infant mortality followed by mother's education (20.9%), residence in rural/urban (13.9%), birth interval (13%) and hygienic toilet (11.9%) (Hosseinpoor et al., 2006). Decomposition of socio-economic inequality in infant mortality in urban India shows that three factors (SC/ST caste, Muslim religion and Poor economic status) together explain 65 percent of total inequality in infant mortality and poor economic status was the largest contributor (55 %) followed by (Goli et al., 2010). A socio-economic decomposition of inequality in under-two mortality in India and its states were carried out by using National Family Health Survey (NFHS-3) data. The results show that poor socio-economic status, mother's illiteracy and rural residence contribute to 96 percent of total socio-economic inequalities in under-two mortality in national level. The contribution of poor socio-economic status was the largest (46%), followed by illiteracy (35%) and rural residence (15%). In some states the contribution of poor economic status was more than 70 percent and in some other states it varies from 40-70 percent, while other states it was relatively lower (Pradhan and Arokiasamy, 2010).

From literature review, it is found that most of studies on early neonatal mortality are hospital based conducted by medical scientists to ascertain the causes of deaths. Few studies have been undertaken by social scientists which examine early neonatal mortality from the socio-economic and environmental, demographic and biological perspective. In some community based intervention studies the impact of behavioural factors such as hygienic delivery and newborn care practices on neonatal mortality have been established. But limited number of studies from large scale demographic health survey has taken into account the impact those behavioural factors on the survival of infants during early neonatal period. It is also interesting to see the socio-economic inequalities in early neonatal mortality i.e., how the deaths are distributed between poor and non-poor and which factors contribute to the socio-economic inequalities in early neonatal mortality. This present study aims to understand the socio-economic and environmental, demographical and biological factors that affect early neonatal mortality.

CHAPTER 3

CONCEPTUAL FRAMEWORK

DATA BASE

AND

METHODOLOGY

CHAPTER-3

CONCEPTUAL FRAMEWORK, DATA BASE AND METHODOLOGY

3.1: Conceptual Framework for Child Survival During Early Neonatal Period

A Conceptual Framework plays a vital role in any research study. It is a representation of the inter-relationship between dependent and independent variables in a study. In this study the dependent variable is the survival of newborns during the first week of life and the independent variables are divided into three broad groups of socio-economic and environmental, demographic and biological, and programmatic and newborn care factors. As the literature review shows these factors influence the survival of newborns during first week of life. Based on the review of literature a conceptual framework is given in figure 3.1.

All the independent variables included in the conceptual framework affect newborn's survival either directly or indirectly. The variables in one group affect the variables in another group and within a group some variables also influence others. Variables such as mother's education and mass media exposure influence mother's nutritional status, age at child bearing, utilization of antenatal care, delivery and newborn care practices which determine the outcomes of pregnancy and ultimately on newborns survival. The economic status of household also influences the quality of food intake, utilization of health care services and place of delivery. Sanitation and quality of drinking water also influences the health of the mother and her newborn infant and ultimately on newborn's survival. Demographic and biological factors such as the age of mother at birth, parity, gestational age, birth weight and sex of the child affect the chance of survival among newborns. Maternal malnutrition is indirectly associated with perinatal and neonatal mortality through pregnancy and delivery related complications. Socio-economic and demographic factors are associated with low birth weight babies and the chance of survival is less among low birth weight babies compared with normal birth weight babies. Poor maternal health, inadequate care during pregnancy and delivery and unhygenic delivery and lack of new born care practices in home deliveries lead to higher chance of dying among newborns during early neonatal period. In this conceptual framework how these independent variables in each group affect the survival of newborns during the early neonatal period are discussed below.

Demographic and Biological Factors:

Mother's demographic and biological characteristics such as, age at child's birth, parity, nutritional status, and anemia level influences her physiology which affects on the outcome of pregnancy. Similarly, child's characteristic at birth such as, sex of the child, birth order, types of birth (singleton or multiple), and birth weight/birth size also influence significantly the newborns' survival. Child bearing at very younger (< 20 years) and very older ages (35-49 years) leads to higher early neonatal mortality compared to middle aged women (20-34 years). Women in younger age groups are not fully biologically mature to bear burden of pregnancy and if they conceive then the fetus can't grow properly which results in low birth weight. They are also more prone to pregnancy and delivery complication because of their small pelvis size. Preterm births are higher among younger and older women compared to middle aged women. Twins and babies born to mothers under 15 years of age had greater risk of dying than singletons and babies born to mothers of age 25-29 years (Samms-Vaughan et al., 1990). Children with previous birth interval of less than 18 months and 18-24 months have significantly lower chances of survival in neonatal period compared with children more than 24-month birth interval (James and Subramanian, 2004). Adolescent childbearing causes many adverse outcomes including unwanted, repeated childbearing and increased risks of having low birth weight, preterm births and neonatal mortality (Lee et al., 2007 cited in Golestan, 2008).

Mother's nutritional status is also linked with early neonatal deaths indirectly through its impact in fetal weight and gestational age. Short heighted women have more delivery complications due to small pelvis size. Teenage pregnancies and pregnancies after 40 years and maternal pre-pregnancy BMI of less than 18.5 are associated with preterm delivery and low birth weight. Older women have a higher chance of antenatal complication which contributes to still births. Gestational age and low birth weight are recognized as contributors to still births and neonatal deaths (Getahun et al., cited in CEMACH: UK, 2009). The main risk factors of neonatal deaths are maternal anaemia, maternal malnutrition, poor antenatal care and multiparity (Kousar et al., 2010). Perinatal mortality is higher among young age (<=18 years) and thin mothers. Birth weight is one of the important factors influences the chance of survival. Low birth weight babies (<2500g, irrespective of gestation) have higher chance of dying compared with normal birth weight babies because they are at a much higher risk of being born with cerebral palsy, mental

retardation, and other sensory and cognitive impairments (AAP, 2002 cited in Golestan, 2008). The chance of survival is more in female child and less in male child during early neonatal period (Schoeps, 2007). Though there may be some gender discrimination in newborn's care and female babies are generally neglected over male babies, still the survival chance is higher among female babies. This variation may be due to the biological differences between male and female child. Low birth order had a positive impact on neonatael chance of survival (Joshi, 2003). The chance of survival is also influenced by the types of birth. The chance of survival is very less among multiple births and very high among singleton births. Babies born in multiple births have higher chance of being born with low birth weight than its counterpart singleton babies. Twins have a four times higher risk of perinatal mortality than singleton births (Tas, 1990).

Socio-economic and Environment Factors:

Caste and education of mother have significant impact on the survival of newborns in the first week of life (Achyut et al., 1997). Ethnicity has been associated with increased risk of still birth and neonatal death. It is likely to be associated with other risk factors such as deprivation and women with greater level of deprivation are more likely to have still births or neonatal deaths. In Wales it was found that those in the most deprived quintile had a 53 percent increased risk of still birth and infant deaths compared with those in the least deprived quintile (Getahun et al., 2007 cited in CEMACH: UK, 2009). Mother's education and mass-media exposure influences the survival of neonates. An educated woman is more serious for her health and health of her newborn and has better care seeking behavior than an uneducated woman and when exposed to mass–media have better information on hygienic delivery and newborn care practices. The chance of neonatal death was higher for no educated mothers compared with high school and above (James and Subramanian, 2004). Mother's education works through changing feeding and care practices, leading to better health seeking behavior and by changing the traditional familial relationships (Caldwell, 1979 cited in Mutunga, 2004). Households with higher socioeconomic status and higher level of parental education had a positive impact on neonate's chance of survival. Households with lower economic status had five times more chance of dying compared with higher economic status households (Joshi, 2003). Newborns from lower economic status have higher chance of dying because of poverty they are unable to afford for any normal or emergency health care for their newborns. During pregnancy the family can't provide quality

foods and nutrition to the expectant mothers. Antenatal care utilization is also very low and at the time of delivery they cannot go for hospital delivery because of lack of money. Poor socio-economic conditions play important role indirectly on early neonatal mortality as it enables people to seek health care services during pregnancy, delivery and post natal care (Galjaart, 2007).

Place of residence is one of the risk factors of neonatal deaths (Schoeps, 2007). Newborns born to mothers living in rural areas have higher chance of dying compared with newborns in urban areas. This disparity is due to the differences in the standard of living and basic health care facilities between rural and urban areas. Religion and occupation of father are significantly associated with perinatal mortality (saksena and Srivastav, 1980). Newborns born to mothers working in primary sector have higher chances of dying because they are more exposed infections, not taking antenatal care properly and the impact of heavy work during preganacy and parents working in service sectors having lower rate of early neonatal mortality because they are in better paid jobs and highly educated. Child health is affected by environmental conditions and economic status of the household .The underlying socio-economic causes of neonatal mortality in urban slum areas are poor living conditions, illiteracy, ignorance and poverty (Fernandez et al., 2003). The quality of drinking water and sanitation facilities are important determinants of the exposure to the diseases. The use of unclean cooking fuels such as wood and coal significantly reduces thechance of neonatal survival by influencing the health of newborns.

Programmatic and Newborn Care Factors:

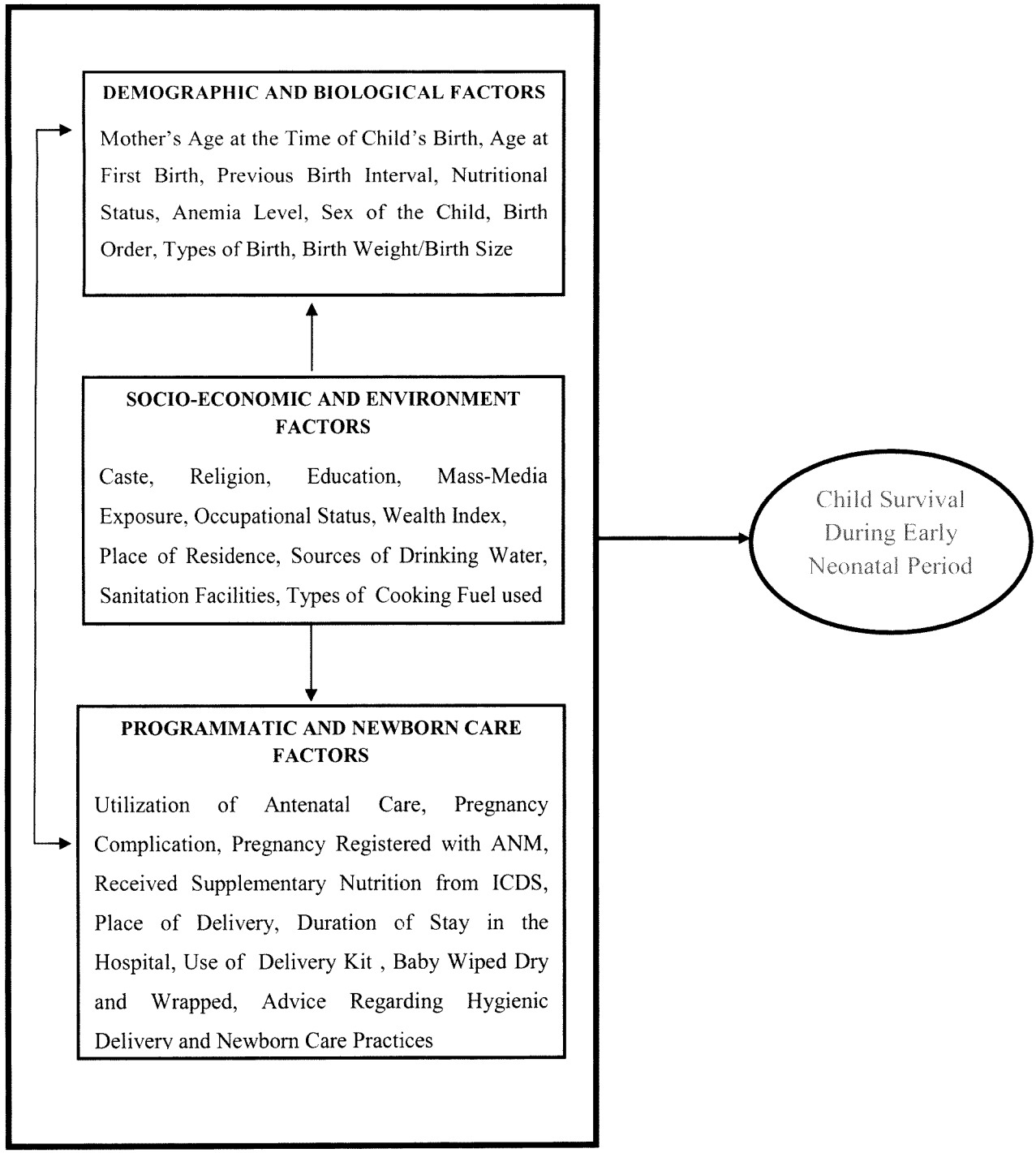
Inadequate antenatal care, inappropriate management of pregnancy and delivery complications, poor hygiene during delivery and the first critical hours after birth and poor quality of newborn care add to the mortality figures (Gunasekera and Gunasekera, 2000). Taking minimum prescribed antenatal care along with multiple micronutrient supplements during pregnancy increases the fetal growth as well as the gestational age which reduces the proportion of low birth weight and preterm babies. It also reduces complications during pregnancy and delivery. Taking tetanus injection in antenatal care reduces chance of neonatal tetanus which is one of the causes of neonatal mortality (Schoeps, 2007). The determinants of perinatal deaths are lack of health awareness and inadequate care during antepartum, intrapartum and postpartum period (Korejo, 2007). Early antenatal registration with minimum 3 antenatal visits, and early referrals in

potentially high risk patients should be encouraged to better equipped facilities in order to improve perinatal mortality rate. Advice should also be given on diet, rest, iron, folic acid and vitamin supplementation (Wassan, 2009). Receiving two or more TT injections and sufficient IFA tablets were found to be negatively related with neonatal mortality (James, 2004).

Pregnancy complication increases the chance of delivery complication and proper medical supervision during pregnancy manages delivery complication. If place of delivery is in institutional set up attended by doctor or trained person then complications can be properly managed which reduces birth injury which is one of the major causes of early neonatal mortality (Achyut et al., 1997). Delivery under medical supervision showed a positive relationship with neonatal mortality. This contradictory result may be due to the fact that most of the women go for hospital delivery due to some complications and the visited hospital can not save the newborns lives (James and Subramanian, 2004). Spontaneous preterm delivery and intrapartum related causes are the most common obstetric events most likely to contribute to the risk of perinatal deaths in poor and disadvantages population especially for delivery occurring outside hospital. Prematurity was the main cause of early neonatal deaths (Hany and Guillermo, 2006). The chance of survival is also affected by the duration of stay in hospital after delivery. In the present study the rate of early neonatal mortality was lower where the duration stay in hospital was at least one week and higher for duration of stay is less than one day. The main reason behind such argument is that duration of stay in hospital ensures regular health check up and in case of emergency immediate action is taken by doctors to sve the newborns lives. Other factors such as pregnancy registered with ANM helps in tracking all the pregnant women for necessary antenatal care and supplementary nutrition from ICDS increases the nutritional status of women. All these programs help in increasing the chance of survival of newborns.

During home deliveries use of delivery kit or clean blade prevents infection which is one of the major causes of neonatal deaths. Providing essential newborn care just after delivery such as, wiping dry and wrapping the baby without being bathed, and initiation of breast feeding within half an hour of birth protects the child against infection and hypothermia which reduces the chance of dying (PATH, 1999 and WHO, 1997). Similarly, Providing necessary information on birth preparedness, hygienic delivery and on essential newborn care increases the chance of survival of neonates during early neonatal period (Gunasekera and Gunasekera, 2000).

Fig 3.1: Conceptual Framework for Child Survival During Early Neonatal Period



3.2: Data Sources

Three major data sets are used in this study are National Family Health Survey (NFHS), Sample Registration System (SRS) and World Health Organization (WHO). The SRS data are used to show the levels and trends of early neonatal mortality rate (ENMR) in India and its major states, while the WHO data are used to show the levels in early neonatal mortality and the share of early neonatal mortality to neonatal mortality in the world, in its regions and among various countries. The NFHS dataset is used to estimate the national, regional and state level estimates of early neonatal mortality rate, the age pattern of deaths during early neonatal period, differential in early neonatal mortality rate among different sub-groups of population and its determinants and finally for the inequality analysis for early neonatal mortality. The major part of the analysis of this study is based on National Family Heath Survey data set.

The National Family Health Surveys (NFHS) are conducted with a representative sample of households throughout the country. The Ministry of Health and Family Welfare (MOHFW), Government of India (GOI), initiated the NFHS surveys to provide high quality data on population and health indicators. The three NFHS surveys conducted so far are the major landmarks in the development of a demographic and health data base for India. An important objective of the NFHS surveys has been to provide national and state estimates of fertility, family planning, infant and child mortality, reproductive and child health, nutrition of women and children, the quality of health and family welfare services, and socioeconomic conditions in regular intervals. The NFHS surveys use standardized questionnaires, sample designs, and field procedures to collect data. The information provided by NFHS surveys assists policymakers and program administrators in planning and implementing population, health, and nutrition programs. The MOHFW designated the International Institute of or Population Sciences (IIPS), Mumbai, as the nodal agency for each of the three rounds of NFHS.

NFHS-1

NFHS-1 is the country's first national family health survey was conducted in 1992-93. Data was collected with a nationally representative sample of 89,777 ever-married women in the age group 13-49 from 88,562 households covering populations in 24 states and the National Capital Territory of Delhi in three phases from April 1992 to September 1993. The main objective of the

survey was to provide national and state-level estimates of fertility, infant and child mortality, the practice of family planning, maternal and child health care and the utilization of services provided for mothers and children. In this survey three types of questionnaire are used to collect data, and these are household, women's and village questionnaire.

NFHS-2

The second National Family Health Survey (NFHS-2) was undertaken in 1998–99, collected information from a nationally representative sample of more than 90,000 ever-married women in the age group 15–49 years. The sample covers 99 percent of India's population living in all 26 states. As in the earlier survey, NFHS-2 provides state and national estimates of fertility, the practice of family planning, infant and child mortality, maternal and child health, and the utilization of health services provided to mothers and children. In addition, the survey provides indicators of the quality of health and family welfare services, women's reproductive health problems, and domestic violence, and includes information on the status of women, education, and the standard of living. It also measured the height and weight of eligible women and children and collected blood samples to assess the prevalence of anemia. Like NFHS-1, this survey also used the same questionnaires to collect all the relevant data.

NFHS-3

The third National Family Health Survey (NFHS-3), collected information from a nationally representative samples of 109,041 households, 124,385 women in the age group 15-49, and 74,369 men in the age group 15-54. It covers 99 percent of India's population living in all 29 states. Like, NFHS-1 and NFHS-2, NFHS-3 provides estimates of important indicators on family welfare, maternal and child health, and nutrition. In addition, it provides information on several new and emerging issues, including family life education, safe injections, perinatal mortality, adolescent reproductive health, high-risk sexual behavior, tuberculosis, and malaria and HIV/AIDS. The three questionnaires used in this survey were Household, Women's and Men's questionnaire. In this present study variables on socio-economic, mother's habitat and environment, demographic, vital nutritional information (such as body mass index and hemoglobin level), maternal and newborn care practices are taken from NFHS-3 for analysis.

Sample Registration System (SRS)

The Sample Registration System (SRS) in India is the largest demographic survey in the world covering about 1.4 million households with 7.1 million populations. It was initiated by the Office of the Register General of India in 1964-65 and on full scale from 1969-70. Since then it has continued to remain as the main source of information on fertility and mortality indicators both at the state and national levels. Apart from the large sample size and geographical spread in most of the districts, the system has a unique feature of dual recording, which involves collection of data through two different procedures viz., continuous enumeration and retrospective half-yearly surveys. The continuous enumeration and retrospective surveys are followed by the process of matching of the two records and subsequent field verification of unmatched and partially matched events. So, the system provides a cross check on the correctness and completeness of the events of births and death listed by the two independent functionaries. From 1971 onward, the SRS which is based on dual record system has been providing information on fertility (CBR, TFR, ASFR, and ASMFR) and mortality (CDR, IMR, NMR, PNMR, Child and Under Five Mortality) levels for India and bigger states separately for rural and urban areas on a regular basis. It also includes data on population composition by broad age groups, sex and marital status and it started providing the estimates of early neonatal mortality rates from 1995 onwards

3.3: Explanation of the Variables Used in the Analysis

NFHS-3 provides a complete birth history of all eligible women including for each live birth, the sex, month and year of birth, survival status, and age at the time of the survey or age at death. Age at death was recorded in days for children dying in the first month of life, in months for other children dying before their second birthday, and in years for children dying at later ages. This information was used to calculate the direct estimates of early neonatal mortality rate which is taken as dependent variable in this study. Other collected socio-economic, environmental and demographic characteristics of both mother and child are taken as independent variables. All the analysis is carried out among births that have occurred during last five years before the survey.

The independent variables used in this analysis are broadly divided into three groups of socio-economic and environmental, demographic and biological characteristics, and programmatic and newborn care practices. The socio-economic and environmental factors are generally the background characteristics of parents mostly of mothers such as, mother's caste, religion, parents level of education, place of residence, Occupational status of parents, wealth index, mass-media exposure, sources of drinking water, sanitation facilities and quality of fuel used in cooking. The second group includes factors like mother's age at child's birth, mother's age at first birth, nutritional status of mother (BMI), anemia level, previous birth interval, sex of the child, types of birth, birth order and birth weight/birth size. The third group programmatic factors includes utilization of the various components of full antenatal care, Pregnancy complication, place of delivery, duration of stay in hospital after hospital delivery, Pregnancy registered with ANM, taking supplementary food from ICDS and new born care factors such as use of delivery kit, use of clean blade, baby wiped dry and wrapped, and during pregnancy received advice from health workers on breast feeding, keeping the baby warm and need cleanliness at the time of delivery. The dependent variable in this study is early neonatal mortality

Dependent Variable

The deaths that occurred within seven days of birth are called as early neonatal mortality. These deaths that happens in different days starting from first day to seventh day is symbolically refereed as 'day 0' 'day 1' 'day 2' 'day 3' 'day 4' 'day 5' and 'day 6' respectively. The early neonatal mortality is coded as '1' (one) if deaths occurred in early neonatal period and '0' (zero) for remaining cases.

Independent Variables

Caste of Mother: Caste of Mother is categorized and coded into four groups, such as, Scheduled Caste (SC)-1, Scheduled Tribe (ST)-2, Other Backward Class (OBC)-3 and Others-4.

Religion of Mother: Religion is divided into three groups and coded as, Hindu-1, Muslim=2 and others=3.

Place of Residence: In place of residence, Rural=1 and Urban=2.

Mother's Level of Education: it is grouped into 3 categories, No Education=1, Primary=2, Secondary and Higher=3.

Mass Media Exposure: Mother's media exposure was measured by asking about the frequency (almost every day; at least once a week; less than once a week; or not at all) with which they read a newspaper or magazine, watch television, or listen to the radio. Individuals, who do not read a newspaper or magazine, watch television, or listen to the radio at least once a week are considered to not be regularly exposed to any media. And those who read a newspaper or magazine watch television, or listen to the radio at least once a week are considered to be regularly exposed to any media. So there are two categories, No Exposure=1 and Exposure=2.

Mother's Occupation: Mother's occupation is categorized in three groups, such as, Not Working=1, Primary Sector=2 and Working in Service Sector=3. Primary Sectors includes working in agric-employee, agri-self employed, household and domestic, skilled and unskilled manual. Service sector includes Prof., tech., Manger, clerical, sales and services.

Father's Occupation: divided into two groups; Primary Sector=1, service Sector=2. Primary Sector includes working in agric-employee, agri-self employed, household and domestic, skilled and unskilled manual. Service sector includes Prof., tech., Manger, clerical, sales and services.

Wealth Quintile: Wealth Index is an indicator of the economic status of households that is consistent with expenditure and income measures. The economic index was constructed using 33 household asset data and housing characteristics. The original variable is grouped into five categories; lowest, second, middle, fourth and highest. But it was regrouped and recoded as, Lowest Quintile (lowest and second)=1, Middle Quintile (middle) =2 and Upper Quintile (fourth and highest) =3.

Types of Fuel used in the Households: In the household different types of fuels used cooking purposes are divided in to two groups. One is 'smoke free fuel' and other one is 'not smoke free fuel'. All solid cooking fuels which include coal/lignite, charcoal, wood, straw, shrubs, grass, agricultural crop waste and dung cakes are categorized as 'Not Smoke Free Fuel=2' and all liquid cooking fuels are categorized as 'Smoke Free Fuel=1'.

Sanitation Facilities: Sanitation facilities categorized into two groups; Improved=1, Not improved=2. Improved type includes flush/pour flush to piped sewer system, flush/pour flush to septic tank, flush/pour flush to pit latrine, ventilated improved pit (VIP) latrine/biogas latrine, pit latrine with slab, twin pit, composting toilet. But, these types of toilet should not shared with other households. Not Improved facilities includes any facility shared with other households,

flush/pour flush not to sewer/septic tank/pit latrine, pit latrine without slab/open pit, dry toilet, no facility/open space/field, and others.

Sources of Drinking Water: It is also categorized into two groups; Improved=1 and Not Improved=2. Improved source includes Piped water into dwelling/yard/plot, Public tap/standpipe, Tube well or borehole, Protected dug well, Protected spring, Rainwater, Bottled water, improved source for cooking, hand washing. Non-improved source includes Unprotected dug well, Unprotected spring, Tanker truck/cart with small tank, Surface water, Bottled water, non-improved source for cooking, hand washing and Other source.

Mother's Age at Child's Birth: It is divided into three groups and coded as, <20 yrs=1, 20-34=2, and 35-49=3

Mother's Age at First Birth: It is divided into two groups and coded as, <20 years=1, >=20 years=2

Previous Birth Interval: The previous birth interval is divided into three groups and coded as, Birth Interval <2 yrs=1, 2-3 years=2 and >=4 years=3

Body Mass Index (BMI): The BMI is a measure of nutritional status which is calculated from the collected information on the height and weight of women in the age 15-49. The BMI is defined as weight in kilograms divided by height in meters squared (kg/m2). A cut-off point of 18.5 is used to define under nutrition or under weight and a BMI of 18.5 or above indicates normal. So BMI is categorized into two groups and coded as, Under Nutrition=1, Normal=2

Anemia Level: Severe=1, Mild=2 and Not Anemic=3

Sex of the Child: Male=1, Female=2

Type of Birth: Single=1, Multiple (more than one birth) =2

Birth Order: It is categorized into three groups; First birth Order=1, Second and Third=2, Fourth and above=3

Child's Birth Weight: Birth weight is an important indicator of a child's vulnerability to the risk of childhood illness and chances of survival. In NFHS-3, a birth weight was recorded for 34 percent of babies born in the five years preceding the survey; this weight came either from a weight recorded on a health card or from the mother's memory (recall). Children whose birth weight is less than 2.5 kilogram's, or children reported to be 'very small' or 'smaller than average' are considered to have a higher than average risk of early childhood death. In this variable all the cases are divided into two groups, one group having birth weight less than 2.5 kg

and other group having 2.5 kg or more and it is coded as, Under Weight (<2.5kg)=1, Normal (>=2.5kg)=2.

Child's Birth Size: In the absence of birth weight for many babies, a mother's subjective assessment of the size of the baby at birth is taken a useful proxy for birth weight. Originally this variable was in four categories (Average, Large, Small and Very Small) but again it was recorded into three groups; Average/Large=1, Small=2, Very Small=3.

Antenatal Care Visit: No Visit=1, 1-2 Visit=2, Three and More Visit=3

Time of Antenatal Care Visit: In the original variable the timing of antenatal care visit is mentioned in terms of months. But in the recoded variable it is divided into two groups. In one group the visits are within first three months which is called visit in first trimester and in the other group the visits are after three months which are called visits in second and third trimester. So, 1st Trimester=1 and 2nd and 3rd Trimester=2.

IFA Tablets Taken: In this variable the number of IFA tablets taken by the women during their pregnancy is mentioned in days but it is recoded into three groups. Not taken at all=1, Taken Less Than 90 days=2 and taken 90 days and more=3.

TT Injections Taken: Tetanus injections taken by the women during pregnancy is categorizes into three groups. Not Taken at All=1, Taken Only Once=2, Taken Two and More=3

Antenatal Care Utilization: It is categorized into no utilization, partial and full utilization. In no utilization women don't take any antenatal care at all. In partial utilization women either take at least any number of IFA tablets, or any number of TT injections or any number of ante natal care visit but not full antenatal. In full antenatal care women have visited at least two antenatal visits with first visit in first trimester, and taken at least 90 IFA tablets and two TT injections during pregnancy. 1= No ANC, 2= Partial ANC, 3= Full ANC.

Place of Delivery: Place of delivery is divided into two groups and coded as, Non Institutional Delivery=1, Institutional Delivery=2. Non Institutional delivery includes deliveries in Own Home, Parents Home and Other. Institutional delivery Includes deliveries conducted in Public Sector, NGO Trust and Private Sector.

Duration of Stay in Hospital Delivery: it is divided into three groups. 1= duration of stay of less than one day, 2=one day to less than one weak, 3=at least one week

Pregnancy Complication: Pregnancy complication is divided into two groups and coded as, No Complication=1, Complication=2. Complication includes those women who have at least one problem either difficulty with vision during day night or suffer from night blindness or have convulsion not from fever or swelling of legs, body or face or feeling excess fatigue or vaginal bleeding. But, No Complication includes those women who do not have any above problem.

Pregnancy Registered With ANM: If any pregnancy is not registered with Auxiliary Nurse Midwife is coded as 1 and if registered is coded as 2.

Received Supplementary Nutrition from Anganwadi centre: If a woman did not receive any nutritional supplements during pregnancy from anganwadi centre is coded as 1 and if received is coded as 2.

Delivery Kit Used: During delivery if delivery kit is not used coded as 1 and if used coded as 2

Clean Blade Used to Cut Umbilical Cord: During delivery if clean blade is not used to cut umbilical cord, coded as 1 and if used coded as 2

Baby Wiped dry and Wrapped: During delivery if baby is not wiped dry and not wrapped, coded as 1 and if wiped and wrapped coded as 2

Advice from ANM on Breastfeeding: During last three months of pregnancy if a woman has not received advice from ANM on breast feeding, coded as 1 and if received coded as 2.

Advice from ANM on Keeping the Baby Warm: During last three months of pregnancy if a woman has not received advice from ANM on keeping the baby warm, coded as 1 and if received coded as 2.

Advice from ANM on Cleanliness at the Time of Delivery: During last three months of pregnancy if a woman has not received advice from ANM on cleanliness at the time of delivery, coded as 1 and if received coded as 2.

3.4: Methodology

The following quantitative methods have been used in this study.

Procedure for Calculation of Early Neonatal Mortality Rate

If total number of deaths in the first seven days of life is available, then the early neonatal mortality rate is calculated as follows:-

$$\text{Early Neonatal Mortality Rate (ENMR)} = \frac{\text{Deaths of infants in 0–6 days after birth}}{\text{Total Live Births}} \times 1000$$

But, if total number of deaths in the first seven days of life is not available, then the early neonatal mortality rate is calculated from Perinatal Mortality Rate (PMR) and Still Birth Rate (SBR) by the following formula:

$$\text{Early Neonatal Mortality Rate (ENMR)} = \frac{PMR-SBR}{1000-SBR} \times 1000$$ (Lahiri, 1993 cited in Achyut, 1997, p. 260)

Before calculating early neonatal mortality rate, three years moving average of PMR and SBR is taken to remove any random fluctuations. The definitions of some other relevant mortality rates are given below:

Perinatal Mortality Rate (PMR): number of still births and infants deaths during first week of life per thousand of live births and still births during the year.

Still Birth rate (SBR): number of still births per thousands of live births and still births during the year.

Late Neonatal Mortality Rate (LNMR): number of infant deaths during 7th day of life to 28th day of life per thousands of live births during the year.

Post Neonatal Mortality Rate (PNMR): number of deaths during 29^{th} day to less than one year per thousands of live births during the year.

Neonatal Mortality Rate: number of infant deaths during the first 28 days of life per thousands of live births during the year.

Infant Mortality Rate (IMR): number of deaths during the year per thousands of live birth during the year.

Bivariate Analysis:

Bivariate analysis (Cross Tabulation) has been carried out to show the gross differentials in the levels of early neonatal mortality rate by different sub-groups of population without having control over any other variables. Here the mortality rate differentials are shown by socio-economic and environmental, demographic and biological, programmatic and newborn care factors.

Multivariate Analysis:

Binary Logistic Regression

The multivariate analysis has been carried out by applying Binary Logistic Regression to study the net effects of each independent variable on the response variable in terms of odds ratio. Here the response variable is 'early neonatal mortality' coded in dichotomous form (0- No Death, 1- Death). Odds ratio of reference category is always one, so an odds ratio of less than one indicates lower chance dying (higher chance of survival) during early neonatal period. Like as, an odds ratio of greater than one indicates higher chance of dying (less chance of survival) during the early neonatal period with respect to the reference category. Along with the odds ratio, the predicted probability of dying is also calculated for all categories.

Predicted Probabilities of Dying

The predicted probability of dying is calculated after taking the relevant estimates from the same logistic regression table and then substituting it in the following formula.

The predicted probability for category j of factor i=Exp (Aij) / [1+Exp (Aij)].

where, $Aij=Ln[P/(1-P)]-[(\sum_j nij*bij)/(\sum_j nij)+bij]$

nij=number of cases in category j of factor i

bij=estimated logit regression coefficient for category j of factor i

p= overall probability (for entire population)

Inequalities and Decomposition Analysis in Early Neonatal Mortality:

The socio-economic inequality of early neonatal mortality is calculated by using the two economics tools of concentration index and concentration curve. Decomposition analysis of concentration index is carried out to show the determinants' contributions to inequality in early neonatal mortality in India.

Definition and Uses of Concentration Curve and Concentration Index

The concentration curve and concentration index are two standard techniques used to study the socio-economic inequalities in any health sector variables of interest. It is used to measure and compare the degree of socioeconomic-related inequality in child mortality, child malnutrition, adult health, health subsidies and health care utilization and many other applications across time and countries (Wagstaff 2000; Gwatkin et al., 2003; Doorslaer et al., 2003). A concentration curve is a graphical representation of inequality by plotting the cumulative percentage of the health variables on y-axis against the cumulative percentage of population, ranked by standard of living (wealth quintile) starting from poorest to ending with the richest on the x-axis. If the cumulative proportions of the health variable under study equals with the cumulative population shares, then there will be complete equality and in that case the concentration curve will be a 45 degree line starting from bottom left hand corner to top-right hand corner and called as line of equality. But, if there is any mismatch between the two sets, there will be inequality in distribution and the curve may either lie above or below the line of equality.

When the curve is above the line of equality, the health variable is concentrated among the poor people, but when curve is below the line of equality, the health variable is concentrated among richer people. The farther the concentration curves from the line of equality the greater the degree of inequality in mortality across wealth quintiles. But the concentration curve does not give a measure of the magnitude of inequality and when the curves cross each other it is very difficult to compare among them. Therefore the concentration index was developed to quantify the degree of socioeconomic inequalities in a health variable and it is directly related with the concentration curve (Kakwani et al., 1997). It is also called summary measure of the degree of income related inequalities in specific health variable.

Concentration index is defined as twice the area between the concentration curve and the line of equality. The index (CI) ranges from +1 to -1. When CI is zero, it means there is no inequality and if takes a negative value the curve lies above the line of equality indicating disproportionate concentration of health variable among the poor and when takes a positive value, the curve lies below the line of equality indicating concentration among richer sections of the populations. The concentration index is calculated from a grouped data by using (Fuller and Lury, 1997) the formula: $\mathbf{CI= (P_1*L_2 - P_2*L_1) + (P_2*L_3 - P_3*L_2) + \ldots + (P_{T-1}*L_T - P_T*L_{T-1})}$

Where, CI: the concentration Index, P: the cumulative percentage of the sample ranked by economic status beginning from the poorest to the richest. L: the corresponding cumulative percentage of health variable and T is the total number of socioeconomic groups. In this study the measurement of the concentration index and plotting of the concentration curve have been done by taking the total births in each five group wealth quintile (poorest, poorer, middle, rich, richest) and number of early neonatal deaths corresponding to each wealth quintile. In NFHS-3 the wealth index is defined as an index of the economic status of households. "It has been developed and tested in a large number of countries in relation to inequalities in household income, use of health services, and health outcomes (Rutstein et al., 2000)". "It is an indicator of the level of wealth that is consistent with expenditure and income measures" (Rutstein, 1999). The index was constructed using a total of 33 household asset data and housing characteristics. Each household is then assigned a score for each asset, and the scores were summed for each household; individuals are ranked according to the score of the household in which they reside. Then the sample is divided into five groups called as quintiles with an equal number of individuals in each quintile and for the whole country only one wealth index has been constructed.

Methodology for Decomposition of Concentration Index

The Method Proposed by Wagstaff et al., (2003) was used to decompose the socio-economic inequality in early neonatal mortality into its determinants. A decomposition analysis allows one to estimate how determinants proportionally contribute to inequality (e.g. the gap between poor and rich) in a health variable. Wagstaff et al., (2003) showed that for any linear regression model linking the health variable of interest y to a set of k health determinants, x_k:

$$y = \propto + \sum_k \beta\, k_x k + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where ε is an error term. Given the relationship between y and xk in equation 1, the concentration index for y (c) can be written as:

$$C = \sum k \left(\frac{\beta k \bar{x} k}{\mu}\right) Ck + \frac{GCk}{\mu} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where μ is the mean of y, $\bar{x}$k is the mean of Xk, Ck is the concentration index for Xk (defined analogously to C). In the; last term (which can be computed as a residual), GCε is the generalized concentration index for ε_i, where C= concentration index defined as:

$$C = \frac{2}{\mu} Cov\ (yi, Ri) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where Y_i and R_i are, respectively the health status of the ith individual and the fractional rank of the ith individual (weighted data) in terms of the index of the household economic status, μ is the (weighted mean of the health of the sample and Cov is the weighted covariance.

In this decomposition analysis, the dependent variable is early neonatal mortality and the independent variables are: place of residence (rural / urban), economic status (Poor / non-poor), education (no education / education), mass-media exposure (non-exposure / exposure), (social group (SC/ST / others), religion (Hindu / others), drinking water (non improved source / improved source), sex of the child (male / female), birth size (small birth size / others), and ANC utilization (no utilization / utilization) and in the variable economic status, the wealth quintile is regrouped as 1 & 2 (poor) and 3, 4, & 5 (non-poor). The following table presents the description of variables used for decomposition analysis.

Table 3.1: Definition of variables used in decomposition analysis for early neonatal mortality in India

Health Variable (Death=1, No Death=0)	Predictors (Yes=1, Otherwise=0)
Early Neonatal Mortality	Place of Residence : rural Economic Status: poor Mother's Education: no education Mass-Media Exposure: no exposure to mass-media Caste: SC/ST Religion: Hindu Drinking Water: not improved source Sex of the Child: male Birth Size: small ANC Utilization: no utilization

Methodological steps for decomposition of socio-economic inequalities in early neonatal mortality

i. Regress the health variable against its determinants and get the coefficients of explanatory variable (k).

ii. Calculate the mean of the health variable and each of its determinants (μ and $\bar{x}$k).

iii. Calculate the concentration indices for the health variable and for the determinants (C and Ck) using equation (3). At this stage, the values of all the variables included in equation (2) are known. Finally the contribution of each factors are quantified through the following steps:

iv. Calculate the *absolute* contribution of each determinant by multiplying the health variable elasticity with respect to that determinant and its concentration index $\left(\frac{\beta k \bar{x} k}{\mu}\right) Ck$

v. Calculate the *percentage* contribution of each determinant simply by dividing its absolute contribution by the concentration index of the health variable $\left(\frac{\beta k \bar{x} k}{\mu}\right) Ck/C.$

3.5: Data Quality

This study is mainly based on National Family Health Survey. Hence it is necessary to give an overview of the general quality of NFHS data and particularly to estimate early neonatal mortality rate. The reliability of mortality estimates from retrospective birth histories like NFHS depends on the completeness of deaths reported and the extent to which the date of births and age at death are accurately reported and recorded. The estimated rate of early neonatal mortality is subject to both sampling and non sampling error. But the sampling error is reasonable as it is based on sophisticated sampling technique. Therefore, here we will check for non-sampling errors particularly under reporting which could result in an underestimate of mortality rate and misreporting of deaths could distort age pattern of mortality. One of the methods to ascertain under reporting of deaths during early neonatal period is the ratio of early neonatal deaths to neonatal deaths. A ratio of less than 25 percent is often used as an indicator of under reporting (NFHS-3, IIPS). In all the rounds of NFHS data the percent of early neonatal deaths to all neonatal deaths are more than 70 percent during last 5 years preceding the survey. The share of infant deaths that occurred during the neonatal period is also quite high. So, in NFHS there appears to be limited under reporting of deaths. The perinatal mortality rate in India (49) from NFHS estimates during the period 2001-05 was higher than the estimates of SRS (35) during 2002-05. Therefore, NFHS captures more still birth and early neonatal deaths than SRS. Hill and Choi, 2006, have assessed the quality of NFHS data by examining the internal consistency and comparing with the historic age pattern of neonatal mortality from England and Wales. The results show that the age patterns of neonatal mortality were comparable with those historical data, indicating no significant underreporting of early neonatal deaths in NFHS birth histories and the digital preference is quite modest in the Indian surveys, with the heaping index never exceeding 2.5.

The other problem is the misreporting of age at death which distorts the age pattern of mortality. This misreporting may be due to preference for reporting the age at death to certain digits or because of misclassification between still birth and early neonatal deaths or confusion regarding the coding of first day as day zero or day one. In this NFHS data through there is evidence of age heaping at some particular digit, but it not so serious. The age pattern of death in percentage terms during the early neonatal period in all the three rounds of NFHS matches with the age

pattern of deaths in terms of probabilities of dying based on analysis of 47 DHS datasets with 10048 neonatal deaths during 1995-2003 (Lawn and et al., 2005). But there may be some heaping on certain days (7, 14, 21, and 30). One method to quantify the magnitude of age heaping at age seventh day is the number of deaths at seventh day divided by one-fifth of the deaths at ages 5 to 9 days. If the index falls somewhere close to 1.0, indicates absence of error (Hill and Choi, 2006). The 'heaping index' on 7^{th} day is calculated by using the above method gives values of 0.970, 0.851 and 1.01 during NFHS-1, NFHS-2 and NFHS-3 respectively showing absence of age heaping at seventh day. The overall quality of NFHS data is fairly of good quality to carry out a study on early neonatal mortality.

3.6: Limitations of the Study:

There are some limitations of this study. The importance of hygenic delivery and newborn care practices is visible from the gross differentials in early neonatal mortality rates. But, the net impact of these factors (use of delivery kit or clean blade, baby wiped dry and wrapped) on early neonatal mortality could not established because they were not included in the multivariate analysis due to their low frequency. In previous studies birth weight of newborn babies is established as one of the crucial factors influencing child survival. In this study though the same fact is established from bivariate analysis but it was not included in the multivariate analysis due to its selectivity in nature, i.e. it includes only those births which were delivered in hospital. Instead of the variable 'birth weight' the variable 'size of all babies at the time of birth' which includes both hospital and home delivery was included in the multivariate analysis. In the conceptual framework of Kikhela (1989) the newborns' care during the first week of life is taken as an important factor which influences newborn's survival during perinatal period. But in this study this fact could not be established because of non availability of information in the data set. Other known determinants of child survival during early neonatal period such as drinking and smoking habit of mother are not taken into the study because of the collected information is not sufficient to draw any valid conclusion.

CHAPTER 4

LEVELS AND TRENDS IN EARLY NEONATAL MORTALITY RATE IN INDIA

CHAPTER-4

LEVELS AND TRENDS IN EARLY NEONATAL MORTALITY RATE IN INDIA

4.1: Levels of Early Neonatal Mortality Rate in India and its Bigger States

The latest published estimates of early neonatal mortality rate for the year 2008 in India and its major states are shown in the table 4.1. The all India average of early neonatal mortality rate was 27 per thousand of live births. Among the bigger states there were wide variations. Madhya Pradesh had the highest rate of early neonatal mortality (38), followed by Chhattisgarh (36), Orissa (34) and Uttar Pradesh (33). On the other hand Kerala had the lowest mortality rate (5), followed by Tamil Nadu (15), Delhi (15), Maharashtra (19) and Karnataka (20). If we compare among north and south Indian states, it is evident that the rates were higher in all northern Indian states (Uttar Pradesh, Madhya Pradesh, Bihar, Chhattisgarh and Rajasthan) than all the south Indian states (Kerala, Tamil Nadu, Karnataka, Andhra Pradesh). There exist large differentials in early neonatal mortality rate between rural and urban areas in India as well as in all the states as shown in Table 4.2. The early neonatal mortality rate in rural areas was more than urban areas both in India and all the states except Delhi. In India the rate of early neonatal mortality in rural areas (31) was nearly two times that of urban areas (16) and among states it varies from one and half times to more than three times that of urban areas.

The share of early neonatal mortality rate with the different components of child mortality is shown in the Table 4.1. The percentage share of early neonatal mortality rate in neonatal mortality rate was 77 percent in the year 2008. Its share in infant mortality rate was 51 percent whereas in under-five mortality rate its share was 39 percent in the year 2008. Among bigger states its share in neonatal mortality varies from the lowest 71 percent each in Kerala, Tamil Nadu, Karnataka and Haryana to highest 96 percent in Jharkhand. Its share in infant mortality rate varies lowest from 42 percent in Kerala and Assam to highest 67 percent in Jammu and Kashmir and its share in under-five mortality varies from the lowest 31 percent in the same state Assam to the highest 60 percent in the same state Jammu and Kashmir.

Table 4.1: Levels of Early Neonatal Mortality Rate and Its Share in NMR, IMR and U5MR, India, 2008

India and Bigger States	ENMR	NMR	IMR	U5MR	Percentage of ENMR to NMR	Percentage of ENMR to IMR	Percentage of ENMR to U5MR
India	27	35	53	69	77	51	39
Madhya Pradesh	38	48	70	92	79	54	41
Chhattisgarh	36	39	57	71	92	63	51
Orissa	34	47	69	89	72	49	38
Jammu & Kashmir	33	39	49	55	85	67	60
Rajasthan	33	43	63	80	77	52	41
Uttar Pradesh	33	45	67	91	73	49	36
Gujarat	30	37	50	60	81	60	50
Assam	27	34	64	88	79	42	31
Bihar	27	32	56	75	84	48	36
Himachal Pradesh	27	33	44	50	82	61	54
Andhra Pradesh	26	34	52	58	76	50	45
Jharkhand	24	25	46	65	96	52	37
Haryana	24	34	54	65	71	44	37
West Bengal	21	26	35	42	81	60	50
Punjab	20	28	41	49	71	49	41
Karnataka	20	24	45	55	83	44	36
Maharashtra	19	24	33	41	79	58	46
Delhi	15	19	35	40	79	43	38
Tamil Nadu	15	21	31	36	71	48	42
Kerala	5	7	12	14	71	42	36

Source: Sample Registration System, Registrar General of India, 2009,

Note: ENMR: Early Neonatal Mortality Rate, NMR: Neonatal Mortality rate, IMR: Infant Mortality Rate, U5MR: Under-five Mortality Rate. All the rates are per thousand of live births.

Table 4.2: Rural-Urban Differentials in Early Neonatal Mortality Rate in India and Bigger States, 2008

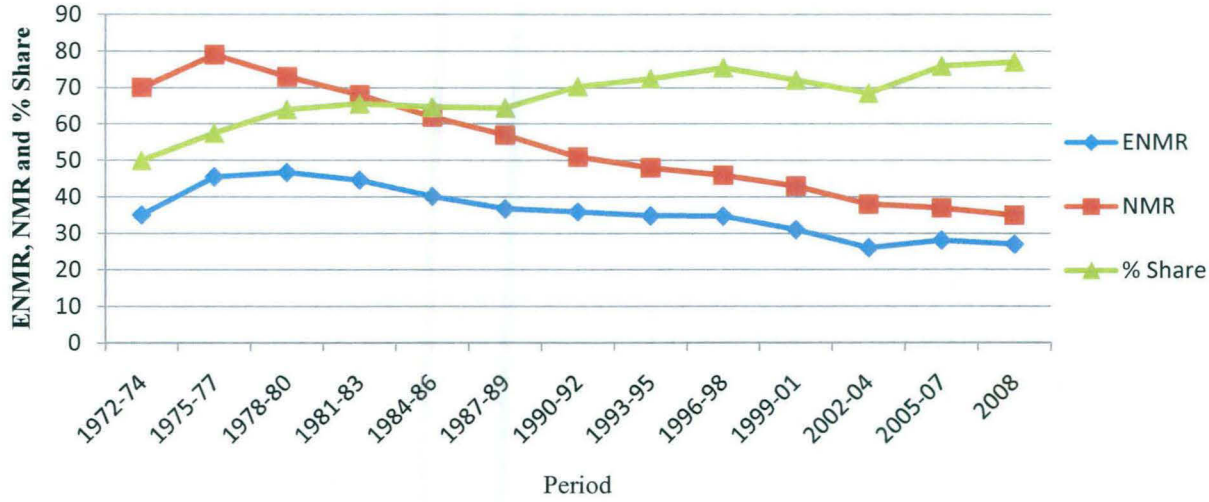
India and Bigger States	Early Neonatal Mortality Rate		
	Total	Rural	Urban
India	27	31	16
Madhya Pradesh	38	40	26
Chhattisgarh	36	37	29
Orissa	34	36	17
Uttar Pradesh	33	35	21
Rajasthan	33	38	17
Jammu & Kashmir	33	36	17
Gujarat	30	33	23
Assam	27	29	11
Bihar	27	28	11
Himachal Pradesh	27	28	9
Andhra Pradesh	26	33	10
Jharkhand	24	27	11
Haryana	24	27	14
West Bengal	21	23	13
Punjab	20	25	9
Karnataka	20	24	10
Maharashtra	19	22	15
Delhi	15	8	16
Tamil Nadu	15	19	11
Kerala	5	6	3

Source: Sample Registration System: Register General of India, 2009

4.2: Trends in Early Neonatal Mortality Rate, Neonatal Mortality Rate and Share of Early Neonatal Mortality Rate to Neonatal Mortality Rate in India during 1972-2008

The trend analysis of early neonatal mortality helps to know the past, present and as well as to predict the future scenario of early neonatal mortality rate for remedial policy interventions. The trend values of early neonatal mortality rate, neonatal mortality rate and the percentage share of early neonatal mortality rate to neonatal mortality rate during the period 1972-2008 are shown in the Figure 4.1. During the period 1972-74, the early neonatal mortality rate was 35 and then increases to highest value of 47 during 1978-80 and thereafter declines continuously and finally reaches to 27 in 2008. In case of neonatal mortality during the period 1972-74, the rate was 70 and then reached the highest level at 79 during the period 1975-79 and after that declined continuously. The trend of the share of early neonatal mortality rate to neonatal mortality rate shows that it was 50 percent during the period 1972-74, and then it rises to 77 percent in 2008 with some fluctuations. The trend line of neonatal mortality rate is steeper than the trend line of early neonatal mortality rate indicating a higher rate of decline in neonatal mortality than early neonatal mortality rate. At same time the general trend line of the share of early neonatal mortality rate to neonatal mortality rate is increasing over the years.

Fig. 4.1: Trends in Early Neonatal Mortality Rate, Neonatal Mortality Rate and Share of Early Neonatal Mortality Rate to Neonatal Mortality Rate, India, 1972-2008



4.3: Reduction in Early Neonatal Mortality Rate among Bigger States of India during the Period 1972-2008

Table 4.3 shows the levels of early neonatal mortality rate and its average annual reduction among bigger states during the period 1972-2008 in India. The average annual reduction of early neonatal mortality rate was in the range of 0.5 (Madhya Pradesh) to 2.1 percentage point (Kerala) among selected bigger states during the period 1972-2008. Ten bigger states had average annual reduction of more than 1 percentage and remaining three states (Madhya Pradesh, Orissa and Rajasthan) had average annual reduction of less than 1 percentage. The average annual reduction of early neonatal mortality rate in Bihar and West Bengal were 2.5 and 3.0 respectively during the period 1982-2008. While all India average annual reduction was just 0.6 percent during the period 1972-2008.

Table 4.3: Percentage Reduction in Early Neonatal Mortality Rate among Bigger States of India during the Period 1972-2008

India and Major States	ENMR-1972	ENMR-2008	Percentage of Average Annual Reduction (1972-2008)
India	35	27	0.6
Andhra Pradesh	46	26	1.2
Tamil Nadu	32	15	1.5
Karnataka	37	20	1.3
Kerala	22	5	2.1
Maharashtra	41	19	1.5
Gujarat	57	30	1.3
Haryana	40	24	1.1
Punjab	41	20	1.4
Rajasthan	48	33	0.9*
Madhya Pradesh	47	38	0.5
Uttar Pradesh	58	33	1.2
Bihar	45	27	2.5#
West Bengal	41	21	3.0#
Orissa	46	34	0.7
Assam	55	27	1.4

Source: Sample Registration System, Registrar General of India, 1972-2008

Note: ENMR =Early Neonatal Mortality Rate

* Average annual reduction during 1973-2008

\# Average annual reduction during 1982-2008

4.4: Regional Variations in Early Neonatal Mortality Rate in India

The regional variations in early neonatal mortality rate among the six NFHS regions during all the three rounds of NFHS are shown in the table 4.4. During NFHS-3 (2005-06) among the six regions, the Central Region had highest rate of early neonatal mortality (35), followed by North-East (32), West and North (27 each), East (26) and the least in South (22). In NFHS-2 (1998-99), the highest rate was in the same Central region (38), followed by East (32), North-East and North (29), South (28 each) and the least was in West (26). In NFHS-1 (1992-93), the highest rate was in East region (38), followed by Central (37), South (34), North-East (27), West (26) and the least was in North (23). The percentage decline in early neonatal mortality during NFSH-1 to NFHS-3 was highest in South Region (35.3 %), followed by East (31.6%) and Central (5.4%). But in other three regions the rate has increased. The highest percentage increase was in North East (18.5%), and North (17.4%). The percentage reduction in the rate of early neonatal mortality during NFHS-1 to NFHS-3 was higher in EAG states (26.7%) than non-EAG states (5.5%). This has resulted in widening the gap in early neonatal mortality rate between EAG and Non-EAG states. In NFHS-1, the difference was just 6 point and it increased to 12 point in NFHS-3. During the same period the percentage reduction in India was just 9.1 percent. The details of the grouping of the six NFHS regions, EAG and non-EAG are given in the appendix.

Table 4.4: Early Neonatal Mortality Rate in NFHS Regions, EAG and Non-EAG during the three Rounds of NFHS, India

India and Regions	NFHS-1 (1992-93)	NFHS-2 (1998-99)	NFHS-3 (2005-06)	Percentage Decline from NFHS-1 to NFHS-3
North	23	29	27	-17.4
Central	37	38	35	5.4
East	38	32	26	31.6
North-East	27	28	32	-18.5
West	26	26	27	-3.8
South	34	28	22	35.3
EAG	36	37	34	5.5
Non-EAG	30	26	22	26.7
India	33	32	30	9.1

Source: National Family Health Survey-1, 2 & 3, IIPS

Note: (-) Minus sign indicates percentage increase

4.5: Early Neonatal Mortality Rate: Comparison between NFHS and SRS estimates

In table 4.5 the national and state level estimates of early neonatal mortality rate from two sources of data (SRS and NFHS) are compared. Since the estimates of early neonatal mortality rate in all the three rounds of NFHS data are calculated by restricting the births and deaths to five years preceding the survey, so the calculated estimates represents the mid year of that period. And the corresponding SRS estimates are average of the five years SRS estimates corresponding with the five years period proceeding of NFHS survey. The states where the total number of deaths from NFHS estimates was at least twenty are taken into account for comparison. The table shows that the national estimates and most of the state estimates in NFHS-3 were little higher than the corresponding national and state estimates of SRS. But during NFHS-1 and NFHS-2 the national and most of the state estimates were little lower than the corresponding estimates of SRS.

Table 4.5 shows that there are no large differences between the two estimates of NFHS and SRS at national level. All India estimate of early neonatal mortality rate in NFHS-3 (30) was little higher than corresponding SRS estimates (27). But in NFHS-1 and NFHS-2 the estimates were little lower than SRS. With regards to state estimates, in NFHS-3 most of the state estimates (10 out of the 14 state) were higher than corresponding SRS estimates and half of the total states having a difference of below 5 point between the two sources of estimates (SRS and NFHS). In NFHS-1 and NFHS-2, most of the state estimates (11 out of 14 in NFHS-1 and 12 out of 14 in NFHS-2) were less than corresponding SRS estimates. In half of the states there was a difference of 5 point between the two sources of estimates (SRS and NFHS). During NFHS-1 and NFHS-2 in some states the estimates were very low (difference of above 8 point) compared with SRS estimates. Therefore, it can be said that these state estimates may not be representative as the rates are very low compared with corresponding SRS estimates.

Table 4.5: Early Neonatal Mortality Rates: Comparison between Estimates of NFHS and SRS

India and States	NFSH-1	SRS-1990	NFHS-2	SRS-1996	NFHS-3	SRS-2003
Punjab	22	22	22	23	21	20
Haryana	25	28	23	30	20	21
Rajasthan	22	40	34	41	34	32
Uttar Pradesh	38	40	39	38	36	31
Bihar	39	33	35	32	33	25
Assam	29	37	31	35	31	27
West Bengal	36	27	24	26	27	21
Orissa	40	48	35	46	31	39
Madhya Pradesh	36	45	36	46	31	34
Gujarat	27	35	30	33	28	28
Maharashtra	26	30	25	26	25	20
Andhra Pradesh	39	40	35	38	32	25
Karnataka	38	41	26	35	22	24
Tamil Nadu	35	37	28	33	15	21
India	33	36	32	35	30	27

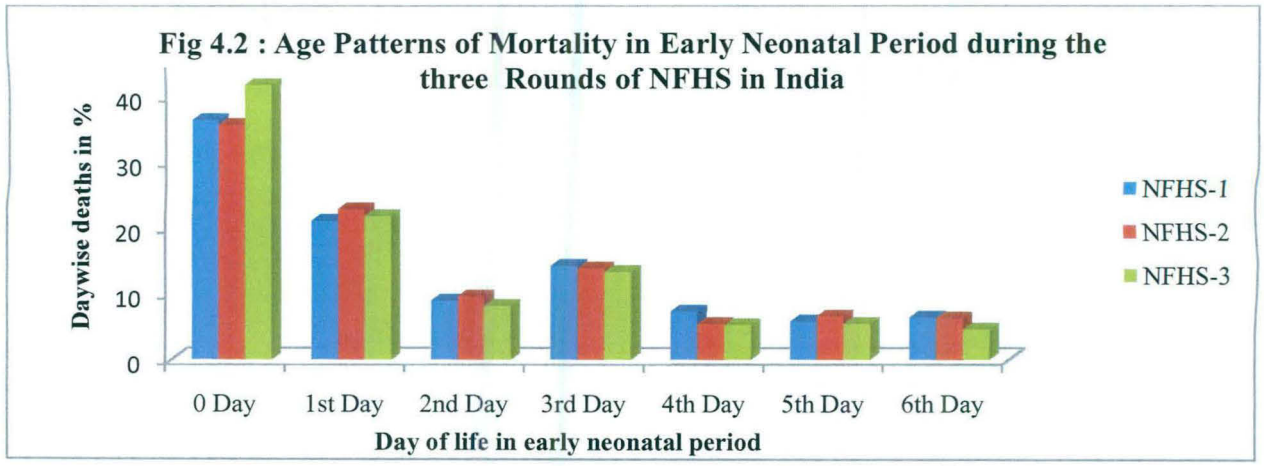
Source: Sample Registration System: Registrar General of India
National Family Health Survey, IIPS

4.6: Age Patterns of Mortality in Early Neonatal Period during the three Rounds of NFHS

Table 4.6 presents the percentage distribution of deaths according to age at death during the first week of life in the three rounds of National Family Health Survey (NFHS). From the table, it is clear that the deaths during these seven days are unevenly distributed with a maximum number of deaths occurring within first 24 hours (day zero) of newborns life. The age patterns of mortality are similar in all the three rounds of NFHS. In day zero during NFHS-1 and NFHS-2 the share was 36.4 percent and 35.6 percent respectively, but in NFHS-3 it has increased to 41.7 percent. From the data, it appears that the deaths are concentrated towards day zero of newborn. In all the three rounds, the highest percentages of deaths have occurred in day zero; followed by day one and day three. During the first three days altogether more than two thirds of the total deaths have occurred.

Table-4.6:Age Patterns of Mortality in Early Neonatal Period during NFHS-1, 2 & 3

Age in Days	(NFHS-1:1992-93)		(NFHS-2:1998-99)		(NFHS-3:2005-06)	
	Deaths	Percentage	Deaths	Percentage	Deaths	Percentage
0 day	749	36.4	633	35.6	703	41.7
1st day	434	21.1	405	22.8	367	21.8
2nd day	184	8.9	170	9.6	137	8.1
3rd day	293	14.2	246	13.8	224	13.3
4th day	150	7.3	96	5.4	88	5.2
5th day	119	5.8	116	6.5	91	5.4
6th day	131	6.4	111	6.2	77	4.6
Total	2060	100	1777	100	1687	100



CHAPTER 5

DETERMINANTS AND INEQUALITIES IN EARLY NEONATAL MORTALITY IN INDIA

CHAPTER-5

DETERMINANTS AND INEQUALITIES IN EARLY NEONATAL MORTALITY IN INDIA

This chapter is divided into three parts. The first part contains the results of gross differentials in the levels of early neonatal mortality rate by different sub-groups of population without controlling any variables. The second part contains the results of net effects of each explanatory variable after controlling all other variables on early neonatal mortality in terms of odds ratio and predicted probabilities of dying. The third part studies the socioeconomic inequalities in early neonatal mortality by using 'Concentration Index' and 'Concentration Curve'. The relative contribution of the determinants to socio-economic inequality in early neonatal mortality is determined by decomposition analysis.

5.1: Socio-economic and Environment Differentials in Early Neonatal Mortality Rate

The study of differentials in early neonatal mortality rate according to various socio-economic and environment, demographic and biological, and programmatic and newborn care factors is very essential for policy implications. Table 5.1 reveals the variations in early neonatal mortality rate, according to mother's socio-economic condition and living environment. Among different caste groups, the rate of early neonatal mortality was highest for newborns born to mothers who belong to Scheduled Caste (33), followed by Schedules Tribes (31), OBC (30) and lowest for General Caste (28). Among religious groups, Hindus have the highest rate of early neonatal mortality (31), followed by others (26) and Muslims (24). In regard to mother's place of residence there exists huge differential between rural and urban areas. The rate was 32 in rural areas but 23 in urban areas. Only at higher level of mother's education, there is positive impact on the survival of newborns during the early neonatal period. The early neonatal mortality rate was highest for those newborns whose mothers' have either no education (35) or having primary education (35) and lowest for mother's having only secondary or higher education (21). Like education, mass media exposure has also some impact on early neonatal mortality rate. Mothers who were exposed to mass media, the mortality rate was 27 and for those who were not exposed to mass media the early neonatal mortality rate was 33 per thousand of live births.

Early neonatal mortality rate also varies with the occupational status of mother. The rate of mortality was higher for those infants whose mothers were working in primary sector (36) and lower for women either working in service sector (27) or not working (27). The possible reasons for higher mortality rate among women working in primary agricultural sector are because of the negative impact of heavy work during pregnancy, more exposed to infections, and not utilizing antenatal care. Father's occupational status was also positively associated with the survival of infant's in the early neonatal period. The mortality rate was 31 if father works in a primary sector and 26 for non-primary sector. Among wealth quintiles the highest disparity was seen between upper and lower quintile. The mortality rate was 35 in lowest wealth quintile, 29 in middle wealth quintile and 23 in upper wealth quintile.

The impact of household's living environment on the rate of early neonatal mortality is assessed in terms of sources of drinking water, types of toilet facilities and types of cooking fuel used in households. The early neonatal mortality rate was 33 for households with not improved sanitation facilities and 21 for households with improved sanitation facilities. Household with improved sources of drinking water the early neonatal mortality rate was 29 and households without improved sources, the early neonatal mortality was 32. The early neonatal mortality was higher (32) for households where no smoke free cooking fuels were used compared with households using smoke free cooking fuels (19).

Table 5.1: Socio-economic and Environment Differentials in Early Neonatal Mortality Rate in India, NFHS-3 (2005-06)

Socio-economic Factor	Number of Early Neonatal Deaths	Number of Live Births	Early Neonatal Mortality Rate	Confidence Interval (95%)
Caste of Mother				
Scheduled Castes	383	11739	32.6	29.4-35.8
Scheduled Tribes	165	5389	30.6	26.0-35.2
OBC	685	22962	29.8	27.6-32.0
Others	403	14560	27.7	25.0-30.3
Religion				
Hindu	1384	44152	31.3	29.7-33.0
Muslim	233	9641	24.2	21.1-27.3
Others	68	2593	26.2	20.2-32.5
Place of Residence				
Rural	1361	42135	32.3	30.6-34.0
Urban	325	14303	22.7	20.3-25.2
Mother's Education				
No Education	978	28237	34.6	32.5-36.8
Primary	275	7920	34.7	30.6-38.7
Secondary and above	433	20280	21.3	19.4-23.4
Mass Media Exposure				
No Exposure	887	26602	33.3	31.2-35.5
Exposure	799	29835	26.8	25.0-28.6
Mother's Occupation				
Not working	942	35384	26.6	24.9-28.3
Primary sector	676	18527	36.5	33.8-39.2
service sector	69	2515	27.4	21.0-33.7
Father's Occupation				
Primary sector	1280	41055	31.1	29.5-32.9
Service sector	385	14682	26.2	23.6-28.8
Wealth Index				
Lower quintile	947	27031	35.0	32.8-37.2
Middle quintile	321	11181	28.7	25.6-31.8
Upper quintile	418	18226	22.9	20.8-25.1
Sources of Drinking Water				
Improved	1289	44501	28.9	27.4-30.5
Not Improved	228	7070	32.2	28.1-36.4
Sanitation Facilities				
Improved	250	11434	21.8	19.2-24.5
Not Improved	1436	45004	31.9	30.3-33.5
Types of Fuel used				
Smoke Free	195	10239	19.0	16.4-21.7
Not Smoke Free	1322	41327	31.9	30.3-33.7

5.2: Demographic and Biological Differentials in Early Neonatal Mortality Rate

Table 5.2 shows early neonatal mortality rate according to demographic and biological characteristics of both the mother and the newborn infant. First, while analyzing mother's characteristics, it was found that mother's age at any child's birth and mother's age at her first birth puts severe impact on the survival of babies in the early neonatal period. Mothers whose age were less than 20 years at the time of child's birth, the early neonatal mortality rate was highest at 43 followed by 34 in the age group 35-49 years and lowest at 26 for the age group 20-34 years. The mortality rate was higher for both younger and older aged women than the middle aged women. The early neonatal mortality rate was 32 for newborns born to mothers of age below 20 years at the time of their first birth and the rate was 26 for mother of age 20 and more years. There exists a negative relationship between mother's previous birth interval and rate of early neonatal mortality. With increasing years of previous birth interval, the mortality rate declines. When the previous birth interval was less than two years, the mortality rate was very high at 43 per thousand of live births. But when the interval increases to 2 to 3 years, the mortality rate sharply declines to 20 and for 4 and above years it further declines to 18 per thousand of live births.

Nutritional status of mother which is measured in terms of body mass index (BMI) and mothers' anemic condition are also linked with early neonatal mortality (Kousar and et al., 2010) Mothers' who were severe anemic, the early neonatal mortality was 41, whereas for mild and not anemic mothers it was 30 per thousand of live births. Child's biological characteristics at the time of birth also put tremendous impact on early neonatal deaths. It was found that early neonatal mortality rate was higher for male child (33) and lower for female child (26). The mortality rate was exceptionally higher in multiple types of births (146) compared with singleton births (28). The early neonatal mortality rate for low birth weight babies (<2.5kg) was 30, whereas for normal babies (>=2.5kg) it was only 12 per thousand of live births. Similarly, very small size babies have higher mortality rate (64) than small size (30) and average/larger size babies (25). Birth order also affects the rate of survival in early neonatal period. The first order births (38) and fourth and above order (32) have higher rate of mortality over second and third order births (23).

Table 5.2: Demographic and Biological Differentials in Early Neonatal Mortality Rate in India, NFHS-3 (2005-06)

Demographic and Biological Factor	Number of Early Neonatal Deaths	Number of Live Births	Early Neonatal Mortality Rate	Confidence Interval (95%)
Mother's Age at Child's Birth				
<20 yrs	507	11882	42.7	39.0-46.3
20-34 yrs	1098	42156	26.0	24.5-27.6
35-49 yrs	81	2400	33.8	26.6-41.1
Mother's Age at First Birth				
<20 yrs	1081	33528	32.2	30.0-34.0
>=20 yrs	605	22909	26.4	24.0-28.0
Previous Birth Interval				
<2yrs	471	10860	43.4	39.5-47.2
2-3 yrs	407	20677	19.7	17.8-21.6
>=4 yrs	141	7679	18.3	15.4-21.4
Body Mass Index				
Under weight	664	21031	31.6	29.2-33.9
Normal	956	33119	28.9	27.1-30.7
Anemia Level				
Severe	41	1003	40.9	28.5-53.0
Mild	942	31338	30.1	28.2-31.9
Not anemic	611	20706	29.6	27.2-31.8
Sex of the Child				
Male	977	29416	33.2	31.2-35.2
Female	709	27022	26.2	24.3-28.2
Type of Birth				
Single	1555	55541	28.0	26.6-29.4
Multiple	131	897	146.0	123.0-169.0
Birth Order				
First	658	17107	38.5	35.6-41.3
Second and Third	553	24429	22.6	20.8-24.5
Fourth and above	475	14902	31.9	29.1-34.7
Child's Birth Weight				
Low Birth Weight (<2500g)	123	4146	39.7	24.5-34.8
Normal (2500 & above)	177	15104	11.7	10.0-13.4
Child's Birth Size				
Average/larger	1114	43866	25.4	23.9-26.9
Small	252	8363	30.1	26.5-33.8
Very Small	219	3402	64.4	56.1-72.6

5.3: Programmatic Factors Differentials in Early Neonatal Mortality Rate

Table 5.3 shows the differentials in early neonatal mortality rate by programmatic factors. The mortality rate was lowest (15) for mothers who have visited at least three times for antenatal care during their pregnancy than those who have not visited at all (24). The early neonatal mortality rate was lowest for women who have visited for antenatal care during the first trimester (16) of their pregnancy than second and third trimester visit (19). Women who have taken IFA tablets for at least 90 days during their pregnancy had lowest rate of early neonatal mortality (16) compared with women who have not taken at all (22). Women who had taken at least two TT injections during their pregnancy, the rate of early neonatal mortality was lowest (17) compared with women who had taken only once (23) and who had not taken at all (28). Similarly, the rate of mortality was lowest (15) for those newborns whose mothers were taking full antenatal care compared with partial utilization (18) and no utilization at all (29).

The early neonatal mortality rate was more or less the same between the group of women having pregnancy complication (19) and another group of women having no pregnancy complication (18). In respect to place of delivery there was hardly any difference in early neonatal mortality rate between institutional (29) and non-institutional delivery (30). But in case of hospital delivery there was large variations with respect to the duration of time spent in hospital after delivery. Those mothers and their newborns who had stayed in hospital less than one day after delivery, the early neonatal mortality was highest (41) and lowest (16) for those who had stayed at least one week and the rate was 28 for duration of stay between one day to less than one week. Therefore, it is not only the hospital delivery but also the duration of stay is very important for the survival of newborns during early neonatal period. Of other programmatic factors, receiving food supplements from Integrated Child Development Services (ICDS) and pregnancy registered with Auxiliary Nurse Midwife (ANM) are negatively related with early neonatal mortality rate. The early neonatal mortality rate was lower for births that have come from registered pregnancy (15) compared with non-registered pregnancies (22). Also, if pregnant women have received food supplements from ICDS, results lower early neonatal mortality rate (12) than those who have not received any supplements from ICDS (20).

Table 5.3: Programmatic Factors Differentials in Early Neonatal Mortality Rate in India, NFHS-3 (2005-06)

Programmatic Factor	Number of Early Neonatal Deaths	Number of Live Births	Early Neonatal Mortality Rate	Confidence Interval (95%)
Antenatal Care Visit				
No visit	216	9035	23.9	21.0-27.0
1-2 visit	210	9706	21.7	18.8-24.6
>=3 visits	308	20602	15.0	13.3-16.6
Time of Antenatal Care Visit				
1st trimester	274	17416	15.7	13.9-17.6
2nd and 3rd trimester	249	12901	19.3	16.9-21.7
IFA Tablets Taken				
Not taken	327	14932	21.9	19.6-24.3
Less than 90 days	257	14457	17.8	15.6-19.9
90 days and more	146	9171	16.0	13.3-18.5
TT Injections Taken				
Not Taken	177	6396	27.7	23.7-31.7
Only Once	61	2647	23.0	17.2-28.6
Two and More	502	30259	16.6	15.1-18.0
Antenatal Care Utilization				
No Utilization	144	4987	28.8	24.3-33.6
Partial Utilization	487	27222	17.9	16.3-19.5
Full Utilization	111	7448	14.9	12.1-17.7
Pregnancy Complication				
No	306	16820	18.2	16.2-20.2
Yes	436	22790	19.1	17.4-20.9
Place of Delivery				
Non Institutional	1026	34549	29.7	27.9-31.5
Institutional	629	21821	28.8	26.6-31.1
Duration of Stay in Hospital				
< 1 day	162	3921	41.3	35.0-47.5
1 day to <1 week	425	15421	27.6	24.9-30.1
1 week & above	39	2446	15.9	10.9-20.9
Pregnancy Registered with ANM				
No	467	20871	22.3	20.4-24.4
Yes	277	18784	14.7	13-16.4
Received Supplementary Nutrition from Anganwadi Centre				
No	653	32035	20.4	18.8-21.9
Yes	90	7619	11.8	9.4-14.2

5.4: Delivery and Newborn Care Differentials in Early Neonatal Mortality Rate

Delivery and newborn care practices are important factors influencing the survival of neonates during early neonatal period. Hygienic delivery practices by using either a delivery kit or a clean blade which prevents umbilical cord infection and newborn care practices such as wiping dry and wrapping the baby without being bathed immediately after birth increases the chance of survival (PATH, 1999 and WHO, 1997) In India of the total home deliveries, in only 22.6 percent of deliveries kits were used and in 95 percent of deliveries clean blades were used and in 95.6 percent of deliveries either a delivery kit or a clean blade were used. In case of newborn care practices, in 46.9 percent of total births newborns were wiped and wrapped immediately after birth. But, in case of providing advice on delivery and new born care practices, overall less than half of the total pregnant women during the last three months of their pregnancy had received advice either from Auxiliary Nurse Midwife (ANM) or Anganwadi Workers (AW) regarding breast feeding, keeping the baby warm immediately after birth and need of cleanliness at the time of delivery (see Table 5.4 in appendix).

Table 5.4 shows the impact of hygienic delivery, newborn care practices and information regarding newborn care on the survival of newborns during early neonatal period. At the time of home delivery if either a disposable delivery kit or a new blade is used for cutting the umbilical cord or baby wiped dry and wrapped without being bathed, then the rate of newborn survival is more than those who were not practicing such methods. In home deliveries where disposable delivery kit was used the early neonatal mortality rate was 14 and where not used the rate was 21 per thousand of live birth. If a baby is wiped dry and wrapped without being bathed immediately after birth, the mortality rate was 17, whereas the rate was 21 in the absent of such practices. If a clean blade is used to cut the umbilical cord the mortality rate was 18 but when not used the rate was doubled (36). When either of the two is used the mortality rate was 18 and when not used, the rate was 39. If breast feeding starts within one hour after birth results in lower early neonatal mortality rate (18) compared with breast feeding starting after one hour of birth. If women during the last three months of their pregnancy were provided any information regarding delivery and newborn care practices such as, advice on breast feeding, keeping the baby warm, need cleanliness at the time of delivery increases the chance of survival of the newborns during early neonatal period. For those women who were advised to breast feed their babies'

immediately after birth the mortality rate was 14 and who were not advised the rate was 18. Similarly, those who were advised to keep the baby warm and need cleanliness at the time of delivery the mortality rate was 15 each and where not advised, the rate was 16 and 17 respectively.

Table 5.4: Delivery and Newborn Care Differentials in Early Neonatal Mortality Rate in India, NFHS-3 (2005-06)

Delivery and Newborn Care Practices and Advice	Number of Early Neonatal Deaths	Number of Live Births	Early Neonatal Mortality Rate	Confidence Interval (95%)
During delivery: delivery kit used				
No	343	16483	20.8	18.6-23.0
Yes	67	4800	14.0	10.7-17.3
During delivery: clean blade used to cut umbilical cord				
No	40	1119	35.8	24.8-46.6
Yes	384	21353	18.0	16.2-19.8
Either blade or delivery kits used				
No	38	985	38.6	26.5-50.6
yes	388	21514	18.0	16.2-19.8
During delivery: baby wiped dry and wrapped				
No	248	11920	20.9	18.3-23.4
Yes	179	10532	17.0	14.5-19.4
Initiation of breast feeding				
Within 1 hour of birth	229	12991	17.6	15.4-19.9
After 1 hour of birth	836	41885	20.0	18.6-21.3
During last 3 months of pregnancy received advice from ANM, AW on : Breastfeeding				
No	126	7012	18.0	14.9-21.1
yes	85	6228	13.6	10.7-16.4
Keeping the baby warm				
No	133	8204	16.2	13.5-18.9
Yes	78	5086	15.3	12.0-18.8
Need cleanliness at the time of delivery				
No	120	7003	17.1	14.0-20.1
Yes	92	6289	14.6	11.7-17.6

From this section, it is caler that among the socio-economic and environment factors the rate of early nenatal mortality was higher among Scheduled caste women, among Hindus, women with no and primary education, living in rural areas, woking in primary sector, belong to lower wealth quintile and households with no improved sanitation facilities and where solid cooking fuels were used. On the other hand the mortality rate was lower among women with secondary and higher education, living in urban areas, belong to upper wealth quintile and households with improved sanitiation facilities and where smoke free coocking fuels were used. Among demographic and biological factors early nenatal mortality rate was higher among women who were below 20 years at the time of therir child's birth, among severe anemic women, child born in mutiple birth and having previous birth interval below two years, in first order births and among very small birth size and low birth weight babies. On the other hand the mortality rate was lower among women in the middle age group (20-34 years), previous birth intervals more that two years, second and and third birth order and child with normal birth weight. Among programmatic and newborn care factors the early nenatal mortality rate was higher among women who have not utilised antenatal care, where duration of stay in hospital was less than 24 hours and during delivery where no delivery kit or blade were used The early nenatal mortality rate was lower among women who have visited atleast three antenatal care, consumed atleast 90 IFA tablets, two and more TT injections and utilizing full antenatal care and where the duration of stay in hospital was at least one week.

These differentials in early neonatal mortality rate are the gross effects. It is important to find out the net impact of these factors on early neonatal mortality for better understanding of the influences. The information on the level of early neonatal mortality of a population provides an average picture. It is also imperative to see how early neonatal mortality is distributed among poor and non-poor population (inequality in early neonatal mortality) and which factors are contributing to this inequalities. This will help policy makers in bridging the gap in early neonatal mortality rate between the two sections of the population and ultimately the reduction of average early neonatal mortality. These issues have been taken up in the next section of multivariate analysis and the analysis of inequalities in early neonatal mortality.

5.5: Determinants of Early Neonatal Mortality from Multivariate Analysis

Table 5.6 presents the results of the multivariate analysis which shows the net effect of each explanatory variable on early neonatal mortality in terms of odds ratio. Among the variables included in the model, caste, religion, education, drinking water, sex of the child, birth order, birth size, mother's age at child birth, antenatal care and place of delivery have significant impact on the survival of newborns during early neonatal period. The chance of dying during early neonatal period was lower for newborns born to scheduled tribe mothers (OR=0.682, $p<0.05$) compared with scheduled caste mothers. The chance of early neonatal deaths was less for newborns born to Muslim mothers (OR=0.781, $P<0.1$) compared with Hindu mothers. The likelihood of dying was less among newborns born to mothers having secondary and higher education (OR=0.601, $P<0.01$) compared with no educated mothers. The quality of drinking water used in the households also put impact on the survival of infants during the early neonatal period. The risk of dying was more in households where no improved sources of drinking water was available (OR=1.281, $P<0.05$) compared with households available with improved sources of drinking water.

Of the demographic and biological factors, the female infants have less chance of dying (OR=0.836, $P<0.05$) compared with male infants. Though the likelihood of dying was lower for all higher order births compared with first order births but it was lowest for second and third order births. The odds of dying among newborns of second and third order births (OR=0.590, $P<0.01$) and of fourth and above order births (OR=0.750, $P<0.05$) were low compared with first order births. The size of baby at the time of birth is an important factor influencing the survival of newborns. The chance of dying was nearly two and half times more among very small birth size babies (OR=2.456, $P<0.01$) compared with large/average/small size babies. Babies born to older women have higher chance of dying during the early neonatal period compared with very young age mothers. The chance of dying was one and half times more among newborns whose mothers were in the age group 35-49 years at the time of newborns birth (OR=1.496, $P<0.05$) compared with very young (<20 years) mothers.

Among the programmatic factors, the utilization of antenatal care in varying degrees also influences the chance of survival among newborns during early neonatal period. The likelihood of dying among newborns born to mothers utilizing partial antenatal care (OR=0.641, P<0.01) and full antenatal care (OR=0.541, P<0.01) were less compared with mothers not utilizing any antenatal care. In case of place of delivery the chance of dying was more in hospital deliveries (OR=1.480, P<0.01) compared with home deliveries. This contradictory result may be that in rural areas most of the high risk pregnant women go for hospital delivery at the last moment due to delivery complications where doctors cannot save the lives of the newborns. And in general in many cases the duration of stay in hospital after delivery is less than 24 hours, resulting higher chance of dying. This finding also matches with the finding of some previous studies where the chance of dying was more in hospital deliveries compared with home deliveries (Achyut, 1997 and James, 2004).

Table 5.5 also shows the predicted probability of dying for all categories of each factor after controlling other factors. The probability of dying was highest among very small birth size babies (73.4 deaths per thousand of live births), followed by newborns born to mothers in the age group 35-49 years (46.1), delivery taken place in hospital (45.6), households not having improved sources of drinking water (39.7) and improved sanitation facilities (37.1), women belong to other religion (37), and household not using improved cooking fuel (36.6). On the other side the predicted probability of dying was least among infants whose mothers' were availing full antenatal care (17.2), followed by second and third order births (18.7), women having secondary and higher education (19), availing partial antenatal care (20.3), among scheduled tribe women (21.5), and in fourth and higher order births (23.4).

From the above discussion it was found that very small birth size babies and newborns born to older age group mothers, deliveries taking place in hospital and living in unhygienic environment (household with not having improved sanitation facilities and drinking water and use of solid cooking flues) and newborns born to other religion have higher chance of dying. On the other hand chance of dying was less where women were taking full antenatal care, having secondary and higher education and second and third order births.

Table-5.5: Odds Ratio and Predicted Probability for Early Neonatal Mortality from Binary Logistic Regression Analysis in India, NFHS-3 (2005-06)

Factor	Category	Odds Ratio	Predicted Probability(P)
Place of Residence	Rural®		31.3
	Urban	0.920	28.8
Caste of Mother	SC®		31.3
	ST	0.682**	21.5
	OBC	0.985	30.8
	General	1.013	31.7
Religion of Mother	Hindu®		31.3
	Muslim	0.781*	24.6
	Others	1.191	37.0
Mother's Education	No Education ®		31.3
	Primary	0.919	28.8
	Secondary & Above	0.601***	19.0
Mass-Media Exposure	No Exposure®		31.3
	Exposure	0.954	29.9
Wealth Index	Lower®		31.3
	Middle	0.983	30.7
	Upper	1.003	31.2
Source of Drinking Water	Improved®		31.3
	Not Improved	1.281**	39.7
Sanitation Facilities	Improved®		31.3
	Not Improved	1.194	37.1
Types of Cooking Fuel used in Household	Smoke Free®		31.3
	No Smoke Free	1.178	36.6
Sex of the Child	Male®		31.3
	Female	0.836**	26.3
Birth Order	First®		31.3
	2nd and 3rd	0.590***	18.7
	4th and above	0.750**	23.6
Birth Size	Large/Average/Small®		31.3
	Very small	2.456***	73.4
Mother's Age at Child's Birth	<20 yrs®		31.3
	20-34 yrs	1.001	31.3
	35-49 yrs	1.496**	46.1
Antenatal Care Utilization	No Utilization®		31.3
	Partial Utilization	0.641***	20.3
	Full Utilization	0.541***	17.2
Pregnancy Complication	No Complication®		31.3
	Complication	1.015	31.7
Place of Delivery	Home®		31.3
	Hospital	1.480***	45.6

(0=No Death and 1= Yes Death) ® Reference Category, Level of significance: * p<0.10, ** p<0.05, *** p<0.01

Note: Predicted Probability of Dying (P) is per thousand of live births

5.6: Socio-economic Inequalities and Decomposition in Early Neonatal Mortality

Socio-economic inequalities are the underlying causes of neonatal deaths through increasing the prevalence of risk factors or reducing access to health care services. It is well documented fact that the burden of ill health and mortality is borne disproportionately by different subgroups of population and people from lower socio-economic status consistently experience poor health outcomes (Macinko et al., 2003). Hence, the improvement of the health status of the poor and reduction of health inequalities between the poor and the non-poor have become the central goals of many international organizations and several national governments across the globe (Wagstaff, 2000). A recent study on health inequality in India shows that the value of the concentration indices (a tool of measuring socio-economic inequalities in certain variables) for a set of child health indicators for India and among states were negative, indicating greater concentration among the poor section of the population. There were wide variations in the inequalities of under-five mortality across states, with the minimum concentration index (-0.0388) in West Bengal and maximum (-0.4107) in Uttaranchal. Among other states, Maharashtra, Madhya Pradesh, Gujarat, Tamil Nadu and Punjab have greater income-related inequalities than Uttar Pradesh, Rajasthan, and Bihar (William et al., 2008). In this section of this study the socioeconomic inequalities in early neonatal mortality is measured by concentration index and concentration curve. The decomposition of the concentration index is carried out to show the relative contributions of the determinants to socioeconomic inequality in early neonatal mortality in India.

In Table 5.6 the concentration index for early neonatal mortality in India is calculated by taking total number of births in each wealth quintile ranked from poorest to richest and the corresponding deaths in the same wealth quintile during the last 5 years preceding the survey. Expressing these births in each wealth quintile as percentage of the total births, and cumulating those gives the cumulative percentage of births ordered by wealth quintile and then this is plotted on the x-axis. Similarly, the cumulative percentage of deaths is plotted on the Y-axis after calculating the relative cumulative percentage deaths. In the final column the concentration index is calculated by applying the formula mentioned in methodology section. This negative value of the concentration index (-0.1095) shows that early neonatal mortality is concentrated among the lowest quintile.

Figure 5.1 shows the concentration curve for early neonatal mortality in India, which is drawn by plotting the cumulating percentage of births ranked in wealth quintile with the corresponding cumulative percentage of deaths. The concentration curve of India so drawn is above the line of equality indicating that the deaths are proportionately more from the lowest wealth quintile. The regional inequalities in early neonatal mortality among the three broad regions EAG (Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Bihar, Jharkhand, Rajasthan, Orissa and Assam), south (Andhra Pradesh, Tamil Nadu, Karnataka, and Kerala) and other (rest of the states) had shown in table 5.7, 5.8 and 5.9. The concentration index of the south Region was lowest (-0.0133) and in other Region it was highest (-0.1616). In EAG region the concentration index was -0.0683. These indices show that the inequalities in early neonatal mortality were lower in south Region, followed by EAG and other regions. The degree of inequalities in south and EAG regions were less compared with all India average. Though the rate of early neonatal mortality was higher in EAG Region (34) compared with other region (25) but, it was opposite in case of inequalities in early neonatal mortality. The concentration curves of the three regions along with India are shown in the figure 5.2.

Table 5.10 shows the result of the decomposition analysis for early neonatal mortality in India. The result shows that all the determinants taken in the decomposition analysis are together explaining 63 percent of total inequality in early neonatal mortality and rest 37 percent are unexplained. Among the determinants, the contribution of no education to inequality in early neonatal mortality was the largest (35%), followed by no antenatal care utilization (25%), poor economic status (12%), living in rural areas (12%) and no mass media exposure (7%).

The above discussion shows that in India larger proportion of early neonatal deaths occur in lowest wealth quintile. Among the three broad regions the same scenario exists with varying degrees of inequalities where lowest in south region and highest in other region. Among the factors which causes inequalities, the contribution of no education and no utilization of antenatal care were in the highest order.

Fig 5.1: Concentration Curve for Early Neonatal Deaths in India, 2005-06

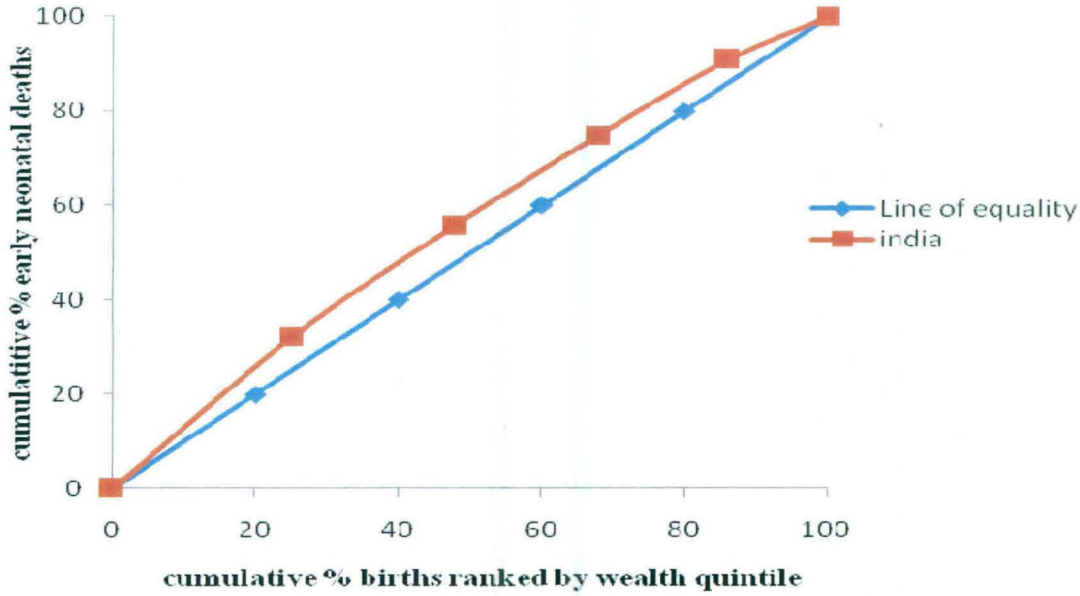


Fig 5.2: Concentration Curves for Early Neonatal Deaths in India, EAG, South and Other Region, 2005-06

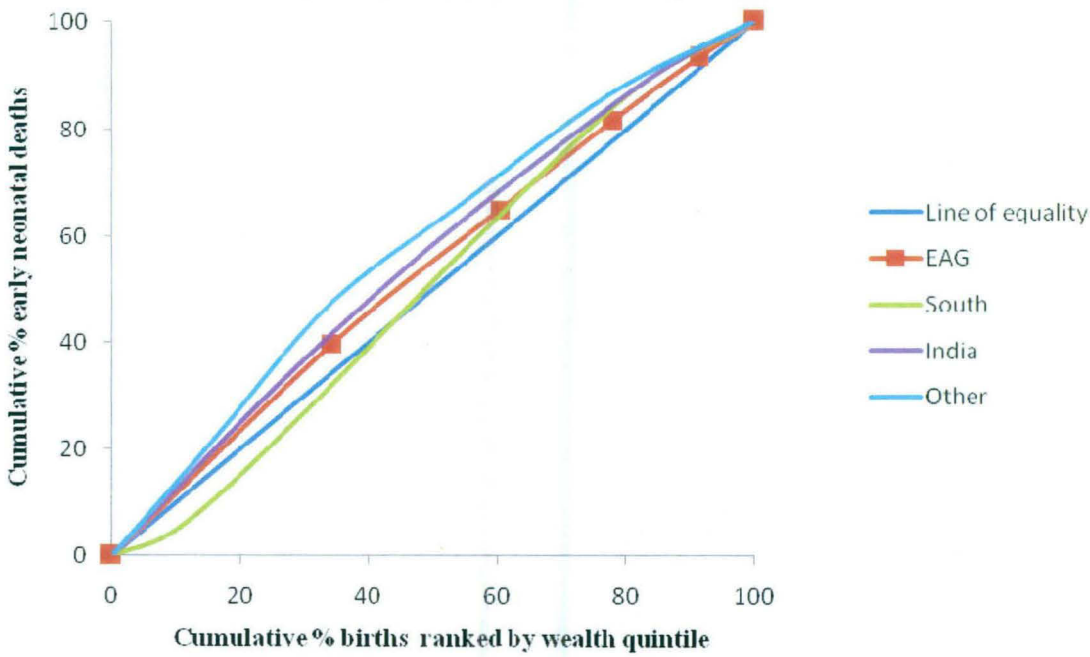


Table 5.6: Concentration Index for Early Neonatal Mortality in India, NFHS-3 (2005-06)

Wealth Group	No. of Births	Rel % Births	Cumul % Births (p)	ENMR per 1,000	No. of Deaths	Rel % Deaths	Cumul % Deaths (L)	Conc. Index
Poorest	14376	25	25	37	532	32	32	-0.0080
Poorer	12654	22	48	33	415	25	56	-0.0201
Middle	11181	20	68	29	321	19	75	-0.0285
Richer	10154	18	86	26	266	16	91	-0.0529
Richest	8072	14	100	19	152	9	100	0.0000
Total/Average	56437	100		**30**	1686	100		**-0.1095**

Table 5.7: Concentration Index for Early Neonatal Deaths in South Region, NFHS-3 (2005-06)

Wealth Group	No. of Births	Rel % Births	Cumul % Births (P)	ENMR per 1,000	No. of Deaths	Rel % Deaths	Cumul % Deaths (L)	Conc. Index
Poorest	965	11	11	11	11	6	6	0.0120
Poorer	1568	18	29	26	40	20	26	0.0226
Middle	2392	27	55	27	64	32	58	0.0125
Richer	2291	26	81	25	58	29	87	-0.0605
Richest	1705	19	100	15	26	13	100	0.0000
Total/Avg	8291	100		**22**	199	100		**-0.0133**

Table 5.8: Concentration Index for Early Neonatal Deaths in EAG Region, NFHS-3 (2005-06)

Wealth Group	No. of Births	Rel % Births	Cumul % Births (p)	ENMR per 1,000	No. of Deaths	Rel % Deaths	Cumul % Deaths (L)	Conc. Index
Poorest	10924	34	34	40	436	40	40	-0.0170
Poorer	8273	26	60	33	276	25	65	-0.0131
Middle	5605	18	78	33	184	17	82	-0.0181
Richer	4248	13	91	30	128	12	93	-0.0201
Richest	2755	9	100	26	73	7	100	0.0000
Total/Avg	31805	100		**34**	1097	100		**-0.0683**

Table 5.9: Concentration Index for Early Neonatal Deaths in Other Region, NFHS-3 (2005-06)

Wealth Group	No. of Births	Rel % Births	Cumul % Births (p)	ENMR per 1,000	No. of Deaths	Rel % Deaths	Cumul % Deaths (L)	Conc. Index
Poorest	2486	16	16	34	85	22	22	0.0008
Poorer	2809	18	34	35	98	25	47	-0.0319
Middle	3175	20	54	23	73	19	66	-0.0400
Richer	3602	23	77	22	80	21	86	-0.0905
Richest	3584	23	100	15	54	14	100	0.0000
Total/Average	15656	100		**25**	390	100		**-0.1616**

Table 5.10: Decomposition of Concentration Index for Early Neonatal Mortality in India, NFHS-3 (2005-06)

Determinants	Mean	Marginal Effect	Concentration Index (CI)	Absolute Contribution to CI	Percentage Contribution to CI
Place of Residence	0.747	0.002	-0.1607	-0.0080	11.6
Economic Status	0.479	0.001	-0.5211	-0.0083	12.0
Mother's Education	0.500	0.005	-0.2911	-0.0244	35.1
Mass-Media Exposure	0.471	0.001	-0.3109	-0.0049	7.1
Caste	0.313	-0.001	-0.2213	0.0023	-3.3
Religion	0.783	0.002	-0.0126	-0.0007	1.0
Drinking Water	0.137	0.004	-0.2326	-0.0043	6.1
Sex of the Child	0.521	0.003	-0.0100	-0.0005	0.8
Birth Size	0.061	0.025	-0.0694	-0.0035	5.1
ANC Utilization	0.126	0.01	-0.4078	-0.0172	24.7
Early Neonatal Mortality	0.0299		-0.1095	-0.0695	**100.0**
			Residual	**-0.0401**	

Note: Estimation is based on the method proposed by Wagstaff et al., 2003

CHAPTER 6

CONCLUSIONS

CHAPTER-6

CONCLUSIONS

Child health is one of the important components of the overall health of a population and its promotion has become an important goal both for international community as well as for many national governments. The death of a child is an extra health burden to the mother and is considered as a loss to the family, to the society and finally to an economy. So every country tries to ensure the survival of each and every child, right from the moment of birth. Among the several indicators of socio-economic development, the level of Infant mortality rate (IMR) is well recognized as an indicator of overall health infrastructure and socio-economic development of a country. The infant mortality rate of many developing countries is still very high as compared to developed countries. Thus, the reduction of infant mortality rate is a target in the Millennium Development Goal-4 for child survival. It has set the target of reducing infant mortality rate by two-thirds between 1990 and 2015. According to 2010 estimate on under-five mortality among the 64 countries with high mortality rates, only 9 countries are on track to meet the Millennium Development Goal-4 by 2015 (UNICEF, WHO and World Bank, 2010). In this context this present study is helpful for those off-track countries and particularly for India for the faster reduction in IMR and under-five mortality rate.

Presently both in developed and developing regions of the world, three-fourths of the neonatal deaths come from early neonatal period. It is a major concern in developing countries and there is huge difference in the levels of early neonatal mortality rate between the two regions. The same scenario is observed in India where neonatal mortality shares nearly two-thirds of infant mortality and the early neonatal mortality shares three-fourths of neonatal mortality. Any substantial reduction in infant mortality rate in future will require reduction in early neonatal mortality to a large extent and this has shifted the focus from infant mortality to neonatal mortality and finally from neonatal mortality to early neonatal mortality.

The present level of early neonatal mortality in India is very high. During the last three and half decades the percentage reduction in early neonatal mortality rate was very low compared with reduction in post neonatal mortality rate and in late neonatal mortality rate. Marked differences in early neonatal mortality rate are also observed between south and north Indian states and

between rural and urban areas. Among some bigger states the percentage share of early neonatal mortality rate to neonatal mortality rate has already reached to more than ninety percent showing the increasing dominance of early neonatal mortality in neonatal mortality. The disparity in early neonatal mortality rate between EAG and non-EAG states is increasing over the years because of the differences in the rate of reduction. Among the six NFHS regions the highest percentage reduction in early neonatal mortality rate during NFHS-1 to NFHS-3 was in south region. The deaths during early neonatal period are unevenly distributed and this pattern has remained the same over the three rounds of NFHS. The highest risk of dying was in zero day where nearly forty percent of total deaths have occurred. Therefore the first twenty four hours in newborns life needs maximum care in order to save a substantial number of deaths during early neonatal period.

From this study it is found that newborns of very small birth size and born to old age mothers have higher chance of dying. Unhealthy living environment (lack of quality drinking water and improved sanitation facilities and households where solid cooking fuels are used) also increases the chance of dying among newborns during early neonatal period. On the other hand lower probability of dying was seen among newborns born to mothers who were taking full antenatal care and having secondary and above education. Newborns born in hospital deliveries having higher likelihood of dying compared with home deliveries which seem to be unexpected, but it was supported by some previous studies (Achyut, 1997 and James, 2004). This contradictory result may be due to the fact that in many cases delivery complicated women at the last moment are transferred to hospitals where doctors cannot save the lives of the newborns. The other explanation from this study is that when the duration of stay in hospital after delivery was not enough resulted higher early neonatal mortality. Hence, in this case it can be said that though hospital delivery is a necessary condition for newborns survival but it may not be always a sufficient condition if the duration of stay is not enough.

In India there exists socio-economic inequality in early neonatal mortality where higher proportion of total early neonatal deaths occurs in lower wealth quintile. Among the three broad regions the highest regional inequality in early neonatal mortality was in EAG region which is the most backward region in terms socio-economic and health indicators. The lowest inequality in early neonatal mortality was observed in south region. In EAG region though early neonatal

mortality rate was higher than other region but in terms of inequalities in early neonatal mortality it was just the reverse. In the decomposition analysis all the predictors together explain 63 percent of total socio-economic inequalities in early neonatal mortality in India. Of the total explained inequalities, the contribution of women with no education was the highest (35%) followed by no antenatal care utilization (24.7%), poor economic status (12%), living in rural areas (11.6%) and women not exposed to mass media (7.1%).

The results of the study are supporting most of the hypothesis. The hypothesis that the early neonatal deaths are concentrated towards the first day of life has come true. The hypothesis that the chance of survival is higher for newborns whose mother's were availing full antenatal care compared with partial and not at all is also true. The hypothesis that the rate of early neonatal mortality is lower for newborns where delivery kits/new blades are used is accepted. The chance of survival is more in home deliveries compared with hospital deliveries is rejected. The hypothesis that the inequality in early neonatal mortality in EAG region is higher than South region has come true. But on the other hand the inequality in EAG region is higher than other region is rejected. Mother's education is the largest contributor to the inequality in early neonatal mortality is also accepted.

From the point of view of policy implications it is quite evident that early neonatal mortality is an important component of infant mortality and particularly in neonatal mortality. Its slow rate of reduction and current substantial share in neonatal mortality urges policymakers to design exclusive programs for newborns in order to increase their chance of survival during early neonatal period. Focus should be given to different sub-groups of population where the probability of dying during these seven days is higher especially in others religion, no educated mothers, women living in unsanitary environment, first order births, very small birth size babies, aged pregnant women, no utilization of antenatal care and deliveries taken place in hospitals. Hygienic delivery and newborn care practices should be promoted in home deliveries and utmost care should be given to newborns during first twenty four hours after birth. Improved water and sanitation facilities should be available to all households. Information, Education and Communication (IEC) programs on simple low cost newborn care and on hygienic delivery should be strengthened. There is a need to ensure full utilization of antenatal care to all pregnant women. In the present scenario of hospital deliveries the duration of stay in hospital should be

increased to at least the first week of life for all newborns along with the serious one and if not possible then essential newborn care should be provided by community health workers at home. The healthcare system should be strengthened to deliver effective maternal and newborn health care. The ongoing integrated maternal and child health program should reach out the regions where the degree of socio-economic inequalities in early neonatal mortality is higher. And priority should be given to areas such as women with no education, no antenatal care utilization, poor economic status, and living in rural areas which are the largest contributors to socio-economic inequalities in early neonatal mortality.

BIBLIOGRAPHY

BIBLIOGRAPHY

Achyut, P., S. Lahiri, and R. Acharya. 1997. "Non-biological correlates of early neonatal deaths: evidence from five selected states of India," *Demography India* 26(2):241-260.

Aggarwal, A. K., R. Kumar, and P. Kumar. 2003. "Early neonatal mortality in a hilly north Indian state: socio-demographic factors and treatment seeking behaviors," *Indian Journal of Preventive Social Medicine* 34(1 & 2).

Araujo, B. F., M. C. Bozzetti, and A. C. A. Tanaka. 2000. "Early Neonatal Mortality in Caxias do Sul: a cohort study," *Jornal de pediatria* 76(3): 200-206.

Bamji, M. S. et al. 2008. "Maternal nutritional status & practices & perinatal, neonatal mortality in rural Andhra Pradesh, India," *Indian J Med Res* 127 :(44-51).

Bang A., M. H. Reddy, and M. D. Deshmukh. 2002. "Child Mortality in Maharashtra," *EPW*, 37(49): 4947-4965.

Bang, A. T., R. A. Bang and H.M. Reddy, 2005. "Home based neonatal care: summary and application of the field trial in rural Gadchiroli, Maharashtra, India: 1993-2003," *Journal of Perinatalogy* 25:S108–S122

Baqui, A. H. et al. 2005b. "Evidence based, cost effective interventions: how many newborn babies can we save," *Lancet* 365: 977-88.

Baqui, A. H. et al. 2006a "Rates Timing and Causes of Neonatal Deaths in Rural India: Implications for Neonatal Health Programs," *Bulletin of World Health Organization* 89 (9).

Barros, F. C. et al. 2005. "The challenge of reducing neonatal mortality in middle income countries: findings from three Brazilian birth cohorts in 1982, 1993, and 2004," *Lancet* 365: 847-854.

Bassani, D.G. et al. 2010. "Causes of neonatal and child mortality in India: a nationally representative mortality survey," *Lancet* 376: 1853-60.

Bhutta, Z.A. et al. 2008. "Implementing community-based perinatal care: results from a pilot study in rural Pakistan," *Bulletin of World Health Organ* 86: 452-459.

Black, R. E. et al. 2010. "Global, regional, and national causes of child mortality in 2008: a systematic analysis," *Lancet* 375: 1969-87.

Bryce, J. et al. 2008. "Countdown to 2015 for maternal, newborn, and child survival: the 2008 report on tracking coverage of intervention," Lancet 371:1247-58.

Caldwell, J. C. 1979. "Education as a Factor in Mortality Decline: An Examination of Nigerian Data," *Population Studies* 33(3): 395-413.

Chavan, Y. S. et al. 1992. "Causes of early neonatal mortality," *Indian Pediatrics* 29: 781-783.

Chien, T. T. T. 2002. "Perinatal Mortality in Viet Nam," *Asia-Pacific Population Journal* 17: 3-16.

Chowdhury, Q. H., R. Islam, and K. Hossain 2010. "Socio-economic determinants of neonatal, post neonatal, infant and child mortality," *International Journal of Sociology and Anthropology* 2(6): 118-125.

Confidential Enquiry into Maternal and Child Health, Perintal Mortality, Executive Summary, April 2005. (2007), England, Wales and Northern Ireland, pp. 1-12.

Dali, S. M. et al. 2003. "Perinatal death audit," *Journal of Nepal Medical Association* 42: 383-386.

Dashtseren, A. 2002. "Determinants of Infant and Child Mortality in Mongolia," *National Statistical Office of Mongolia, UNFPA FO in Mongolia* pp. 1-26.

Dyregrov, A. And S. B. Matthiesen. 1987. "Stillbirth, neonatal death and Sudden Infant Death (SIDS): Parental reactions," *Scandinvian Journal of Psychology* 28: 104-114.

Edmond, K. M. et al. 2007. "Effect of early infant feeding practices on infection-specific neonatal mortality: an investigation of the causal links with observational data from rural Ghana," *American Society for Nutrition* 86 :(1126 –31).

Ekman, B., I. Pathmanathan and J. Liljestrand. 2010. 'Integrating health interventions for women, newborn babies, and children: A framework for action," *Lancet* 372: 990-1000.

Engmann, C. *et al.* 2009. "Stillbirth and early neonatal mortality in rural Central Africa," *International Journal of Gynecology and Obstetrics* XXX: 2-6.

Fernandez, A., J. Mondkar, and S. Mathai. 2003. "Urban slum-specific issues in neonatal survival," *Indian Pediatrics* 40 :(1161-66).

Fuller, M. and D. Lury. 1977. "Statistics workbook for social science student," Oxford: Phillip Allan.

Galjaart, P. 2008. "Early neonatal deaths in Sub-Saharan Africa," The Netherlands: KIT(Royal Tropical Institute) Vrije Universiteit Amsterdam.

Garssen, J. and A. Meulen. 2004. "Perinatal mortality in the Netherlands backgrounds of a worsening international ranking," *Demographic Research* 11: 357-394.

Golestan, M., R. Fallah, and S. A. Karbasi. 2008. "Neonatal mortality of low birth weight infants in Yazd, Iran," *Iranian Journal of Reproductive Medicine* 6 (4) : 205-208.

Goli, S., P. K. Singh and P. Arokiasamy. 2010. "How far socioeconomic determinants affect the demographic and health inequalities in urban India: evidences from NFHS-3," American Population Association.

Gunasekera, D. P. S. and P. C. Gunasekera. 2000. "Improving perinatal and neonatal mortality in Sri Lanka: is it cost effective?," *Sri Lanka Journal of Child Health* 29: 23-6.

Gunasekera, D. P. S. and P. C. Gunasekera. 2000. "Improving perinatal and neonatal mortality in Sri Lanka: is it cost effective?," *Sri Lanka Journal of Child Health* 29: 23-6.

Health Research and Information Division. 2009. Perinatal Report 2007, Ireland.

Hill, K. And Y. Choi. 2006. "Neonatal mortality in the developing world," *Demographic Research* 14(18): 429-452.

Hinderaker, S. G. et al. 2003. "Perinatal Mortality in Northern Rural Tanzania," ***J** Health Popul Nutr* 21(1):8-17.

Hosseinpoor, A. R. *et al.* 2005. "Socioeconomic inequality in infant mortality in Iran and across its provinces," *Bulletin of the World Health Organization* 83: 837-844.

Hosseinpoor, A.R. et al. 2006. "Decomposing socioeconomic inequality in infant mortality in Iran," *International Journal of Epidemiology* 35: 1211-1219.

International Institute for Population Sciences (1992-93), "National Family Health and Survey-I", *Ministry of Health and Family Welfare*, New Delhi.

International Institute for Population Sciences (1998-99), "National Family Health and Survey-II", *Ministry of Health and Family Welfare*, New Delhi.

International Institute for Population Sciences (2005-06), "National Family Health and Survey-III", *Ministry of Health and Family Welfare*, New Delhi.

Jacoby, H. and L. Wang. 2003. "Environmental Determinants of Child Mortality in Rural China: A Competing Risks Approach," *World Bank, Washington D.C.*

Jain, A. K. 1985. "Determinants of Regional Variations in Infant Mortality in Rural India," *Population Studies* 39: 407-424.

James, K. S. and S. V. Subramanian. 2004. "Neonatal mortality in India: the role of maternal factors," *Demography India* 33(2):157-171.

Jehan, I. et al. 2009. "Neonatal mortality, risk factors and causes: a prospective population-based cohort study in urban Pakistan," *Bulletin of the World Health Organization* 87: 130-138.

Joe, W., S. Mishra, and K. Navaneetham. 2008. "Health Inequality in India: evidence from NFHS 3," *Economic and Political Weekly:* pp. 41-47.

Jonge, A. D. et al. 2009. "Perinatal mortality and morbidity in a nationwide cohort of 529 688 low-risk planned home and hospital births," *International journal of obstetrics and gynecology* :1-6.

Joshi R. 2003. "Perinatal and neonatal mortality in rural Punjab: A community based case-control study," *Achutha Menon Centre For Health Science Studies: Working* Paper No. 3.

Kakwani, N., A. Wagstaff, E. V. Doorslaer, and K. A. Eddy. 1995. "Socioeconomic Inequalities in Health: Measurement, Computation and Statistical Inference," New South Wales: University of New South Wales, Ch.6. 83-92.

Kakwani, N., A. Wagstaff, E. V. Doorslaer, and K. A. Eddy. 1995. "Socioeconomic Inequalities in Health: Measurement, Computation and Statistical Inference," New South Wales: University of New South Wales, Ch.7. 95-108.

Kakwani, N., A. Wagstaff, E. V. Doorslaer, and K. A. Eddy. 1995. "Socioeconomic Inequalities in Health: Measurement, Computation and Statistical Inference," New South Wales: University of New South Wales, Ch.8. 159-164.

Kidanto, H. L., S. N. Massawe, L. Nystrom, and G. Lindmark. 2006. "Analysis of Perinatal mortality at a teaching hospital in Dar es Salaam, Tanzania, 1999-2003," *African Journal of Reproductive Health* 10 (2): 72-80.

Kikhela, D. N. 1989. "Techniques of collection and analysis of data on perinatal mortality in Kinshasa, Zaire," *International Development Research Centre:* 1-100.

Koolman, Xander., & Doorslaer, Eddy Van., (2003), "On the Interpretation of a Concentration Index of Inequality",

Korejo, R. et al., 2007. "An audit and trends of perinatal mortality at the Jinnah Postgraduate Medical Centre, Karachi," *JMPC* 57(4): 168-171.

Kousar, T. et al. 2010. "Risk factors and causes of death in Neonates,"

Kumar, D., A. Verma, and V. K. Sehgal. 2007. "Neonatal mortality in India," *Rural and Remote Health* 7: 833.

Kumar, V. et al. 2008. "Effect of community based behavior change management on neonatal mortality in Shivgarh, Up, India: a cluster-randomized controlled trial," *The Lancet* 372(9644): 1151 – 1162.

Kusiako, T., C. Ronsmans, and L. V. Paal. 2000. "Perinatal mortality attributable to complications of childbirth in Matlab, Bangladesh," *Bulletin of the World Health Organization* 78(5): 621-627.

Lav, S. P., D. P. Davies, K. P. Fung, and T. F. Fok. 1985. "Perinatal and neonatal mortality in Hongkong an appraisal," *Journal of the Hong Kong Medical Association* 37(3): 112-116.

Lawn, J. et al. 2005. "4 million neonatal deaths: when? Where? Why?" *The Lancet.*

Lawn, J., K. W. Ketende, and S. N. Cousen. 2006. "Estimating the causes of 4 million neonatal deaths in the year 2000," *International Journal of Epidemiology 35(706-718).*

Lee, A. C. C. 2008. "Risk factors for neonatal mortality due to birth asphyxia in southern Nepal: a prospective, community-based cohort study," *Pediatrics* 121(5): e1381–e1390.

Majeed, R. *et al.* 2007. "Risk factors of birth asphyxia," *J Ayub Medical College* Abbottabad: 19(3): 67-71.

Marmot, Michael. 2005. "Social determinants of health inequalities", Lancet Vol. 365.

Mavalankar, D. V., C. R. Trivedi and R. H. Gray. 1991. "Levels and risk factors for perinatal mortality in Ahmedabad, India," *World Health Organization* 69(4):435-442.

Millennium Development Goals in India, 2010-A Civil Society Report.

Ministry of Health and Family Welfare.1997. Family welfare Programme in India 1995-96, New Delhi.

Mokuolu, A., O. Olugbenga, and Sulelman, B.M. 2010. "Prevalence and Determinants of pre-term deliveries in the University of LLorin Teaching Hospital," *LLorin, Nigeria* 2(e3): 11-14.

Morris, J. N. and J. A. Heady. 1955. "Objects and methods: no. 1 of social and biological factors in infant mortality," *Lancet.*

Mosley, W. H. and L.C. Chen. 1984. "An Analytical Framework for the Study of Child Survival in Developing Countries," *A Supplement to Population and Development Review.* 10: 24-45.

Mufti, P., F. Senta, and K. Nazir. 2006. "Early neonatal mortality: effects of interventions on survival of low birth babies weighing 1000-2000g," *Journal of Pakistan Medical Association* 56(4):174-176.

Mustafa, H. E. and C. Odimegwu. 2008. "Socioeconomic determinants of infant mortality in Kenya: analysis of Kenya DHS 2003," *Journal of Humanities and Social Science* 2(2):1-16.

Mutunga, C. J. 2004. "Environmental Determinants of Child Mortality in Kenya," *Kenya Institute for Public Policy Research and Analysis* (KIPPRA), Nairobi, Kenya.

Mutunga, C. J. 2004. "Environmental Determinants of Child Mortality in Urban Kenya," *ICTP*, Trieste, Italy.

Ngoc, N. T. N. et al. 2006. "Causes of still births and early neonatal deaths: data from 7993 pregnancies in six developing countries," *Bulletin of the World Health Organisation* 84(9): 699-705.

Osrin, D. et al. 2005. "Effects of antenatal multiple micronutrient supplementations on birth weight and gestational duration in Nepal: double bind randomised controlled trial," *Lancet* 365: 855-62.

PATH 1999. Clean Delivery Kit Workshop Report. Nairobi, Kenya.

Peniche, M. et al. 2010. "Maternal factor in early neonatal death: the need to train first-contact health personnel," *Bol Med hosp infant Mex* 67: 444-451.

Peniche, M. T. M. et al. 2010. "Maternal factors in early neonatal death: the need to train first-contact health personnel," *Bol Med Hosp Infant Mex*: 67: 444-451.

Perinatal Statistics Report, Report Research and Information Division, 2007, October (2009), ESRI, pp. 4-86.

Phelan, S. T., R. Goldenberg, G. Alexander, and S. P. Cliver. 1998. "Perinatal Mortality and Its Relationship to the Reporting of Low-Birthweight Infants," *American Journal of Public Health 88(8):*121(5): 1236-1239.

Pinnelli, A. 1986. "Infant survival in Italy: recent Trends" *Genus* 46(1-2): 79-107.

Poel, E. V. D., O. O. Donnell, and E. V. Doorslaer. 2009. "What explains the rural-urban gap in infant mortality: household or community characteristics?," ***Demography*** 46(4): 827–850.

Population Reference Bureau. 2010. World Population Data Sheet, Washington.

Pozzi, L. 2000. "The determinants of Infant and Childhood Mortality:a Complex Tangle in the Historical Research," pp. 77-86.

Pradhana, J. and P. Arokiasamy. 2010. "Socio-economic inequalities in child survival in India: A decomposition analysis," *Health Policy* 98 (2010): 114–120.

Registrar General of India (1971-2006), "Sample Registration System",

Registrar General of India. 1995-2009. "Sample Registration System statistical Report 2008," New Delhi: Registrar General of India.

Registrar General of India. 2009. "Compendium of India's Fertility and Mortality Indicators 1971-2007 based on SRS," New Delhi: Registrar General of India.

Rosato, M. R. et al. 2008. "Community participation: lessons for maternal, newborn, and child health," *Lancet* 372: 962-71.

Saksena, D. N. and J. N.Srivastav. 1980. "Biosocial Correlates of Peri-natal Mortality," *Journal Of Biosocial Science* 12: 69-81.

Samms-Vaughan, M. E. et al. 1990. "Neonatal mortality determinants in Jamaica," *Journal of Tropical Pediatrics* 36: 171-175.

Saugstad, L. F. 1981. "Weight of all births and infant mortality" *journal of Epidemiology and community Health* 35: 185-191.

Saugstad, L.F. 1981. "Weight of all births and infant mortality," Journal of Epidemiology and Community *Health* 35: 185-191.

Schoeps, D. et al. 2007. "Risk factors for early neonatal mortality," *Rev Saude Publica* 41 (6).

SEARCH. Home-Based Newborn and Child Care. Gadchiroli, Maharstra, India

Shah, U., A. K. Pratinidi, and P. V. Bhatlawande. 1984a. "Peri-natal mortality in rural India: intervention through primary health care. 11 neonatal mortality," *Journal of Epidemiology and Community Health* 38: 138-142.

Shah, U., A. K. Pratinidi, and P. V. Bhatlawande. 1984b. "Peri-natal mortality in rural India: intervention through primary health care. 1 stillbirths," *Journal of Epidemiology and Community Health* 38: 134-137.

Singh, J.P. et al. 1988. "Mortality characteristics of neonates with birth weight above 2000g," *Indian Pediatrics* 25: 179-181.

Singh, M. and V. K. Paul 1988. "Strategies to reduce perinatal and neonatal mortality," *Indian Pediatrics* 25: 499-509.

Speybroeck, N. et al. 2010. "Decomposing socioeconomic health inequality," *International Journal of Public Health* 55: 347-351.

Srivastava, J.N. 1992. "Correlates of perinatal mortality in Lucknow city: Repeat study of a hospital's experiences," *The Journal of Family Welfare* 38(4): 43-52.

Summary of Regional Vital Statistics 2000, Perinatal Instiute, Report 2000, pp. 1-2.

Tavcioska, G. 2010. "Basic newborn resuscitation. Guideline appraisal of WHO document," *Paper presented at: Training Course in Sexual and Reproductive Health Research.* Geneva:1-5.

The Child Health Research Project, Special Report., October (1999).

UNICEF, WHO. 2006. Essential New Born Care. Training of Trainer workshop.

UNICEF, WHO. 2010. Levels and trends in child mortality, report, 2010.

UNICEF, WHO. 2010. The World Bank, the United Nations Population Division, Levels and Trends in Child Mortality, Report 2010

United Kingdom. 2009. Perinatal mortality 2007: Confidential enquiry into maternal and child health. London.

USA. 2002. Use of the Clean Home Delivery Kit in Nepal: A Qualitative Study, Final Report. PATH.

Victora, C. G. et al. 2000. "Effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries pooled analysis" *The Lancet* 355:451-455.

Visaria, L. 1985. "Infant Mortality in India: Level, Trends and Determinants," *EPW* 20(32): 1352-1359.

Wada Na Todo Abhiyan, September 2010

Wagstaff, A. 2000. "Socioeconomic inequality in child mortality: comparisions across nine developing countries," *Bulletin of World Health Organization* 78(1).

Wagstaff, A. And E. V. Doorslaer. 2002. "Overall vs. Socioeconomic Health Inequality: A Measurement Framework and Two Empirical Illustrations," pp. 1-8.

Wagstaff, A., E. V. Doorslaer, and N. Watanabe. 2001. "On decomposing the causes of health sector inequalities with an application to malnutrition Inequalities in Vietnam," York: International Health Economics Association.

Wassan, K., S. Raniand and G. Haider. 2009. "Perinatal mortality- a hazardous dilemma", *Rawal Medical Journal* 34(2): 195-198.

WHO. 2006. Neonatal and perinatal mortality: Country, regional and global estimates.

WHO. 2008. Essential Newborn Care Course (ENCC): Report of the Regional Workshop, Bangkok, Thailand, 13–14 September 2007.

Yasmin, S., D.Osrin, E. Paul, and A.Costello. 2001. "Neonatal mortality of low-birth-weight infants in Bangladesh," *World Health Organization* 79(7): 608-614.

Yiengprugsawan, V. et al. 2007. "Measuring and decomposing inequality in self reported morbidity and self assessed health in Thailand," *Bio Med Central 6(*23): 349-354.

Yiengprugsawan, V. et al. 2010. "Decomposing socioeconomic inequality for binary health outcomes: an improved estimation that does not vary by choice of reference group," *Bio Med Central 3(*55): 349-354.

Zadkarami, M. R. 2008. "Risk factors for perinatal mortality: random effect model," *Asian journal of Epidemiology* 1(2): 53-63.

APPENDICES

APPENDICES

Fig 4.1: Rural-urban Differentials in Early Neonatal Mortality Rate in India and Bigger States, SRS, 2008

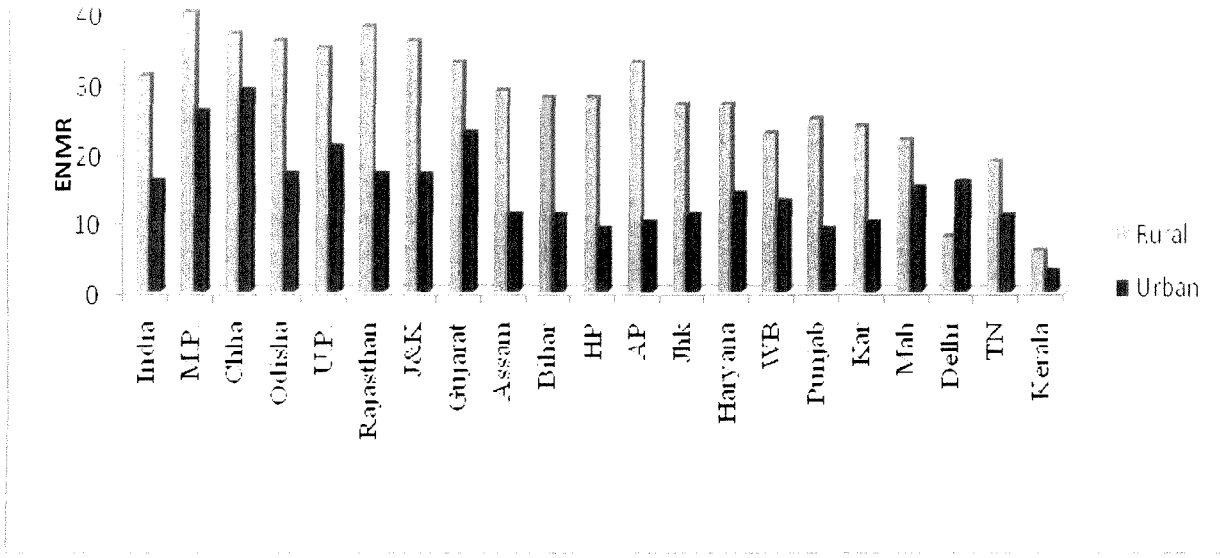


Table 4.3: Trend in Early Neonatal Mortality Rate and Percentage Share of Early Neonatal Mortality Rate to Neonatal Mortality Rate in India, 1972-08

Period	ENMR	NMR	Percentage of ENMR to NMR
1972-74	35	70	50
1975-77	45	79	57
1978-80	47	73	64
1981-83	45	68	66
1984-86	40	62	65
1987-89	37	57	64
1990-92	36	51	70
1993-95	35	48	72
1996-98	35	46	75
1999-01	31	43	72
2002-04	26	38	68
2005-07	28	37	76
2008	27	35	77

Source: Sample Registration System, Registrar General of India, 1972-2008

Table 5.5: Logistic Regression: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	caste			6.429	3	.092	
	caste(1)	-.383	.164	5.463	1	.019	.682
	caste(2)	-.015	.106	.019	1	.889	.985
	caste(3)	.013	.128	.010	1	.920	1.013
	REL			4.520	2	.104	
	REL(1)	-.247	.132	3.505	1	.061	.781
	REL(2)	.175	.194	.814	1	.367	1.191
	POR(1)	-.083	.124	.448	1	.503	.920
	MEDU			16.491	2	.000	
	MEDU(1)	-.085	.125	.462	1	.497	.919
	MEDU(2)	-.510	.128	15.798	1	.000	.601
	mass_media(1)	-.047	.098	.230	1	.632	.954
	WI			.031	2	.984	
	WI(1)	-.018	.114	.024	1	.877	.983
	WI(2)	.003	.151	.000	1	.985	1.003
	DW(1)	.248	.111	5.023	1	.025	1.281
	Fuel(1)	.163	.164	.998	1	.318	1.178
	TF(1)	.178	.134	1.748	1	.186	1.194
	MATB1			7.363	2	.025	
	MATB1(1)	.001	.122	.000	1	.994	1.001
	MATB1(2)	.403	.189	4.541	1	.033	1.496
	SEX(1)	-.179	.082	4.791	1	.029	.836
	BS1(1)	.898	.118	58.346	1	.000	2.456
	COM(1)	.015	.083	.033	1	.856	1.015
	POD(1)	.392	.101	15.157	1	.000	1.480
	BOR			23.291	2	.000	
	BOR(1)	-.528	.112	22.414	1	.000	.590
	BOR(2)	-.288	.133	4.655	1	.031	.750
	FULL			18.089	2	.000	
	FULL(1)	-.445	.110	16.377	1	.000	.641
	FULL(2)	-.614	.179	11.843	1	.001	.541
	Constant	-3.523	.273	166.634	1	.000	.030

Variable(s) entered on step 1: caste, REL, POR, MEDU, mass_media, WI, DW, Fuel, TF, MATB1, SEX, BS1, COM, POD, BOR, FULL.

Note: Caste= Scheduled Caste (Reference Category)

Caste (1)= Scheduled Caste

Caste (2)=Other Backward Caste (OBC)

Caste (3)= General

REL= Hindu (Reference Category)

REL (1)=Muslims

REL (2)= Others

POR (1)= Urban (Reference Category is Rural)

MEDU= No Education (Reference Category)

MEDU (1)= Primary

MEDU (2)= Secondary and Higher

mass_media (1)= Exposure (Reference category is no exposure)

WI= Poor

WI (1)= Medium

WI (2)= Rich

DW (1)= Improved Drinking Water (Reference category is Non Improved)

Fuel (1)= Improved Fuel (Reference category is Non Improved)

TF (1)= Improved Toilet facilities (Reference category is Non Improved Toilet Facilities)

MATB1= child's birth at Mother's age less than 20 (Reference category)

MATB1 (1)= child's birth at Mother's age 20-34

MATB1 (2)= child's birth at Mother's age at 35-49

SEX (1)= female (Reference Category is male)

BS1(1)= Low birth weight (reference category is normal)

COM (1)= having pregnancy complication (Reference category is having no pregnancy complication)

POD (1)= Hospital delivery (Reference Category is Home delivery)

BOR = Birth order 1 (Reference category)

BOR (1)= birth order 2-3

BOR (2)= birth order 4 and above

Full= No utilization of antenatal care (Reference category)

Full (1)= Partial utilization of antenatal care

Full (2)= Full utilization of antenatal care

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	32142	62.3
	Missing Cases	19413	37.7
	Total	51555	100.0
Unselected Cases		0	.0
Total		51555	100.0

a. If weight is in effect, see classification table for the total number of cases.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-3.986	.040	9807.616	1	.000	.019

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	6090.971[a]	.006	.033

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Table 5.4: Number of Births Followed the Delivery Protocol at the time of Home Delivery

	During Delivery Delivery Kit Used		During Delivery Clean Blade Used		Either Delivery Kit or Blade Used		Baby Wiped Dry and Wrapped	
	No. of Births	Percentage	No. of Births	Percentage	No. of Births	Percentage	No. of Births	Percentage
Yes	4800	22.6	21353	95	21514	95.6	10532	46.9
No	16483	77.4	1119	5	985	4.4	11920	53.1
Total	21283	100	22472	100	22499	100	22452	100

Note: Calculated from NFHS-3 data set

NFHS REGIONS:

North: Delhi, Haryana, HP, J&K, Punjab, Rajasthan, Uttaranchal

Central: Chhattisgarh, Madhya Pradesh, Uttar Pradesh.

East: Bihar, Jharkhand, Orissa, West Bengal

North-East: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura.

West: Goa, Gujarat, and Maharashtra.

South: Andhra Pradesh, Karnataka, Kerala, Tamil Nadu

Note: In NFHS-1, Sikkim is absent.

EAG and Non-EAG States:

EAG: Rajasthan, Uttar Pradesh, Bihar, Assam, Jharkhand, Orissa, Chhattisgarh, Madhya Pradesh

Non-EAG: Rest of the states