Neonatal Mortality in South Asia: Trends, Differentials and Determinants

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1.1 Introduction

Neonatal period, the period during first four week of life (the first 28 days) carry one of the highest risk of death in the history of human life. Every year all over the world, 130 million babies are born and about 4 million babies among them die in the first four weeks. More than one-third of the neonatal deaths in the world occur in three South Asian countries - India, Pakistan and Bangladesh. Among all these countries, India has the largest number of neonatal deaths primarily because of large number of births. The top ten countries of the world which contribute 67% of neonatal deaths are India (27%), China (10%), Pakistan (7%), Nigeria (6%), Bangladesh (4%), Ethiopia (4%), Democratic Republic of the Congo (3%), Indonesia (2%), Afghanistan (2%) and United Republic of Tanzania (2%). Globally, the main direct causes of neonatal deaths are preterm birth (28%), severe infections (26%), asphyxia (23%) and neonatal tetanus (7%) (Lawn et al., 2005, UNICEF,2004).

Among the four million neo-natal deaths across the world; 3 million of these deaths occur in the early neonatal period i.e., in the first week of life. Moreover it is estimated that more than 3.3 million babies are still born every year; one in three of these occurs during delivery and could largely be prevented (WHO, 2006). In developing countries, the risk of death in the neonatal period is six times greater than in developed countries. In south-central Asia, with 43 perinatal deaths per 1000 births (live+stillbirths), shows rates close to those registered in sub-Saharan Africa. Given the high mortality rate in the south central Asia sub region, over 40% of global neonatal deaths take place here, which presents a formidable challenge (WHO, 2006). According to Paul and Beorari, 60% of all neonatal deaths and 68% of the world's burden of perinatal deaths occur in Asia. He suggest that factors contributing to the high newborn mortality rates in south Asia include widespread low birth weight, lack of skilled health care at birth, and low levels exclusive breast-feeding in the initial month of life. He further estimated that 11 million children in South Asia are born each year at weights less than 2500 grams which are 50% of all low birth weight neonates in the world (Paul and Beorari, 2002).

The studies suggested that infant mortality rate worldwide has dropped from 95 per 1000 live births in 1993 to 60 per 1000 live births in 1995 (Costello, 1995; Stembera, 1990). According to the estimates neonatal mortality rates are highest in Pakistan (51 per 1000 live births) followed by Bangladesh (50 per 1000 live births) followed by India (47 per 1000 live birth) and Nepal (39 per 1000 live births) (NIPORT et al. 2001; Save the children 2001; Save the children 2002; Costello and Dharma 2000). Infant born with low birth weight suffer from extremely high rates of morbidity and mortality from infectious diseases. Low birth weight infants have higher mortality rates during the postnatal period and in some cases their risk

may be greater than those of low birth weight infants during the neonatal period. Infant weight between 2000-2499 grams at birth is 4 times more likely to die during first 28 days of life than infants whose weight lie between 3000-34999 grams (UNICEF, 2004).

In South Asia 70% of infant deaths occur during the first month of life because of neglecting the newborn care (Costello and Manadhar, 2000). Newborn care is strongly influenced by women's social and health status and by home care and practices for mother and newborn, as well as by maternal and newborn cares services (Rodolfo et al. 2000). In South Asian countries are valued less than men and it attributed in terms of female infanticide, limited access to food, lack of educational opportunities, restricted mobility, lack of participation in decision-making, early marriage, dominance of mothers in law, expectation to bear many children, heavy workloads, physical and emotional abuse and inadequate access to health services. (UNICEF, 2004)

Among the infant deaths, almost 70 percent of deaths take place in the first month; little more than 50 percent take place in the first week and about 20-25 percent take place on the first day. In other words the first day and first week of life are very crucial period of life as survival is considered. The success of decline in infant mortality depends on the large extent to mortality in the early neo-natal period. Early neonatal deaths have obstetric origins, similar to those leading to stillbirths. Worldwide, there are over 6.3 million perinatal deaths a year, almost all of which occur in developing countries, and 27% of them in the least developed countries alone. Intrapartum deaths (i.e. those occurring during delivery) are closely linked to place of, and care at, delivery. In developing countries, just over 40% of deliveries occur in health facilities and little more than one in two takes place with the assistance of doctor, midwife or qualified nurse (WHO, 1996; UNICEF, 2004).

In India and Bangladesh, neonatal care has been included as an integral component of essential service delivery or primary health care. In Pakistan the agenda of safe motherhood, which advances newborn health, has recently gained attention and has been included as an important component of the Reproductive Health Service Package (RHSP). Neonatal health is not by itself the focus of any existing policy of the government of Nepal. However, Nepal government's decision to undertake a Safe Motherhood Program (SMP) in ten districts of the country has given a boost to neonatal care, as the SMP package includes the care of newborns. During the 1990s, the countries in the region instituted a number of programs including the Child Survival Program, Baby Friendly Hospital initiatives, acute respiratory infection (ARI) control program, and training of traditional birth attendants (TBA), the Extended Program of immunization (EPI), Control of diarrheal diseases, the National Program for family planning and Primary care, the RHSP and IMCI.

In India infant mortality has reduced from 129 deaths per thousand live births in 1971 to 50 deaths in 2009. Similarly in rural and urban areas of India infant mortality has reduced from 138 and 82 deaths per thousand live births in 1971 to 55 and 34 deaths in 2009 (SRS, 2009). Since neonatal mortality plays a significant role in infant mortality, more than two third of the infant deaths occur due to neonatal deaths. Neonatal mortality in India has reduced from 75 deaths per thousand live births in 1971 to 34 deaths in 2009. Similarly in rural and urban

areas neonatal mortality has reduced from 81 and 45 deaths per thousand live births in 1971 to 38 and 21 deaths in 2009 (SRS, 2009). According to the sample registration system (2009), Madhya Pradesh experience highest IMR, NNMR and ENNMR as 67 ,47 and 37 deaths per thousand live births respectively, whereas Kerala has the lowest IMR, NNMR and ENNMR as 12, 7 and 5 deaths per thousand live births in 2009 respectively (SRS, 2009).

1.2 Review of relevant literature

Male mortality is generally higher than female because in the very first month after birth, males are biologically weaker than females. In India female mortality is 14% lower than their male counter parts during this period (Pandey et al. 1998). A large proportion of births in Pakistan occur at home and it was difficult to obtain the exact birth weights of these babies. A question was asked in PDHS, was the baby very large, large, medium, small or very small at the time of the birth. This is clearly far from the concept of birth weight because mother herself evaluates her baby as being very large or very small than average (Kimm, 1979). Babies born very big are abnormal babies and their risk of mortality during neonatal period is also higher than the normal size born babies (Ree et al., 1999). Globally, on an average infant mortality rate dropped from 95 per thousand live births in 1993 to 60 per thousand live births in 1995 (Costello, 1995; Stembera, 1990). The father's education, mother's education and their work status each have independent effects upon child survival in developing countries (Sandiford et al., 1995; Forste, 1994; Caldwell et al., 1983).

As neonatal deaths in the first day are most difficult to reduce, reduction in neonatal mortality would normally be accompanied by an increase in the percentage of neonatal deaths that occur in the first 24 hours of life (Hall, 2005). Approximately 70% of neonatal deaths occur in the first six days and an unexpected low proportion of early neonatal deaths could be a result of under-reporting deaths in this age group (Boerma, 1988; Curtis, 1995). In developing countries only 68% of women received any antenatal care (WHO/UNICEF, 2004), and only 53% have their babies delivered by a skilled attendant (UNICEF, 2001). In south Asia most of the progress in reducing child mortality has been the result of global initiatives and vertical programmes, which fail to meet the needs of infants in the first month of life (Bhutta, 2000)

1.3 Need for the study

The objective of MDG (Millennium Development Goal 4) cannot be attain unless affords are made to reduce neonatal mortality especially during early neonatal period. The experience of neighbouring countries (Bangladesh, Nepal, Pakistan) also indicate more than 50% infant deaths in first week of life and about one-fourth on the first day of life. There are very few studies focusing on these two periods of life. It is thought that obstetrics care especially institutional delivery may have significant impact on early neonatal mortality. To understand role of maternal care factors in determining early neonatal mortality this paper proposes to study neonatal mortality with special focus on first day and first week.

1.4 Objectives:

The specific objectives of the study are:-

1. To study the levels and trends of mortality on the first day, first week and first month in India, Pakistan, Nepal and Bangladesh.

2. To study the differential in mortality on first day, first week and first month of birth by demographic and socio-economic characteristics in selected countries.

3. To study the relative role of maternal health care, birth characteristics and socio-economic characteristics of mother in determining mortality on the first day, first week and first month of birth in selected countries.

2.1 Data and Methods

In the present chapter description of sources of data and methodology used for analysis is given which are described below:-

2.2 Sources of data

All data used in this study are taken from Demographic and Health Survey of the respective countries. The DHS collects information on mortality, fertility, health indicator, socio-economic variables, immunization, nutritional status, living standard etc. All the surveys use standard set of questions and similar indicators are developed.

1. India, National Family Health Surveys-III (2005-06).
2. India, National Family Health Surveys-I (1992-93).
3. Bangladesh, Demographic and Health Survey-V (2007).
4. Bangladesh, Demographic and Health Survey-IV (1993-94).
5. Nepal, Demographic and Health Survey-V (2006).
6. Nepal, Demographic and Health Survey-IV (1996).
7. Pakistan, Demographic and Health Survey-V (2006-07).
8. Pakistan, Demographic and Health Survey-II (1990-91).

2.3 Quality of data

Demographic and Health Surveys use nationally representative samples. DHS are known for their good quality in data collection and processing. However, there may be some problems like; -misclassification of data such as neonatal deaths may be misclassified as stillbirths because of cultural beliefs and practices, while it is difficult to estimate the degree of underreporting. According to Bang (2002) a study in Indian state of Maharashtra found an NMR 20 points higher (51.2 deaths per thousand as opposed to 32 deaths per thousand) than that recorded in NFHS-2.

2.4 Definition:

Very early neonatal mortality rate= Number of deaths during the first 24 hours of life per 1000 live births in a given year.

Early neonatal mortality rate= Number of deaths during the first 7 days of life per 1000 live births in a given year.

Neonatal mortality rate= Number of deaths during the first 28 days of life per 1000 live births in a given year.

2.5 Methodology:

In the present study three indicators of mortality, i.e. 1) mortality on the first day, 2) first week and 3) first month of life are estimated as probability that a baby born during 1-59 months prior to survey die 1) on the day of birth, 2) in the first week of birth 3) first month.

In the present study the mortality rates are computed by following characteristics:-

Socio-economic variables

a) Place of residence

b) Mother's education

c) Father's education

d) Mother's Work status

Demographic variables

a) Age of mother

b) Birth order

c) Preceding Birth interval

d) Sex of the baby

Maternal Health

a) Antenatal care (3+ ANC visits)

b) Institutional delivery

c) 2+ Tetanus injections before birth

Average annual growth rate of change is calculated using the formula:-

$$(R_1 - R_2)/T$$

Where, R_1 =Mortality rate for the year of the survey used as the baseline

R_2 =Mortality rate for the year of final survey.

T= number of years between the first and second survey.

2.6 Bivariate Analysis:

A Binary Logistics Regression analysis has been used to identify the characteristics- Socio-economic variables, Demographic variables and Maternal Health care- having statistically significant effect on Very early neonatal mortality rate, Early neonatal mortality rate and Neonatal mortality rate.

2.7 Binary Logistic Regression Model:

Binary Logistic Regression Model: this model has utilized the dependent variables, Very early neonatal mortality rate, Early neonatal mortality rate, Neonatal mortality rate and it was recorded in binary form. Logistic regression models are commonly estimated by maximum likelihood function. For these outcome variables, logistic model takes the form:

Logit P= Ln (P/(1-P))= b_0 +b_1x_1+b_2x_2…………………..+b_ix_i+e.

Where b_1, b_2 and b_i represent the coefficient of each predictor's variables included in the model, while e is an error term. (P/ (1-P)) represents the natural logarithm of odds of the outcome. The SPSS statistical package utilized yields odds ratios which indicates the magnitude of the predictors variables on the probability of the outcome occurring. The odds ratios are the measure of odds on the three indicators of mortality (Very early neonatal mortality rate, Early neonatal mortality rate and Neonatal mortality rate) as indicated by dependent variables. As the regards to the direction of logit coefficients, odds greater than one indicate as increased probability of mortality, while those less than one indicate that a decreased probability.

Table 1.1 Description of sample size of women from selected countries, DHS.

Countries	Sample Size (N)
Bangladesh(1993-94)	9,640
India(1992-93)	89,777
Nepal(1996)	8,429
Pakistan(1990-91)	6,611
Bangladesh(2007)	10,996
India(2005-06)	1,24,385
Nepal(2006)	10,793
Pakistan(2006-07)	10,023

An attempt has been made to overview very early neonatal mortality, early neonatal mortality and neonatal mortality of four selected countries of South-Asia namely Bangladesh, India, Nepal and Pakistan at two survey point i.e., from 1990's to 2006-07. This also explores the levels and trends of mortality according to different regions because these countries are quite diverse in their geographical, cultural, environmental, social and economic conditions.

3.1 Average actual annual change in very early neonatal mortality, early neonatal mortality and neonatal mortality.

This section covers the level and trends of mortality and average annual change in three indicators of mortality at two different survey points. The very early neonatal mortality is one of the most important indicators of mortality because it is very difficult to control the mortality on first day as first day after birth is very sensitive in human life.

The very early neonatal mortality is lowest in Pakistan (1990-91) (7.32 deaths per thousand live births) and highest in Nepal (1996) (12.10 deaths per thousand live births) at survey point-1. A drastic change is observed in Pakistan (2006-07) i.e. a very early neonatal mortality rate is highest in Pakistan (19.51 deaths per thousand live births) which is more than double as compared to survey point-1. Nepal experience lowest VENMR (9.56 deaths per thousand live births) at survey point-2 which is highest in survey point-1. Early neonatal mortality rate is highest in India (1992-93) (33.25 deaths per thousand live births) and lowest in Pakistan (1990-91) (30.46 deaths per thousand live births) at survey point-1. ENMR is highest in Pakistan at survey point-2 which is lowest in Pakistan at survey point-1. At survey point-2 ENMR is lowest in Nepal (23.12 deaths per thousand live births). While estimating Neonatal mortality rate at survey point-1, it is observed that there is not much variation in NMR among the countries. At survey point-1, NMR is highest in Bangladesh (49.94) and lowest in India (47.36). At survey point-2, NMR is highest in Pakistan (53.12) and lowest in Nepal (32.42). Average annual actual change in VENMR is negative for three countries namely Bangladesh, India and Pakistan and it is positive only in Nepal. ENMR and NMR is positive for three countries namely Bangladesh, India, Nepal and negative only in Pakistan.

3.2: Gender differential in VENMR, ENMR and NMR

It is well known fact that male mortality is generally higher than female because biologically males are weaker than females in very first day of life. Among all eight survey it is found that sex ratio was highest in Nepal (1996) (sex ratio: 170) and lowest in Nepal (2006) (sex ratio: 115) in case of very early neonatal mortality rate. In case of early neonatal mortality rate only Nepal (2006) shows a negative trends i.e. female mortality is higher (23.9 deaths per thousand live births) than males (22.3), and sex ratio was highest in Pakistan (2006-07) (i.e. 159 males per 100 females). In case of Neonatal mortality rate, again Nepal (2006) shows a negative trend and sex ratio was observed to be 88 i.e. male mortality is lower 30.3 deaths per thousand live births as compared to females which shows 34.6 deaths per thousand live births.

3.3: Regional variation in VENMR, ENMR and NMR

In survey point-1, Bangladesh is divided into five regions but in survey point-2 one more region namely Sylhet is added. In survey point-1, Khulna region has lowest VENMR i.e., 9.3 deaths per thousand live births and highest in Rajshani region i.e. 12.3 per thousand live births. Similarly at survey point-2, Khulna region has lowest (11.8) and Barisal region highest (19.6) VENMR. Again at survey point-1, Khulna region has lowest (28.6) and Rajshani region has highest (36.7) early neonatal mortality rate. At survey point-2, Dhaka has lowest (22.0) and Sylhet has highest (39.8) early neonatal mortality rate. In case of Neonatal mortality rate at survey point-1, it is lowest in Dhaka (46.6) and highest in Barishal (54.2). In survey point-2, it is lowest in Khulna (30.4) and highest in Sylhet (51.4) region of Bangladesh.

India, a very diverse country in their geographical, cultural, environmental and social conditions is divided into six regions, namely North, Central, East, North East, West and South regions. At survey point-1, VENMR is lowest in western region (8.1 death per thousand live births) and highest in central region (17.4). Similarly, ENMR is lowest in north region (22.7) and highest in central region (37.2) at survey point-1. At survey point-2, ENMR is lowest in south region (22.2) and highest in central region (35.5). NMR is highest in central region (56.2) and lowest in north region (35.2) at survey point-1. At survey point-2 NMR is lowest in south region (27.8) and highest in central region (46.8).

Nepal is divided into five regions namely, Eastern, Central, Western, Midwestern and Far western regions. At survey point-1, VENMR is lowest in western region (i.e., 8.2 deaths per thousand live births) and highest in Midwestern region (19.2). At survey point-2, it is lowest in Far western region (6.3) and highest in Midwestern region (16.9). ENMR does very much across the regions, at survey point-1, it is lowest in Farwestern region (28.7) and highest in Midwestern region (36.8). At survey point-2, it is lowest in Farwestern region (19.0) and highest in Midwestern region (35.4). In case of NMR at survey point-1, it is lowest in Central region (45.4) and highest in Midwestern region (52.4). At survey point-2, it is lowest in Far western region (27.4) and highest in Midwestern region (48.1).

Pakistan is divided into four regions namely, Punjab, Sindh, NF Frontier and Balochistan. VENMR is lowest in Balochistan at survey point-1 and survey point-2 both (i.e. 1.3 and 8.1) and also highest in Punjab region at survey point-1 and survey point-2 (i.e. 8.6 and 22.2). ENMR is lowest in NW Frontier (20.9) and highest in Sindh region (38.6) at survey point-1. At survey point-2, it is lowest in Balochistan (25.5) and highest in Sindh (44.3). Similarly, NMR is highest in Sindh (50.6) and lowest in NW Frontier (34.5) at survey point-1. At survey point-2, NMR is lowest in Balochistan (31.1) and highest in Punjab (57.1) region.

Differential in very early neonatal mortality, early neonatal mortality and neonatal mortality in selected countries of South Asia at two different survey points by Socio-economic, demographic and maternal health care characteristics.

4.1 Differential in VENMR by socio-economic, demographic and maternal health care services.

Table 4.1 shows that rural mortality is higher than urban mortality though in Pakistan it is other way. In India and Nepal, urban and rural mortality is quite small. Very early neonatal mortality does not show any consistent role in mother's education, only in India it decreases with mother's education though mortality of new born does not show much difference with no education and primary education. In recent survey, India and Bangladesh show consistent decline in mortality with mother's education. In 1990's, India and Bangladesh show uniform decline in mortality with father's education. In general it was observed that mortality of working mother's is higher than non working, but here mothers work status does not show any consistent trends. Among all the countries and at both the survey point shows lowest mortality of newborn of mother's in age group (20-35) but Pakistan does not show the same trends. Birth interval shows that the mortality of new born is higher with the higher birth order or (2+) but born after two years of previous birth have the lowest mortality in all the four countries and on both the survey points. Mortality varies with the maternal health care characteristics of mother's , those mother's who have taken antenatal care (3+) have lower mortality as compared to those who have not taken. However the same pattern is not observed in Pakistan on both the survey points. New born children's of mother who had taken two or more than two tetanus toxide injections have lower mortality as compared to those who had not taken. Generally it was observed that mortality is higher in institutional deliveries because only the complicated cases are referred to hospital, but this trend is not observed in the present study.

4.2 Differential in ENMR by socio-economic, demographic and maternal health care services

Table 4.2 shows that mortality is higher in rural areas as compared to urban areas in all the countries and on both the survey points. In survey point 2, early neonatal mortality rate shows consistent results with mother's education i.e., mortality rate decreases with the increase in mother's education. Father's education does not show any uniform pattern among all the four countries. Generally working mothers have higher mortality as compared to non working mothers but here mothers work status does not show any consistent trends. It was observed that mother's in age group (20-35) show lowest mortality in almost all the three countries except in Pakistan which does not show the same trend. Those mothers who give birth in the interval of more than two years after the first birth experiences lower mortality as compared to those mothers who give birth in the interval less than two years. Mortality also varies with maternal health care characteristics of mothers, those mothers who have taken antenatal care (3+) show lower mortality but Pakistan does not show the same result. Children's of mother who had taken two or more than two tetanus toxide injections show lower mortality in both the surveys and in all the countries. Institutional delivery does not show any uniform trends in all the surveys.

4.3 Differential in NMR by socio-economic, demographic and maternal health care services.

Table 4.3 shows as usual trends ie mortality in rural areas are higher than urban areas in all the countries and on both the survey points. Neonatal mortality rate consistently decrease with increase with mothers education this fact was found true in both the survey point and in all the countries. Mortality rate decreases with increase in father's education except in India at survey point-2. Work result does not show any consistent result in all the countries. It was observed in all the survey that teen age mothers have higher mortality. Mothers in the age group (20-35) show lowest mortality except in Pakistan on both the surveys and Bangladesh in survey point-2. Those children who were born in the interval of more than 2 years have shown lowest mortality as compared to those who were born within two years. Mortality also varies with maternal health care characteristics of mother's, those mothers's who have taken antenatal care (3+) and tetanus toxide injections shows lower mortality as compared to those who have not taken. Those children who are born at home experiences higher neonatal mortality as compared to those who born in hospitals.

Result of logistic regression analysis carried out for four selected countries of South Asia at both the survey points. It shows the role of maternal health care services, socio economic characteristics and demographic characteristics on three indicators of mortality. The binary logistic regression analysis is carried out for very early neonatal mortality rate, early neonatal mortality rate and neonatal mortality rate after controlling for maternal health care services, socio-economic and demographic characteristics.

5.1 Result of logistic regression analysis carried out in Bangladesh at both the survey points (Table 5.1)

In Bangladesh, antenatal care (3+) shows significant effect on early neonatal mortality and neonatal mortality at survey point-1 which is not observed in survey point-2. Very early neonatal mortality in case of institutional delivery is 4 times more likely as compared to home delivery in both the survey. Those children who are born in the birth interval of more than two years shows significant results on three indicators of mortality and on both the survey points. All the six regions of Bangladesh do not show any significant result on the three indicators of mortality.

5.2 Result of logistic regression analysis carried out in India at both the survey points (Table 5.2)

Antenatal care (3+) and institutional delivery is highly significant on three indicators of mortality and on both the survey points. Also, those children who are born in the interval of more than two years are highly significant in both the surveys and on three indicators of mortality. Central region is more likely as compared to northern region and similarly rural areas are more likely as compared to urban areas. Working mothers are more likely on three indicators of mortality and on both the surveys.

5.3 Result of logistic regression analysis carried out in Nepal at both the survey points (Table 5.3)

Antenatal care (3+) and institutional delivery does not show any significant results on three indicators of mortality and on both the surveys. Sex of the child (Female versus male) shows significant result on both the surveys and on three indicators of mortality. Western region and mid western region are more likely as compared to Eastern region. All the three indicators of mortality show are highly associated with place of residence i.e., rural areas are more likely as compared to urban areas. Here work status of mothers does not show any significant results.

5.4 Result of logistic regression analysis carried out in Pakistan at both the survey points (Table 5.4)

In Pakistan, institutional delivery is highly associated with three indicators of mortality. In both the survey points antenatal care (3+) does not show such a strong association with mortality. Those children who are born with the interval of more than 2 years are highly significant in case of early neonatal mortality and neonatal mortality in both the surveys where as very early neonatal mortality does not show the same. Overall, regions does not show any significant results on mortality on both the surveys. Here working mothers are two times more likely as compared to non working mothers in survey point 2 on all the three indicators of mortality.

Summary and Conclusion: In present study an attempt has been made to focus on very early neonatal mortality rate, early neonatal mortality rate and neonatal mortality rate in selected countries of South Asia at two different survey points. The result of the analysis shows that three indicators of mortality varies according to the country and time, according to maternal health care services, demographic and socio-economic characteristics. VENMR increases with time (survey point 1 to survey point 2) among all the three countries except in Nepal. In Pakistan, all the three indicators of mortality increases over time (i.e. from 1990 to 2007) while in Nepal all these three indicators of mortality decreases over time (from 1996 to 2006). The most interesting result is that VENMR is lowest in Pakistan at survey point 1 which is highest in survey point 2 among all the eight surveys. Neonatal mortality rate is highest in Pakistan (2006-07) and lowest in Nepal (2006). Mortality rate also varies according to regions. In Bangladesh, very early neonatal mortality rate is highest in Rajshani region at survey point 1 and Barisal region at survey point 2. Similarly in India it is highest in Central region at both the survey points. VENMR is highest in Mid Western region of Nepal and highest in Punjab region of Pakistan at both the survey points.

Result of the analysis indicates that mortality varies according to place of residence i.e. children's mortality in rural areas are higher than urban areas except in Pakistan. In Pakistan very early neonatal mortality rate in urban areas are higher than rural areas. In general, father's education does not show any significant results on three indicator of mortality while mother's education more or less shows some significant results. Among all the four countries maternal health care services are highly associated with three indicators of mortality. Birth

interval is also highly associated with mortality i.e. those children who are born in the interval of more than 2 years are less likely to die.

Limitation of the study

Neonatal deaths are less probable to be recorded if a baby dies in the first hours or days after birth or is very small. Misclassification between stillbirths and neonatal deaths is also possible. In some settings, this misclassification might be purposeful to avoid filling a death certificate that would be required if a neonatal death is confirmed. Assessments of the validity of retrospective surveys suggest that in poor settings in south Asia they might greatly underestimate neonatal deaths. One of the problems while collecting these data is heaping i.e. the preference for reporting deaths at a particular day, week, month and year.

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Table 3.1 **Average actual annual change in VENMR, ENMR and NMR.**

VENMR	ENMR	NMR	VENMR	ENMR	NMR	VENMR	ENMR	NMR
Bangladesh(1993-94)			Bangladesh(2007)			Bangladesh		
10.63	32.01	49.94	13.97	27.49	36.37	-0.26	0.35	1.04
India(1992-93)			India(2005-06)			India		
12.06	33.25	47.36	12.47	29.79	38.30	-0.031	0.266	0.697
Nepal(1996)			Nepal(2006)			Nepal		
12.10	30.96	48.55	9.56	23.12	32.42	0.25	0.78	1.61
Pakistan(1990-91)			Pakistan(2006-07)			Pakistan		
7.32	30.46	47.79	19.51	39.93	53.12	-0.76	-0.59	-0.33

VENMR=Very early neonatal mortality rate.
ENMR=Early neonatal mortality rate.
NMR=Neonatal mortality rate.

Table 3.2 **Gender differential in VENMR, ENMR and NMR**

	VENMR			ENMR			NMR		
COUNTRIES	Male	Female	Sex Ratio	Male	Female	Sex Ratio	Male	Female	Sex Ratio
Bangladesh(1993-94)	12.4	8.8	141	36.6	27.3	134	58.4	41.1	142
India(1992-93)	14.3	9.7	148	37.1	29.2	127	51.4	43.1	119
Nepal(1996)	15.2	8.9	170	36.1	25.6	141	54.5	42.4	129
Pakistan(1990-91)	8.2	6.4	127	36.0	24.7	146	55.6	39.6	141
Bangladesh(2007)	17.3	10.6	163	31.2	23.8	131	38.7	34.1	113
India(2005-06)	13.4	11.4	117	33.2	26.1	127	40.4	36.0	112
Nepal(2006)	10.2	8.9	115	22.3	23.9	93	30.3	34.6	88
Pakistan(2006-07)	23.7	14.9	160	48.5	30.5	159	59.6	46.0	130

VENMR=Very early neonatal mortality rate.
ENMR=Early neonatal mortality rate.
NMR=Neonatal mortality rate.

TABLE 4.1: VENMR IN BANGLADESH, INDIA, NEPAL AND PAKISTAN BY
SELECTED CHARACTERISTICS.

BACKGROUND CHARACTERISTICS	BD1 VENMR	IA1 VENMR	NP1 VENMR	PK1 VENMR	BD2 VENMR	IA2 VENMR	NP2 VENMR	PK2 VENMR
Residence								
Urban	5.1	8.6	8.9	10.7	10.1	8.5	7.9	20.9
Rural	11.2	13.1	12.3	5.8	15.0	13.8	9.8	18.9
Mother's education								
No education	11.2	13.0	12.0	5.6	16.9	15.6	12.5	20.9
Primary	9.1	12.8	10.8	10.4	15.0	15.1	4.3	16.9
Higher	11.0	8.3	14.3	15.4	11.3	7.1	5.8	16.9
Father's education								
No education	11.4	14.5	13.2	3.8	19.3	13.2	14.7	18.2
Primary	10.2	12.5	8.4	10.3	12.0	15.5	7.6	18.9
Higher	8.5	9.5	13.4	10.5	10.3	11.3	8.1	20.4
Mother's Work Status								
No	10.1	11.6	17.5	7.7	14.5	12.9	7.6	14.9
Yes	14.2	13.2	10.5	5.3	11.4	11.5	10.4	33.2
Mother's age								
<20	14.1	16.6	22.9	10.9	20.3	17.2	11.3	32.0
20-35	8.6	10.7	8.4	7.2	10.8	10.8	8.2	19.5
35+	16.4	10.3	18.1	4.7	10.9	18.1	17.5	9.7
Birth interval								
First birth	14.9	15.4	18.2	11.6	18.8	15.9	9.7	28.1
Less than 2 year	17.9	19.0	10.6	10.1	28.2	18.0	19.2	23.3
More than 2year	6.9	7.6	10.0	4.5	8.4	8.2	6.4	14.3
Sex of Child								
Male	12.4	14.3	15.2	8.2	17.3	13.4	10.2	23.7
Female	8.8	9.7	8.9	6.4	10.6	11.4	8.9	14.9
Antenatal care(3+)								
No	11.4	14.4	11.2	6.1	8.1	10.2	7.5	15.8
Yes	3.6	7.5	12.0	10.3	7.9	5.2	3.2	17.7
Tetanus injections								
No	11.5	13.6	11.4	8.1	9.8	10.2	8.9	18.8
Yes	9.6	8.5	10.4	3.8	6.8	6.8	3.3	14.5
Institutional delivery								
No	10.5	12.3	12.3	5.9	13.1	12.4	10.5	20.3
Yes	17.9	11.2	7.9	16.2	18.8	12.5	5.3	18.0
Total	10.6	12.1	12.1	7.3	14.0	12.5	9.6	19.5

VENMR=Very early neonatal mortality rate.
BD1=Bangladesh (1993-94).   BD2=Bangladesh (2007).
IA1=India (1992-93).   IA2=India (2005-06).
NP1=Nepal (1996).   NP2=Nepal (2006).
PK1=Pakistan (1990-91).   PK2=Pakistan (2006-07).

TABLE 4.2: ENMR IN BANGLADESH, INDIA, NEPAL AND PAKISTAN BY SELECTED CHARACTERISTICS.

BACKGROUND CHARACTERISTICS	BD1 ENMR	IA1 ENMR	NP1 ENMR	PK1 ENMR	BD2 ENMR	IA2 ENMR	NP2 ENMR	PK2 ENMR
Residence								
Urban	22.3	24.9	18.8	26.5	23.1	22.6	18.3	38.9
Rural	33.1	35.7	31.8	32.2	28.6	32.3	23.8	40.4
Mother's education								
No education	35.5	37.4	31.6	29.7	30.6	34.5	28.9	42.6
Primary	26.4	31.7	30.7	31.0	29.9	34.8	17.6	37.2
Higher	27.8	20.8	25.0	34.8	23.8	21.2	11.7	33.0
Father's education								
No education	37.1	40.8	37.5	30.6	33.0	31.4	32.3	39.8
Primary	25.3	34.4	23.6	31.8	32.2	35.0	22.6	43.0
Higher	28.0	25.4	28.7	30.1	18.3	27.5	18.7	38.4
Mother's Work Status								
No	31.7	32.3	39.4	28.3	28.5	28.6	21.6	32.7
Yes	33.9	35.8	28.5	41.3	23.6	32.7	23.8	61.3
Mother's age								
<20	40.7	48.5	43.0	23.2	39.4	42.7	31.1	58.4
20-35	27.6	27.9	26.5	31.0	21.8	25.9	20.8	40.0
35+	39.6	36.6	40.5	33.6	18.9	34.0	23.0	24.2
Birth interval								
First birth	45.8	43.8	39.7	38.5	38.1	38.5	31.8	59.2
Less than 2 year	42.4	47.6	38.2	39.2	61.6	43.3	28.3	46.9
More than 2year	23.4	22.0	24.3	23.3	14.5	19.1	16.1	28.9
Sex of Child								
Male	36.6	37.1	36.1	36.0	31.2	33.2	22.3	48.5
Female	27.3	29.2	25.6	24.7	23.8	26.1	23.9	30.5
Antenatal care(3+)								
No	34.4	38.0	25.5	27.7	14.2	22.6	18.7	31.4
Yes	3.6	23.5	19.6	27.8	12.9	14.9	8.8	32.3
Tetanus injections								
No	38.2	38.2	26.6	29.1	17.0	25.4	21.3	37.1
Yes	23.7	23.6	21.8	25.9	11.6	16.4	9.5	27.2
Institutional delivery								
No	32.3	34.5	31.1	28.6	27.2	30.5	23.3	39.3
Yes	17.9	28.6	27.2	42.7	29.1	28.7	22.4	41.1
Total	32.0	33.2	31.0	30.5	27.5	29.8	23.1	39.9

ENMR=Early neonatal mortality rate.
BD1=Bangladesh (1993-94). BD2=Bangladesh (2007).
IA1=India (1992-93). IA2=India (2005-06).
NP1=Nepal (1996). NP2=Nepal (2006).
PK1=Pakistan (1990-91). PK2=Pakistan (2006-07).

TABLE 4.3: NMR IN BANGLADESH, INDIA, NEPAL AND PAKISTAN BY SELECTED CHARACTERISTICS.

BACKGROUND CHARACTERISTICS	BD1 NMR	IA1 NMR	NP1 NMR	PK1 NMR	BD2 NMR	IA2 NMR	NP2 NMR	PK2 NMR
Residence								
Urban	30.8	33.5	29.3	37.2	27.3	27.9	25.1	49.1
Rural	52.0	51.4	49.9	52.5	38.7	41.8	33.4	54.8
Mother's education								
No education	54.3	54.5	51.2	50.5	43.8	44.9	39.0	58.3
Primary	46.2	40.9	40.1	39.2	37.2	44.3	29.8	45.7
Higher	38.3	28.8	33.7	37.4	30.9	26.8	16.2	41.3
Father's education								
No education	57.1	58.5	54.9	51.2	46.6	41.4	42.5	57.1
Primary	41.9	49.0	45.5	47.6	39.5	47.9	32.9	56.1
Higher	42.2	35.9	43.8	43.9	23.7	33.9	26.9	48.3
Mother's Work Status								
No	48.4	46.3	53.9	45.9	37.9	36.5	28.7	43.4
Yes	58.9	50.1	47.1	57.0	31.0	42.7	34.1	81.9
Mother's age								
<20	67.0	66.0	69.2	53.3	51.2	53.2	47.4	75.4
20-35	41.2	40.9	42.5	47.1	29.8	33.7	27.1	52.8
35+	66.7	51.7	53.1	46.8	20.1	44.7	40.9	36.6
Birth interval								
First birth	69.4	59.0	59.1	66.4	47.3	47.0	44.2	77.1
Less than 2 year	74.0	67.8	68.3	60.6	77.0	57.2	38.5	59.9
More than 2year	35.5	33.2	37.2	34.4	22.1	25.5	23.4	40.3
Sex of Child								
Male	58.4	51.4	54.5	55.6	38.7	40.4	30.3	59.6
Female	41.1	43.1	42.4	39.6	34.1	36.0	34.6	46.0
Antenatal care(3+)								
No	50.9	56.5	45.5	44.5	18.8	30.4	23.1	43.8
Yes	8.2	31.0	24.8	34.7	14.2	18.8	12.3	42.6
Tetanus injections								
No	53.9	56.5	46.9	45.7	21.3	34.6	29.8	53.5
Yes	38.2	32.5	30.4	35.6	14.7	21.1	10.9	34.7
Institutional delivery								
No	50.4	50.4	49.2	47.4	36.8	40.3	33.2	54.3
Yes	25.4	35.8	34.8	50.4	33.7	35.1	28.9	50.9
Total	49.9	47.4	48.6	47.8	36.4	38.3	32.4	53.1

NMR=Neonatal mortality rate.
BD1=Bangladesh (1993-94). BD2=Bangladesh (2007).
IA1=India (1992-93). IA2=India (2005-06).
NP1=Nepal (1996). NP2=Nepal (2006).
PK1=Pakistan (1990-91). PK2=Pakistan (2006-07).

Table 5.1 Odds Ratio from Logistic Regression Analysis for VENMR, ENMR, NMR in Bangladesh at both the survey points.

BACKGROUND CHARACTERISTICS		Bangladesh(1993-94)			Bangladesh(2007)		
		VENMR	ENMR	NMR	VENMR	ENMR	NMR
Antenatal care (3+)							
Yes (Versus No)		0.209	0.091**	0.169**	1.225	0.994	0.86
Tetanus injections							
Yes (Versus No)		0.863	0.669*	0.756	0.77	0.692	0.72
Institutional delivery							
Yes (Versus No)		4.041	1.31	1.318	4.076**	2.258*	1.911*
Mother's age							
15-20	Ref.						
20-35		1.315	1.108	0.884	0.609	0.903	0.876
35+		2.695	1.605	1.617	1.013	1.387	0.991
Birth interval							
First Birth	Ref.						
Less than 2 Year		1.178	0.738	0.9	2.074	1.232	1.295
More than 2 Year		0.333*	0.433**	0.458***	0.596	0.477*	0.523*
Sex of Child							
Female (versus Male)		0.862	0.968	0.823	0.415*	0.602	0.608*
Region's							
Barishal	Ref.						
Chittagong		0.62	0.911	0.859	0.557	0.819	1.057
Dhaka		0.726	0.943	0.856	0.865	0.904	1.017
Khulna		0.484	0.505	0.527	0.239	0.453	0.516
Rajshani		0.671	0.861	0.733	0.446	0.649	0.886
Sylhet		-	-	-	0.643	0.746	1.184
Residence							
Rural (Versus Urban)		2.884	1.156	1.447	1.559	1.393	1.31
Mother's education							
No education	Ref.						
Primary		1.422	0.996	1.042	0.85	0.9	0.903
Higher		2.42	1.389	1.063	0.443	0.829	0.815
Father's education							
No education	Ref.						
Primary		0.63	0.617	0.64*	0.407	0.602	0.53*
Higher		0.535	0.874	0.817	0.447	0.459*	0.436**
Mother's Work Status							
Working(versus not working)		1.453	1.109	1.222	0.792	0.904	0.841

VENMR=Very early neonatal mortality rate.　　　*P< 0.05 , 　**P<0.01, 　***P<0.001
ENMR=Early neonatal mortality rate.
NMR=Neonatal mortality rate.

Table 5.2 Odds Ratio from Logistic Regression Analysis for VENMR, ENMR, NMR in India at both the survey points.

BACKGROUND CHARACTERISTICS		India(1992-93)			India(2005-06)		
		VENMR	ENMR	NMR	VENMR	ENMR	NMR
Antenatal care (3+)							
Yes (Versus No)		0.564***	0.799**	0.77***	0.65**	0.779**	0.795**
Tetanus injections							
Yes (Versus No)		0.767*	0.678***	0.7***	0.892	0.771**	0.754***
Institutional delivery							
Yes (Versus No)		1.852***	1.432***	1.279***	2.51***	1.61***	1.526***
Mother's age							
15-20	Ref.						
20-35		0.952	0.77***	0.819***	1.249	1.043	0.957
35+		0.985	1.077	0.967	1.896*	1.69**	1.543**
Birth interval							
First Birth	Ref.						
Less than 2 Year		1.013	0.935	0.96	0.992	0.857	0.893
More than 2 Year		0.431***	0.461***	0.493***	0.543***	0.454***	0.484***
Sex of Child							
Female (versus Male)		0.661***	0.776***	0.81***	0.961	0.804**	0.891
Region's							
North	Ref.						
Central		1.662**	1.493***	1.449***	1.629**	1.29*	1.276*
East		1.304	1.474***	1.324***	1.372	1.076	0.999
North east		1.151	1.075	1.121	0.784	0.871	0.982
West		0.845	1.168	1.092	0.55*	1.023	0.986
South		1.409	1.575***	1.272**	0.339***	0.793	0.734*
Residence							
Rural (Versus Urban)		1.594***	1.249**	1.303***	1.227	1.145	1.266**
Mother's education							
No education	Ref.						
Primary		1.546***	1.089	0.953	1.103	1.011	1.069
Higher		1.131	0.799*	0.787**	0.42***	0.521***	0.523***
Father's education							
No education	Ref.						
Primary		0.903	0.891	0.956	1.372	1.081	1.179
Higher		0.647***	0.692***	0.732***	1.203	1.042	0.989
Mother's Work Status							
Working (versus not working)		1.185	1.031	1.04	1.34*	1.324***	1.269***

VENMR=Very early neonatal mortality rate.   *P< 0.05 ,   **P<0.01,   ***P<0.001
ENMR=Early neonatal mortality rate.
NMR=Neonatal mortality rate.

Table 5.3 Odds Ratio from Logistic Regression Analysis for VENMR, ENMR, NMR in Nepal at both the survey points.

BACKGROUND CHARACTERISTICS		Nepal(1996)			Nepal(2006)		
		VENMR	ENMR	NMR	VENMR	ENMR	NMR
Antenatal care (3+)							
Yes (Versus No)		1.166	0.924	0.655	0.845	0.78	1.162
Tetanus injections							
Yes (Versus No)		0.763	0.645	0.666	0.5	0.544	0.38**
Institutional delivery							
Yes (Versus No)		0.674	0.936	0.921	0.384	1.878	1.884
Mother's age							
15-20	Ref.						
20-35		0.389*	0.614	0.602*	0.512	1.085	1.168
35+		0.608	0.729	0.55	0.636	0.916	0.828
Birth interval							
First Birth	Ref.						
Less than 2 Year		0.629	0.78	1.089	2.186	0.816	0.694
More than 2 Year		0.864	0.764	0.854	0.525	0.3**	0.33***
Sex of Child							
Female (versus Male)		0.363**	0.5***	0.652**	1.175	1.343	1.543
Region's							
Eastern	Ref.						
Central		1.041	1.019	0.982	0.631	1.067	0.706
Western		1.024	1.178	1.346	1.16	2.652*	1.667
Midwestern		1.757	1.177	1.038	1.828	3.803**	2.637**
Farwestern		0.825	0.825	0.823	0.264	0.758	0.498
Residence							
Rural (Versus Urban)		1.797	1.511	1.169	1.041	1.286	1.139
Mother's education							
No education	Ref.						
Primary		1.05	1.437	0.983	0.647	0.459	0.484*
Higher		2.019	1.397	1.081	0.24	0.166**	0.168***
Father's education							
No education	Ref.						
Primary		0.4*	0.555*	0.775	0.44	0.532	0.598
Higher		0.569	0.762	0.853	0.688	0.771	0.694
Mother's Work Status							
Working (versus not working)		0.688	0.894	0.921	1.001	0.692	0.997

VENMR=Very early neonatal mortality rate.   *P< 0.05 ,   **P<0.01,   ***P<0.001
ENMR=Early neonatal mortality rate.
NMR=Neonatal mortality rate.

Table 5.4 Odds Ratio from Logistic Regression Analysis for VENMR, ENMR, NMR in Pakistan at both the survey points.

BACKGROUND CHARACTERISTICS		Pakistan(1990-91)			Pakistan(2006-07)		
		VENMR	ENMR	NMR	VENMR	ENMR	NMR
Antenatal care (3+)							
Yes (Versus No)		1.099	0.817	0.772	1.11	1.064	1.076
Tetanus injections							
Yes (Versus No)		0.228**	0.833	0.83	0.654	0.644**	0.569***
Institutional delivery							
Yes (Versus No)		3.138**	2.318***	1.845**	1.155	1.227	1.193
Mother's age							
15-20	Ref.						
20-35		0.719	1.556	1.143	1.044	0.876	0.851
35+		0.713	2.03*	1.405	0.55	0.57	0.566
Birth interval							
First Birth	Ref.						
Less than 2 Year		0.824	0.991	0.856	0.725	0.514**	0.462***
More than 2 Year		0.461	0.528**	0.459***	0.644	0.441***	0.443***
Sex of Child							
Female (versus Male)		0.91	0.7*	0.806	0.481**	0.55***	0.773*
Region's							
Punjab	Ref.						
Sindh		0.675	1.139	0.994	0.78	0.85	0.815
NW Frontier		0.513	0.813	0.783	0.351*	0.662	0.53**
Balochistan		0.103	0.984	0.846	0.167	0.57	0.486
Residence							
Rural (Versus Urban)		0.825	1.701**	1.431*	0.971	1.048	1.009
Mother's education							
No education	Ref.						
Primary		1.597	1.093	0.795	0.743	0.888	0.732
Higher		1.411	1.181	0.745	0.68	1.125	0.981
Father's education							
No education	Ref.						
Primary		2.145	1.055	1.075	0.57	0.921	0.913
Higher		1.565	1.015	1.136	1.419	0.863	0.879
Mother's Work Status							
Working (versus not working)		0.888	1.668**	1.475*	2.794***	2.438***	2.059***

VENMR=Very early neonatal mortality rate.   *P< 0.05 ,   **P<0.01,   ***P<0.001
ENMR=Early neonatal mortality rate.
NMR=Neonatal mortality rate.