## CHAPTER 1

### Introduction

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CHAPTER 1

Introduction

1.1 General

The first five years of life are the most crucial to the physical and intellectual development of children and can determine their potential to learn and thrive for a life time. That is why it is specifically stated as one of the goals of the millennium development goals (MDGs) to reduce child mortality by two-thirds by 2015. Although there has been a substantial reduction in infant and child mortality rates in most developing countries in the recent past, it still remains a major public health issue in South Asian countries particularly in India.

Mortality and its converse indicator, longevity or life expectancy are among the most important measures of well-being and development in developing countries. Since child mortality has an overwhelming influence on life expectancy, it is important to analyze the determinants of child mortality in India and particularly in the state of Manipur. Moreover, child mortality indicates the health status of not only child but also the health status of mothers as well as society as a whole. The child mortality has received a new momentum of the study since there is a strong associationship between mortality and fertility as high mortality corresponds high fertility and vice-versa. Thus, the study of especially on child has as immense contribution towards the regulation of population growth and enhancing the health status of the society.
The general medical definition distinguishes mortality of a child with respect to the child age: death within the first week of life is included with prenatal mortality (which also includes late foetal mortality) and death within the first month is referred to as neonatal mortality, and death within one year is referred to as infant mortality. The death under five is referred to as child mortality [WHO, (2005)]\(^{(1)}\). Since peri and neonatal mortality is heavily influenced by prematurity, fatal genetic conditions of the foetus, and problems associated with delivery. The mortality after first month, which is mostly related to socio-economic and health conditions of the household. It is possible to analysis the determinants of child mortality at various levels of causality [Mosley & Chen (1984)]\(^{(2)}\]. The biomedical and epidemiological literature typically focuses on the immediate determinants of child mortality, in particular the impact of various diseases and weakened resistance. In contrast, socio-economic, environment & sanitation, medical and health care, demographic, exposure to mass media, etc., are usually focused on underlying determinants of child mortality that make children more vulnerable to the attack of various diseases. Moreover, the child mortality rates vary from countries to countries and even within the country also it is varied in region to region and state to state. In developed countries, the main factor influencing on child mortality is demographic factors whereas socio-economic, health care, etc., are main factors influencing on child mortality in developing countries. Thus, the study of child mortality is different from country to country and region to region.

**World population and its trend**

In July 2013, the world population reached 7.2 billion with 5.9 billion or 82.5 percent of the world’s population living in the less developed regions out of
these, 898 million resides in the least developed countries with 12.5 percent of the world population. More developed regions, whose total population amounts to 1.25 billion inhabitants, account for 17.5 percent of the world population. Moreover, most of the world population lives in a few countries. In 2013, 37 percent of the world population lived in China and India. And, eight countries accounted for a further 22 percent of the world population inhabitants namely, United States of America, Indonesia, Brazil, Pakistan, Nigeria, Bangladesh, the Russian Federation and Japan. By 2028, the population of India is projected to surpass that of China and taken together the two countries will account then for about 35 percent of the world population [UN, (2013)\(^3\)].

Since the human history on earth, the world population grew slowly if at all. Growth rates began increasing slowly during the 17\(^{th}\) and 18\(^{th}\) centuries as mortality started to decline. With accelerating gains in longevity, the growth rate of the world population increased, especially during 20\(^{th}\) century, when it reached a peak at 2.07 percent per year in 1965-1970. Since then, the speed of population growth has been decelerating, largely as a result of falling fertility in the developing world. By 2005-2010, the population growth rate at the world level has reached 1.20 percent per year and it is projected to 0.51 percent per year by 2045-2050 and to 0.11 percent by 2095-2100 [UN, 2013\(^3\)].

As fertility decline has not occurred simultaneously in all countries, the pace of population growth still differs considerably among countries. Thus, whereas the population of more developed regions rose at an annual rate of 0.42 percent per year during 2005-2010, that of the less developed regions increased more than three
times faster, at 1.37 percent annually, and the least developed countries as a group have experienced even more rapid population growth, at 2.28 percent per year [UN, 2013(3)]

**India’s population and its trends**

According to Census of India 2011(4), the population of India is 1,210,193,422 at 2011 as compared to a total of 1,028,737,436 in 2001. In absolute terms, the population of India has increased by more than 181 million during the decade 2001-2011. But, the population of India, at the term of 20th century was only around 238.4 million. This has increased by more than four times in a period of one hundred and ten years to reach 1210 million in 2011. It is significant that the percentage decadal growth during 2001-2011 has registered the sharpest decline since independence. It declined from 23.87 for 1981-1991 to 21.54 percent for the period 1991-2001, a decrease of 2.33 percentage points. For 2001-2011, this decadal growth has become 17.64 percent, a further decrease of 3.90 percentage points.

In India, the total number of children in the age group of 0-6 years as per the provisional population totals of Census 2011(4) is 158.8 million (a share of 13.12 percent to the total population). In Census 2001, the total number of children in the age group of 0-6 years was about 163.8 million, about 5 million more than the number recorded in 2011. This reduction is indicative of a fall in fertility and is a positive sign. In Manipur state, the total number of children in the age group of 0-6 years as per the final population totals of Census 2011 is 3,53,237 out of which 1,82,684 are male children and 1,70,553 are female children. It is an increase of
26,871 children from the census 2001. And, the share of children in the age group of 0-6 years to the total population is 12.98 percent but it was 14.2 percent at 2001.

**Level and trend of child mortality**

All over the world, a substantial progress has been made towards achieving MDG-4 of United Nations to reduce child mortality by two-thirds during 1990-2015. The World Health Organization defines child mortality as deaths of children under the age of five. The number of under5 deaths worldwide has declined from nearly 12 million in 1990 to 6.6 million in 2012. While that translates into 17,000 fewer children dying every day in 2012 than in 1990, it still implies that deaths of 18,000 children under age five everyday in 2012 [UNICEF, 2013(5)].

Since 1990, the global under5 mortality rate has dropped 47 percent—from 90 deaths per 1,000 live births in 1990 to 48 in 2012. Particularly, Eastern Asia, Northern Africa, Latin America and Caribbean, South-Eastern Asia, and Western Asia have reduced their under5 mortality rate by more than 50 percent except Sub-Saharan Africa and Oceania.

The average annual rate of reduction in under5 mortality in the world has accelerated from 1.2 percent a year over 1990-1995 to 3.9 percent over 2005-2012 but remains inadequate to reach MDG-4, particularly in Oceania, Sub-Saharan Africa, Caucasus and Central and Southern Asia. The highest rates of child mortality are still in Sub-Saharan Africa with an under-five mortality rate of 98 deaths per 1,000 live births—more than 15 times the average for developed regions. The under5 deaths are increasingly concentrated in Sub-Saharan Africa and Southern Asia,
while the share in the rest of world dropped from 32 percent in 1990 to 18 percent in 2012.

About half of under5 deaths occur in only five countries: India, Nigeria, Democratic Republic of Congo, Pakistan and China. India (24 percent) and Nigeria (11 percent) together account for more than one-thirds of all under-five deaths.

The proportion of the under5 deaths that occurs within the first month of life (the neonatal period) has increased 17 percent since 1990, from 36 percent to about 43 percent, because declines in the neonatal mortality rate are slower than those in the mortality rate for older children. And, almost 30 percent of neonatal deaths occur in India. Sub-Saharan Africa has the highest risk of death in the first month of life and is among the regions showing the least progress.

In India, under5 mortality rate was 114 in 1990 and it was reduced to 88 in 2000 and 56 in 2012. Thus the annual rate of reduction during 1990-2012 is 3.6. However, the MDG target for 2015 set by United Nations in the country is 38. Therefore, there is huge gap of the rate of reduction in child mortality and the United Nation’s target. According to this trend, there may be a reduction of about 45 under5 mortality rate in 2015 and it is far from MDG-4 of United Nations.

**Causes of child deaths**

The leading causes of child deaths in world are pneumonia (17 percent of all under-five deaths), preterm birth complications (15 percent), intrapartum-related complications i.e., complications during births (10 percent), diarrhoea (9 percent),
and malaria (7 percent). Globally, about 45 percent of under5 deaths are attributable to under-nutrition [UNICEF, 2013\(^5\)].

In India, the main causes of child deaths according to UNICEF (2013)\(^5\) are pneumonia (11 percent), diarrhoea (11 percent), measles (4 percent), injuries (3 percent), neonatal conditions (55 percent) and others (16 percent). The neonatal conditions are due to infections (29%), preterm (24%), Asphyxia (19%), diarrheal (3%), congenital (3%), tetanus (1%) and others (20%).

**Global initiatives to reduce child mortality**

WHO has been initiated various programmes for reducing child mortality and to achieve the United Nations millennium Development Goal-4. They are accountability for women’s and children’s health, global plan of action for children’s health and the environment, WHO child growth standards, etc.

The call for action to address children’s environmental health at the third WHO International Conference on Children’s Health and Environment in Busan, Republic of Korea (June 2009)\(^6\) asked WHO to facilitate the development of a global plan of action to improve children’s environmental health and regularly monitor and report on its progress. This draft Plan of Action is designed to provide a road map for WHO, governments, inter-governmental and non-governmental organizations, and all concerned stakeholders to contribute to the attainment of the MDGs, and other internationally agreed development declarations, commitments and goals, in particular those relate to reducing child mortality (MDG-4) and ensuring environmental sustainability (MDG-7).
The UN Children’s Fund (UNICEF) and the World Health Organization (WHO) have launched their Global Action Plan for pneumonia and diarrhoea, which aims to end preventable child deaths from these conditions by 2025. The launch was supported by the publication of a series of articles in the medical journal ‘The Lancet’ showing that the tools to accomplish this goal already exist, and that the targets should be achievable at a reasonable cost. WHO and UNICEF have proposed the ‘Aggressive Target’ of bring the number of pneumonia deaths in children under age five to less than 3 percent per 1,000 and the number of diarrhoea deaths to less than 1 percent per 1,000.

Further, reaching the MDG on reducing child mortality will require universal coverage with key effective, affordable interventions; care for newborns and their mothers; infant and young child feeding; vaccines; prevention and care management of pneumonia, diarrhoea and sepsis; malaria control; and prevention and care of HIV/AIDS. In countries with high mortality, these interventions could reduce the number of deaths by more than half and to deliver these interventions, WHO promise four main strategies: appropriate home care and timely treatment of complications for newborns, integrated management of childhood illness for all children under five years old, expanded programmes on immunization and infant and young child feeding.

In India, by the Alma Ata declaration of 1978, the Government of India envisaged a national goal for the attainment of an infant mortality rate (IMR) of 60 by the year 2000, since then, substantial resources have been put into child survival programmes over the past 30 years. In 1979, the Family Planning Programme
evolved into Family Welfare Programme. In this context, Maternal and Child Health became an integral part of the Family Welfare Programme. The integration was based on the understanding that reductions in the birth rates will also contribute significantly to reductions in infant and child mortality rates, and contribute to safe motherhood [MoHFW, 2013(7)].

The National Diarrheal Control Programme began in 1978 subsequently in 1979; the Expanded Programme of Immunization (EPI) was established to provide the tetanus toxoid (TT) vaccine to pregnant women, and the BCG, DPT, Polio and Measles vaccines to children. The Universal Immunization Programme (UIP) and Universal Rehydration Therapy (ORT), both launched in 1985, and the Safe Mother Programme initiated during the VIIIth Plan, were prominent components of the Family Welfare Programme. The Acute Respiratory Infection (ARI) control programme was established in 1990.

In the early 1990s, these programmes (UIP, Diarrheal Disease Control Programme, Safe Motherhood Programme and ARI control programme) were integrated and further strengthened to shape the Child Survival and Safe Motherhood (CSSM) Programme. In 1997, the CSSM programme was further expanded to the Reproductive and Child Health (RCH) programme with a larger basket of services and greater focus on reproductive rights of women. The National Population Policy (2000)(8) and National Health Policy (2002)(9) addressed the issues of child survival and maternal health and increased the outreach and coverage of the comprehensive package of RCH services through the government and voluntary non-government sectors in partnership. In accordance with the United Nations
Millennium Development Goals, the National Population Policy of India (NPP, 2000\textsuperscript{(8)}) has set an ambitious goal of reducing infant mortality to 30 by the year 2010. India has failed to achieve this goal. And then, after completion of the first phase of RCH in 2004-2005, the government of India entered into RCH phase-II.

In 2005, the government of India launched the National Rural Health Mission (NRHM) to improve the availability and quality of accessible health care, especially for those residing in rural areas, including the poor women and children. The major goals of the mission are to reduce IMR and maternal mortality rate (MMR), improve universal access to public services and enhance the prevention and control of communicable, and non-communicable diseases, including locally endemic diseases (NRHM, MoHFW, 2005\textsuperscript{(10)}). RCH-II was submerged within the NRHM.

Although India has realized impressive gains in child health outcomes by these programmes for certain social groups, inequalities in the potential for child survival between low and high socio-economic households persist. This suggests that coverage is still very low in some populations, particularly among the poor. Renewed efforts are therefore required to address poverty and inequality in child health.

**Rational of the study**

From the above discussions, it is clear that at the present juncture, India is unlikely to achieve MDG-4 at the national level as well as at the state levels as it contribute to the reduction of child mortality. It is a high time to study of the
determinants of child mortality in India as a whole and in Manipur state particular to achieve MDG-4 targets of United Nations. Further, it seeks to identify socio-economic, demographic, environment & sanitation, breastfeeding, medical/health care and sex preference factors etc. that determine child survival in the study area. Despite its immense contribution, no systematic and scientific community based research on child mortality has so far been taken up in this tiny state of Manipur. Keeping this in view, the propose study is initiated empirically to analyse the effects of some important determinants which are expected to cause the child mortality in the study area.

1.2 Objective

General objective

The main objective of the present study is to determine the determinants of child mortality of Manipur valley and their associations.

Specific objectives

The specific objectives are

- To determine the influence of socio-economic, demographic, environment and sanitation, medical/health care, exposure to mass media, breastfeeding and sex preference on differential mortality pattern of childhood.

- To construct a life table of child mortality
1.3 Methodology

**Study design:** Cross sectional

**Study area:** Four valley districts of Manipur

**Survey period:** 1st May, 2008 to 30th April, 2009

**Reference period:** From 1st May, 2003 up to survey period

**Study subject:** The subjects included in the study are

(i) Under5 children born alive within the reference period

(ii) The parents of under5 children

**Sample size:** 836 under5 children estimated by using the formula

\[ n = \frac{r}{e^2} \]

with 95% precision and 0.75 % permissible error of the rate, where \( r = \) under5 mortality rate (obtained from prior information) and \( e = \) permissible error.

**Sampling design:** Two stage sampling with proportional allocation

**Study variables:** (i) Response variable—survival status of under5 children under study

(ii) Prognostic variables: factors related to socio-economic, demographic, environment and sanitation, medical/health care etc.

**Tools:** Pre-tested and semi-structural interviewed schedule.

**Statistical analysis:**

- Descriptive statistics viz., mean, standard deviation, chi-square test etc.
- Logistic regression analysis
- Factor analysis
- Cox’s Proportional hazard model
Table 1: District-wise sample selection

<table>
<thead>
<tr>
<th>District</th>
<th>Residence</th>
<th>Total village/town*</th>
<th>Selected Village/town</th>
<th>Total households*</th>
<th>Selected household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imphal East</td>
<td>Rural</td>
<td>204</td>
<td>10</td>
<td>42897</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>6</td>
<td>2</td>
<td>26285</td>
<td>50</td>
</tr>
<tr>
<td>Imphal West</td>
<td>Rural</td>
<td>134</td>
<td>6</td>
<td>73566</td>
<td>207</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>10</td>
<td>2</td>
<td>5512</td>
<td>55</td>
</tr>
<tr>
<td>Bishnupur</td>
<td>Rural</td>
<td>49</td>
<td>3</td>
<td>30870</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>7</td>
<td>1</td>
<td>4433</td>
<td>28</td>
</tr>
<tr>
<td>Thoubal</td>
<td>Rural</td>
<td>103</td>
<td>4</td>
<td>62212</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>9</td>
<td>2</td>
<td>5469</td>
<td>49</td>
</tr>
<tr>
<td>Total</td>
<td>Rural</td>
<td>490</td>
<td>23</td>
<td>209545</td>
<td>654</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>32</td>
<td>7</td>
<td>41699</td>
<td>182</td>
</tr>
</tbody>
</table>

*Census 2001 report.

Population

Every household in four valley districts of Manipur is considered as a population unit assuming that every household has at least one under 5 child. According to Census of India 2001, the total households in four districts of Manipur is 251,244 of which 209,545 households and 41,699 households are respectively inhabited in rural and urban areas. Altogether these households are distributed in 490 inhabited villages and 32 towns as shown in table 1.

Sampling frame

The primary sampling units of the present study are those households of the four districts of Manipur. Thus, the sampling frame is the list of households inhabited in the study area. There are 2,09,545 households in rural areas and 41,699 households in urban areas. In district wise, Bishnupur district has 30,870 households in rural areas and 4,433 households in urban area. Imphal East district has 42,879 and 26,285 households in rural and urban areas respectively. In Imphal West district, 42,879 and 26,285 households respectively are distributed in 134 villages and 10
towns. Thoubal district has 62,212 households in 103 villages and 5,469 households in 9 towns.

**Sampling method**

The two stage sampling under proportional allocation is used here to select a sample of size of 836 households from the population. In the first stage, 23 villages and 7 towns altogether 30 inhabitants have been selected under proportionate to the existing number of villages/towns in four districts. District-wise selected number of villages and towns are shown in table 1. In the second stage, 836 households of which 654 households from rural area and 182 households from urban area have been randomly drawn from the selected villages and towns under proportional allocation.

**Method of data collection and tool for data collection**

The personal interview method is used in collecting data with a pre-tested semi-structural interviewed schedule.

**Field work**

The field work was conducted during 1st May, 2008 and 30th April, 2009. In this task, each and every selected household was visited personally and asked all questions which are listed in schedule to the respondents to get the relevant information of the study. The main respondents of the survey are those mothers in the households having children of under5 year of age. However, there were some already selected households having no under five children and they were replaced by others households residing in the same village and or towns by applying quota
sampling method since the objective of the study is to estimate the child mortality rate in the study area.

**Data processing**

Once the field work has been completed, the filled up questionnaires were properly checked and made full correction as there were some error in measurement and missing observations. After the data had been cleaned and then data were processed through SPSS-20 for analysis.

**1.4 Brief description of the study area**

**Location**

Manipur is one of the 7 north eastern states of India with city of Imphal is its capital. The state is bounded by Nagaland (Indian state) to the north, Mizoram (Indian state) to the south, and Assam (Indian state) to the west; Myanmar lies to the east. It covers an area of 22,347 sq. Km. The state lies at latitude of $23^\circ83'N-56^\circ68'N$ and longitude of $93^\circ00'E-94^\circ78'E$. Manipur may be characterized in two distinct physical regions—an outlaying area of rugged hills and an oval shaped valley of approximately 2,000 sq. Km. These two regions are not only distinct in respect of physical features but also conspicuous with regard to various flora and fauna. The oval shaped valley comprising four districts viz., Bishnupur, Imphal East, Imphal West and Thoubal, is surrounded by Blue Mountains and is at an elevation of 790 metres above the sea level. The slope of the valley is from north to south.

The following facts in terms of the state and study area are according to the final result of ‘Census 2011’ of Manipur and its districts:
<table>
<thead>
<tr>
<th></th>
<th>Manipur</th>
<th>Study area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area</strong></td>
<td>22,327 sq. Km.</td>
<td>2,000 sq. Km.</td>
</tr>
<tr>
<td><strong>Capital</strong></td>
<td>Imphal</td>
<td></td>
</tr>
<tr>
<td><strong>Lingua franca</strong></td>
<td>Manipuri</td>
<td>Manipuri</td>
</tr>
<tr>
<td><strong>Number of Districts</strong></td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td><strong>Name of Districts</strong></td>
<td>Bishnupur, Chandel, Churachandpur, Imphal East, Imphal West, Senapati, Tamenglong, Thoubal and Ukhrul</td>
<td>Bishnupur, Imphal East, Imphal West and Thoubal</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>2,570,390</td>
<td>1,633,672</td>
</tr>
<tr>
<td></td>
<td>Male: 1,290,171</td>
<td>810,775</td>
</tr>
<tr>
<td></td>
<td>Female: 1,280,219</td>
<td>822,897</td>
</tr>
<tr>
<td><strong>Density/km²</strong></td>
<td>115</td>
<td>817</td>
</tr>
<tr>
<td><strong>Population growth (2001 to 2011)</strong></td>
<td>12.05%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Total children population (0-6 years)</strong></td>
<td>338,259</td>
<td>213,670</td>
</tr>
<tr>
<td></td>
<td>Male: 174,700</td>
<td>110,084</td>
</tr>
<tr>
<td></td>
<td>Female: 163,554</td>
<td>103,586</td>
</tr>
<tr>
<td><strong>Sex Ratio</strong></td>
<td>992</td>
<td>1,015</td>
</tr>
<tr>
<td><strong>Child Sex Ratio(0-6 years)</strong></td>
<td>936</td>
<td>941</td>
</tr>
<tr>
<td><strong>Literacy (%)</strong></td>
<td>79.21</td>
<td>80.49</td>
</tr>
<tr>
<td></td>
<td>Male (%): 86.06</td>
<td>88.37</td>
</tr>
<tr>
<td></td>
<td>Female (%): 71.73</td>
<td>72.81</td>
</tr>
</tbody>
</table>
1.5 Review of literature

There are a number of different analytical frameworks through which to view the effects of different determinants on childhood mortality. Demographic research by Mosley and Chen (1984)\(^2\) has made the distinction between variables considered to be exogenous or socioeconomic (i.e., cultural, social, economic, community, and regional actors) and endogenous or biomedical factors (i.e., breastfeeding patterns, hygiene, sanitary measures, and nutrition). The effects of the exogenous variables are considered indirect because they operate through the endogenous biomedical factors. Likewise, the bio-medical factors are called intermediate variables or proximate determinants because they constitute the middle step between the exogenous variables and child mortality.
Mosley and Chen (1984)\(^2\) were among the first to study the intermediate biomedical factors affecting child mortality, labeled 'proximate determinants.' They distinguished 14 proximate determinants and categorized them into 5 groups: maternal [fertility] factors such as age, parity and birth interval; environmental contamination such as air, food/water/fingers, skin/soil/inanimate objects and insect vectors factors; nutrient deficiency such as calories, protein, micro nutrients (vitamins and minerals); injury such as accidental and intentional; and personal illness control such as personal preventive measures and medical treatment.

Klaauw and Wang\(^{11}\) develop a flexible parametric framework for analyzing infant and child mortality. This framework is based on widely used hazard rate models, which they extend with two features. First, the model allows individual characteristics and household's socio-economic and environmental characteristics to have different impacts on infant and child mortality at different ages. Second, they allow for frailty at multiple levels, which can be correlated with each other. The first feature seems to be particularly relevant in describing infant and child mortality, child specific and household's socio-economic and environmental characteristics have significantly different impacts on mortality rates at different ages of the child. They also use the estimated model to perform a number of policy experiments. The policy experiments show that infant and child mortality rates can be reduced substantially by improving the household's socio-economic and environmental characteristics. Their model predicts that a significant number of under5 deaths can be averted by providing access to electricity, improving the education of women, providing sanitation facilities and reducing indoor air pollution. In particular, reducing indoor air pollution and increasing the educational level of women might
have substantial impacts on child mortality. According to these frameworks, the related literatures which are numerous on this study have been undertaken to visualize the importance of it. The present section is therefore devoted to a brief review of only those research works which have direct or indirect relevance to the present work. The chronological factorwise review of literature generally called systematic review is adopted here.

**Socio-economic factors**

**Education of parent**

Hobcraft, McDonald et al. (1985)\(^{(12)}\) suggest that higher education of parents shows clear cut reductions in risks for all survival intervals from infant up to under5 child. In a related study from Southern Sudan, Roth and Kurup (1989)\(^{(13)}\) highlight the maternal education is the most significant determinants of child survival. However, in Basu and Basu (1991)\(^{(14)}\), there is no clear relation to sex ratio of childhood mortality even though absolute levels of child mortality are lower for educated mothers. A study in Bangladesh by Kabir and Amin(1993)\(^{(15)}\), parental education was found to have major influence on child mortality. They highlighted that the relative risk of children dying is high when both the mother and father are illiterate. The similar study by Chowdhury et al. (1995)\(^{(16)}\) in infant and child mortality among high and low risk Bangladeshi mothers in relation to the socio-economic variables, it is highlighted that the children of mothers with no schooling were found to have 1.07 higher odds ratio than children of mothers with some schooling and the relation between risk of child death and education of mother was statistically significant. In later study by Majumdar, et al. (1997)\(^{(17)}\) in Bangladesh, it
is found that both mother’s and father’s education are also associated with differential infant and child mortality risks.

The study to examine the effect of socio-economic background characteristics, demographic characteristics and health care behavior using information from women’s birth histories pertaining to children born during 12 years before the NFHS-1992-93 by Pandey, et al. (1998)\(^{(18)}\), it is observed that mother’s literacy has substantial and often statistically significant adjusted effects on infant and child mortality. In a related study in Malawi, Baker (1999)\(^{(19)}\) education does have a strong inverse relationship with risks of child mortality. The introduction of education controls also changes the relative risks of child mortality in different regions of Malawi.

According to Rutstein (2000)\(^{(20)}\), the changes in socioeconomic status may lead to positive changes in fertility behaviour, nutritional status, and the use of health services. They may also have their own impacts on the development of better childcare practices, better food preservation, household cleanliness, etc. Two indicators were used to summarize change in socioeconomic status and to control for this effect when considering the other explanatory factors: the percentage of women who have completed at least primary school and the percentage of women living in households with electricity. As expected, increases in both indicators were associated with declines in mortality. It was also suggested by Ali (2001)\(^{(21)}\) that the mother’s education shows a considerable reducing effect on child mortality. The effect diminishes to almost half once predictors (rural/urban) and covariates are adjusted. Thus, the effect of mother’s education on child survival is stronger in
urban than rural areas. The differentials in under5 mortality according to mother’s level of education is increased consistently since 1970 to 1991 in Sao Paulo, Brazil (Sastry (2002)(22)). He found that the ratio of under5 mortality among the least adjusted mortality for children of illiterate mother’s fell 45 percent between 1970 and 1991, while for mother’s with higher education, under5 mortality fell percent. Mahy (2003)(23) suggests that children of women with less education or who live in rural areas have higher levels of mortality than children of other women in almost all developing countries.

In the study of the child mortality in rural India by Klaauw & Wang (2004)(11) based on NFHS-2 data, the child mortality can be reduced substantially, particularly by improving the education of women. And they constructed a flexible duration model framework, which allows for frailty at multiple levels and interactions between the child’s age and individual, socio-economic and environmental characteristics. The model predicts that infant mortality rates reduce from 73 to 60 per 1,000 live births and the child mortality rates reduce from 99 to 76 when mother’s educational level changes from illiterate to literate. Similar study by Syamala (2004)(24) in Gao, India, women educated up to primary level, the chances of child survival increased to 2.6 percent over that of the children of illiterate mothers. In a related study in the child mortality in a developing country: a statistical analysis, by Jamal et al. (2008)(25) employs cross- tabulation and multiple logistic regression techniques to estimate the predictors of child mortality. The result of cross-tabulation indicates that parents’ education is vital factor associated with risk of child mortality but in logistic regression analysis only the father’s education has been found significant to reduce child mortality.
Occupation

In past literatures, it had been found the close relationship between occupation of parents and child survival rates. A higher level of child mortality then is found among women who do not work, Basu & Basu (1991)(14). A shortage of time is one of the major reasons for this negative relation between maternal employment and child survival. By Kabir & Amin (1993)(15) in their work “Factors influencing child mortality in Bangladesh and their implications for the national health programme”, the children of white collar worker parents have a lower risk of mortality than the children of other parents. In a study of Kishor and Parasuraman (1998)(26), it is suggested that employed mothers have 10 percent higher infant mortality rate and 36 percent higher child mortality rate than unemployed mothers. The higher mortality of children if mothers work reflects the fact that employment for women is in addition to their traditionally ascribed roles. They alone must fulfill all of these obligations. Similar negative effects on child mortality would surely be evident if fathers have the sole responsibility for the care of infants while having to fulfill their obligations as earners. Unless gender roles and gender relations are renegotiated, children will continue to lose.

However, the study of “Differential in child mortality in Malawi” Baker (1999)(19), the controls for other socio-economic variables, durable goods and the dummy variable for employment of the mother, neither variable turns out to be a significant predictor of child death and causes no significant change to the coefficients of the other variables.
Ali (2001)\(^{(21)}\), on his study “Poverty and child mortality in Pakistan”, observed that, although female labour force participation is low in Pakistan, the incidence of child death is higher among working than non-working mothers. Further, an urban-rural comparison indicates that such differentials are conspicuous in rural areas. The possible explanation of this association may be sought in the fact that in Pakistan, a majority of women work force start working after marriage and only a few of the women are in white collar jobs. These working women devote less time to the rearing of their children and thus expose them to a greater risk of ill health. In the study on Child Mortality, Poverty and Environment in developing countries, Franz & FitzRoy (2006)\(^{(27)}\), with the female share of the agricultural labour force and tuberculosis should capture at least some of the mortality effects of the agricultural environmental degradation that is most advanced in the Central Asia regions.

**Rural/urban residence**

A study of Kabir and Amin (1993)\(^{(15)}\) reveals that type of place of residence has significant variation in child mortality. The children of rural resident parents have more chance of mortality than urban residence in Bangladesh. Another study in Bangladesh, by Chowdhury et al. (1995)\(^{(16)}\) indicates the child mortality rate is higher in rural area than urban area for both high and low risk Bangladeshi mothers. The NFHS-2 subject report on “Infant and child mortality in India”, Pandey et al. (1998)\(^{(18)}\), which examined the infant and child mortality and their determinants for India as a whole and for individual states using data from the 1992-1993 NFHS. The effect of socio-economic background characteristics, demographic characteristics, and mother’s health care-behaviour using information from women’s
birth histories pertaining to children born during 12 years before the survey on infant and child mortality are examined. Among socio-economic background characteristics, urban/rural residence is found to have substantial unadjusted effect on infant and child mortality but the effect is much smaller when the effects of other socio-economic variables and basic demographic factors are controlled. Although there are large differences in unadjusted infant and child mortality between rural and urban areas, most of these differences disappear when we control for the effects of other variables. This contrast between strong unadjusted effects and weak adjusted effects suggests that most of the urban/rural difference in infant and child mortality is due to factors closely related to residence rather than to residence itself. The adjusted effect of urban/rural residence on mortality tends to increase with child’s age. For India as a whole, the adjusted effect of residence on neonatal and post-neonatal mortality is very small and not statistically significant, while the adjusted effect on child mortality is larger and statistically significant. Urban/rural residence tends to have a statistically significant or substantial effect on infant and child mortality, after adjusting for other factors, in those states where mortality levels are high.

Another study conducted by Claeson et al. (1999)\(^{28}\) on “Reducing child mortality in India, keeping up the pace” suggests that the infant and child mortality in India has substantially declined over the past 15 to 20 years since the study period. According to SRS data, infant mortality declined by 35 percent during the past 15 years. According to NFHS, under5 mortality declined by about 25 percent between 1978-83 and 1988-93. The decline in child mortality in urban areas has been slower than rural areas. In Baker’s (1999)\(^{19}\) finding on “Differential in child
mortality in Malawi” he subdivides the whole Malawi into three regions as North, Center and North and examines regional differentiation on child mortality. He proceeds with multivariate regressions in attempts to discover what it is about the regions that explain the differences in mortality. In his first model includes dummy variables for the region the mother was living in at the time of the survey. This establishes regional differentiation of mortality. Results from the model show the large effects of regional dummy variables on child mortality. The relative risk of child mortality in the south relative to the North is 1.27, and the relative risk in the center relative to the north is 1.32. There appears to be only a small difference between the child mortality of the south and center, and the difference between the two regions is not statistically significant. In the study of “Impact of some biosocial variables on infant and child mortality” by Biswas et al. (2000)\(^{(29)}\), it is found that during infancy and early childhood, mortality in rural area is higher but during 2\(^{nd}\) year of life urban child mortality is higher.

In related study of Brazil, Sastry (2002)\(^{(30)}\) compares the actual estimates child mortality for rural and urban areas for each year from 1970 to 1991 with adjusted estimates that hold all other covariates constant at their states wide means, reveals that rural under5 mortality was higher only because the inhabitants of rural areas were more disadvantaged. In the same year, Bang et al. (2002)\(^{(31)}\), studied the child mortality in Maharashtra, India and they indicated that the child mortality is high in the tribal areas and urban slums and made a suggestion that this is due to the geographical and distance result in inaccessibility and unacceptability of the health services to those two population groups. Mahy (2003)\(^{(23)}\) also found that , in all
developing countries, children of women who live in rural areas have higher levels of mortality than children of other women.

In this particular application, this three-part model predicts mortality better than a duration model for the under5 child mortality in general since it uncovers some interesting differences between the impacts of household environmental and socio-demographic determinants on the neonatal, infant and subsequent mortality risk. Results show that access to municipal water decreases the risk and sanitation is found to have a more pronounced impact on mortality than water.

Jacoby and Wang (2004)(32) examine the linkages between child mortality and morbidity, and the quality of the household and community environment in rural and urban China using a competing risks approach. The key findings include (1) use of unclean cooking fuels (wood and coal) significantly reduces the neonatal survival probability in rural area—an outcome that is also confirmed in two other studies (India and Guatemala); (2) access to safe water or sanitation reduces child mortality risks by about 34% in rural areas; (3) higher maternal education levels reduce child mortality and female education has strong health externalities (i.e. controlling for other factors, a child living in a neighborhood with more educated mothers has about 50% lower mortality risk); (4) 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; (5) significant linkages between Acute Respiratory Infections (ARI) incidence and use of unclean cooking fuels are found using the city level data constructed from the survey. This study indicates that effective policy interventions for improving health outcomes often lie
both within and outside the health sector. Cross-sectional approaches can potentially produce large health benefits.

Based on the data, Jacoby and Wang (2004)\(^{(32)}\) projected that air quality in the cities and lack of access to clean water in the countryside are the key factors for children’s health. She then looked at water, sanitation and cooking fuels as health indicators to verify this projection. She noted there is a great deal of literature identifying the key determinants of child morbidity. Mortality, on the other hand, is difficult to establish because information is often lacking, multiple causes are at play, and deaths often occur in the home. Wang looked at the age of death for children and found most death occurred in the first nine months. In rural areas, her results suggest unclean cooking fuel is a key factor in rural mortality rates for babies. These results are similar to evidence from India and Guatemala. Additional results include children born in hospitals and living in better neighborhoods is more likely to survive. Access to safe drinking water is another critical variable. The mother’s education also plays a role in the survival rate for children under five years of age. Results in urban area found male children had higher mortality rates than female children; a result Jacoby and Wang said is inconsistent with data from other countries.

**Income**

In past finding carried out by researchers, it has been found that the economic condition is one of the important factors for under5 mortality. In Mare’s (1982)\(^{(33)}\) study, higher income children have an advantage for all race-sex groups except black girls and a stronger advantage for boys than for girls. Compared to the
schooling differentials, however, there is less tendency for socioeconomic differentials to increase with age among boys, a possible consequence of family income being a less reliable index of socioeconomic conditions experienced by older children than of those experienced by younger children. Despite the measurement unreliability of income, however, clear socioeconomic differentials appear for most groups, and economic effects are as strong as those of mother's schooling. A study of Kabir and Amin (1993)\(^{(15)}\) conducted in Bangladesh observes that income is one of the factors influencing child mortality in Bangladesh and those children of white collar workers have lower risk of mortality. In the similar study on “infant and child mortality among high and low risk Bangladeshi mothers in relation to the socio-economic variable” by Chowdhury et al. (1995)\(^{(16)}\), also suggested that relationship between risk of child death and income is found to be statistically significant and parents having high income have low risk of their child deaths.

In the study of Pandey et al. (1998)\(^{(18)}\) it is observed that economic level of the household have substantial and often statistically significant adjusted effects on infant and child mortality. Further they also pointed out that high-risk households include those headed by Hindus belonging to a scheduled caste or scheduled tribe, those without access to a flush or pit toilet, those with very low economic status, and those where mothers are illiterate. Baker (1999)\(^{(19)}\) developed four model in his study in Malawi. The fourth model added controls for other socio-economic variables, durable goods and the dummy variable for employment of the mother. Neither variable turns out to be a significant predictor of child death and causes no significant models for differential in child mortality change to the coefficients of the other variables. The analyses just described assume that the three regions of Malawi
have the same structural relationships between the explanatory variables and child mortality. Bhuyan (2000)\(^{34}\) also suggests that economic condition and mortality of child move in the same direction among high parity women, poor women with high parity has higher risk of children deaths than high income women.

In the study of urbanization, development and socio-economic inequalities in under5 mortality: evidence from Sao Paulo, Brazil from 1970 to 1991, Sastry (2000)\(^{22}\) suggests that the concentration index of economic inequality in under5 mortality rose sharply after adjusting for covariates. This suggests, not surprise, that inequality in wealth index is strongly associated with inequalities in education and living conditions and that there are multiple pathways through which to reduce economic inequalities in health beyond simply reducing economic disparities. After adjusting for covariates, the periphery metro Sao Paulo consistently had the least economic inequality in under5 mortality. In the study of Syamala (2004)\(^{35}\), the association between standard of living and survival chances of children was positive- when living standard improved from low to medium, the survival chances improved by 6.58% in India. As the living standard increased from medium to high, there is a considerable improvement in the survival chances by 9.21%. The variables viz., poor and income distribution were statistically significant effects on child mortality in developing countries as suggested by Franz and FitzRoy (2006)\(^{27}\). Uddin et al. (2008)\(^{36}\) in their finding highlights the mother’s standard of living index has substantial impact on child mortality in Bangladesh.

**Religion and caste/tribe**

In a study of the factors influencing child mortality in Bangladesh and their implications for the national health programme, Kabir and Amin (1993)\(^{15}\) find that
religious differentials appear to be low and not significant effect on child mortality. In a study of Pandey et al. (1998)\(^{(18)}\), religion and membership in a scheduled caste of scheduled tribe is known to affect many aspects of life in India and is likely to affect levels of infant and child mortality. Children from Hindu-caste/tribe households have the highest unadjusted neonatal mortality in the country. However, the religion and caste/tribe membership of the household has a much smaller effect on neonatal mortality after adjusting for other variables. The Hindu-caste/tribe group has the highest adjusted child mortality in the country as a whole and in nine states, the Muslim and other religion groups have the highest adjusted child mortality in four states viz. Maharashtra, Gujarat, Goa and Madhya Pradesh and the Hindu-caste/tribe group has the highest adjusted child mortality in three states viz., Rajasthan, Uttar Pradesh and Orissa. It is also concluded that the effect on mortality of religion and scheduled caste/tribe membership varies according to child’s age. A study of Baker (1999)\(^{(19)}\) in three regions of Malawi (North, Central and South of Malawi) indicates that the religion and ethnicity are significant indicators of child mortality when not controlling region, but once controls for the three regions are introduced, they both lost their significance. It is also important to note that in studies which included region as a variable, regional variation in socio-economic factors has shown to be an important explanatory variable. In the study of Bashai et al. (2003)\(^{(37)}\) also suggests that the Muslim household children has 8.5% higher chances of death than other religions. Moreover, a study of Syamala (2004)\(^{(24)}\) on relationship between socio demographic factors and child survival: evidences from Goa, India, it is found that the children of Roman Catholics have a higher degree of survival chances than that of Hindus. The difference in proportion of children surviving was more prominent in the case of children born of mothers below age 19
than those born of the remaining two groups. Among the remaining groups, the proportion of children surviving was higher with the Roman Catholics, the differences were however narrow. However a study of Iyer and Monteiro (2004)\(^{38}\) in Rio de Janeiro, Brazil, it has been observed that the religion is not important factor in high mortality for both child and adolescent period of life i.e., upto 20 years of age. The same finding is also observed in Nigeria by Ogunjuyigbe (2004)\(^{39}\) religion has not influenced or changed the perception of the Yorubas concerning certain norms which influence on under5 mortality. Contrast to it, Mutunga (2004)\(^{40}\) suggests that religion is an important factor which influences on child mortality after controlling environmental factor on it.

In a study of Bahlotra & Soest (2005)\(^{41}\) it is found that the probability of continued fertility is decreasing in number of child survival and Muslims and other non-Hindu shows higher tendencies to continue fertility. Finally it is concluded that Muslims and non-Hindu religions have higher risk of child survival. According to National Family Health Survey-3.(2005-06), India\(^{42}\), Hindus have the highest rate of infant mortality of 59 per 1,000 livebirths, followed by Buddhists/Neo-Buddhists (53), Muslims (52), Sikhs (46), and Christians (42). Christians and Sikhs have relatively low mortality rates at all ages under five years. One exception is the mortality difference between Hindus and Muslims. In urban areas, the under5 mortality rate is higher among Hindus (55) than Muslims (45). But in rural areas, both have the same level of under5 mortality (82-83).

**Electricity**

It is generally believed that children of mothers living in households with electrification facilities are having higher chances of survival than the children of
mothers living in households without electrification. However, the literatures in this subject are limited. From the past studies, it is found that electricity supply has little effect on child mortality, Wirakartakusumah (1988)\textsuperscript{(43)}. In a study of Klaauw & Wang (2004)\textsuperscript{(11)} in rural India, it is also observed that the reductions in infant and child mortality are significant with access to electricity. Providing access to electricity to households reduces neonatal mortality with 2.6 children, infant mortality with 4.0 children and child mortality with 5.5 children. The reductions in infant and child mortality are actually significant. Providing 1 percent of the households with access to electricity reduces child mortality with approximately 0.11. In a similar study of Ganasekaran (2008)\textsuperscript{(44)} on determinants of infant and child mortality in rural India, it is observed that a substantially higher proportion of households (64 percent) in low mortality group were using electricity for lighting which was followed by medium (46 percent) and high (22%) mortality groups.

**Biological/demographic factors**

**Birth interval**

A short interval between two pregnancies, and hence a rapid succession of births, will be associated with a shorter period of breast feeding (when this is used) and the probability of the mother's having to divide her attention between two or more babies. In the first case, when the child is breastfed and then taken off the mother's milk because of the arrival of another baby, the changeover to artificial milk, which is perhaps lacking in protein or contaminated by bacteria, makes the child vulnerable to infection. In the second case, the small children are exposed to different kinds of accidents which adequate attention would otherwise avoid. In the study of Gaecia (1983)\textsuperscript{(45)} it is evident that the greatest risk of infant death occurs
when the interval between two successive births lasts for less than a year. Next in importance, although the risk of death is considerably lower, is the interval which lasts from 12 to 18 months. From then onwards and up to a period of 48 months, as the interval increases so the risk normally decreases. An inverse relation between interval and infant mortality becomes modified when the time span between two live births is greater than 4 years. Although it is possible to associate long birth intervals with higher infant mortality, the decrease in the number of events in each cell obliges us to take these figures with caution. Moreover, it clearly illustrates the rareness of these cases and, for the same reason, their lack of importance in the Mexican context. In a similar study of Knodel and Hermalin (1984)\(^{46}\), it is observed that the degree to which differentials in birth interval and the survival of the previous birth account for differentials in the infant mortality rates of the indexed birth among different sibship sizes. For every category of birth interval, the highest infant mortality is still found among births from the largest sibship sizes. Also noticeable is the much higher infant mortality at very short intervals (less than 12 months) of births in large sibships, possibly due to the higher proportion of premature births among mothers who have many births. In addition, there is an upturn in mortality at the longest intervals (48 months or more) which might be attributable to a maternal age effect. Hobcraft et al. (1985)\(^{12}\) agrees with the above findings and suggests that any birth within two years before the index birth is linked with considerable excess infant and child mortality for the index child, even when birth order, age of mother, other spacing effects and education are controlled.

According to Basu & Basu (1991)\(^{14}\) the adverse physical consequences of short birth intervals due to general poverty, then maternal employment may become,
at least negatively, disconnected from child survival. This would also help decrease the discrimination against girls because the overall level of female employment in a community has an important bearing on the sex ratio of childhood mortality. In the related study of Biswas et al. (2000)(29), it is highlighted that the effect of preceding birth interval on child mortality is not significant in the presence of breastfeeding and next pregnancy interval although have expected sign. The effect of next pregnancy interval appeared to be one of the prime factors influencing mortality at age 12-23 months. During infancy and early childhood this variable is not significant. This finding is also supported by the finding of Griffiths et al. (2001)(47). It is further observed from the study of Berger et al. (2002)(48-50) that a larger preceding birth interval has a clear negative impact on the survival of children while a higher education of the mother improve the life expectation of a child.

According to Mahy (2003)(23), births that occur in quick succession often have poor child survival reasons related to maternal health and environmental factors. Research has found that maternal nutrition and maternal depletion are key factors affecting mortality levels for births following a short birth interval. Also, competition for resources with similar-aged siblings can affect the well-being of a child. In this paper, he examines three birth intervals less than 24 months, 24 to 47 months, and 48 months or more. In addition, research has shown that after about 48 months the benefits of a longer birth interval diminish. The relative risks associated with of childhood mortality are remarkably consistent across countries. Regardless of the overall level of under5 mortality, there is a stable association between the risk of dying and the length of the birth interval. On average, under5 mortality for births within 24 months of a previous birth is 64 percent higher than births with a 24-47
month interval. Births after a 48-month interval have a reduced risk of 28 percent compared with births after a 24-47 month interval. The reduced risk of a long birth interval exists throughout a child’s first five years. Infants and children age 1 to 4 have an increased risk of dying after a short birth interval. Latter, in a study of Syamala (2004)\(^{24}\), it is found that the survival chances of child have increased by 7.89% when birth interval increased from 0-2 years to more than 2 years. The analysis of children surviving according to the length of birth interval shows a high risk of death for too closely spaced births. Improvements in the survival chances of children with widened birth interval are obvious. Hence it may be concluded that infant mortality tends to respond quickly to the length of birth interval and that appropriate spacing of births can very well lead to a reduction in deaths occurring among closely spaced births. Cesar et al. (2004)\(^{51}\) suggests that there is strong negative association between short birth interval and infant and child survival.

Result from Bahlotra and Soest (2005)\(^{41}\) also shows that unobserved heterogeneity in the form of mother or community specific effects explains part of the correlation between neonatal mortality of successive children observed in the data. Another part is explained through birth spacing: neonatal mortality shortens the birth interval to the next child, and this increases the risk of another neonatal death.

A study on relationship between piped water supply and child mortality: evidences from Madhya Pradesh and West Bengal, India by Gutta & Guha (2006)\(^{52}\), it is found that preceding birth interval is important determinant of child loss. If birth interval is less than 24 months then child death is higher, both in case of Madhya Pradesh and West Bengal. In fact in Madhya Pradesh, child loss increases
from 18 percent in case if preceding birth interval is 24 months or more to 36 percent if preceding birth interval is less than 24 months. The difference in West Bengal is more (10 and 24 percent respectively). The length of previous birth interval is likely to affect child mortality directly. Also a substantial portion of the association between birth interval and mortality risk may reflect the effect of factors that are correlated with birth intervals. A similar finding of Makepeace and Pal (2006)\(^{(53)}\) in India is observed that the shorter birth interval (prior and posterior) and twin births significantly enhance mortality risks among 0-5 year old male and female children. Beribew et al. (2007)\(^{(54)}\) also confirm the previous findings and suggest that birth interval is significantly associated with under-five mortality. Children whose next birth interval is less than 24 months are 2.5 times more likely to die compared to those whose next birth interval OR=2.46 (95% CI: 1.37, 4.44) is greater than 24 months. Maitra and Pal (2007)\(^{(55)}\) suggest the birth interval and child survival are positively and highly correlated.

It is also observed from NFHS-3 of India (2008),\(^{(42)}\) the longer the birth interval, the lower the risk of child mortality, even for intervals of 48 months or more. In India, 11 percent of births occur within 18 months of a previous birth and 28 percent occur within 24 months. More than 60 percent occur within three years of the previous birth. Only 28 percent have an optimal birth interval of 36-59 months. The median closed birth interval in India is 31 months. The median closed birth interval for women age 15-19 is 25 months, which is substantially less than the median interval of 37 months for women age 30-39 and 40 months for women age 40-49.
Maternal age at delivery

One of the important factors in the study of child mortality is maternal age at the time of delivery. It influences the health and survivorship of the children and mortality is higher among children of teenage mothers; Hobcraft et al. (1985)\(^{12}\). But there is nothing to suggest the general increased risks of children born to mothers at older ages (35 years or over). However, a study of Majumdar et al. (1997)\(^{17}\) in Bangladesh has conveyed that the risk of child survival is high to mothers at age below 20 years and then reduces after 20 years age of mother. And, other notable differences are that maternal age at birth and birth order produce much smaller differentials than in the period of infancy. Pandey et al. (1998)\(^{18}\) have found that mother’s age under 20 at delivery is associated with much higher mortality of first born children. Among second and higher birth orders, the relationship between mother’s age at delivery and mortality is U-shaped.

In a study of Claeson et al. \(^{56, 57}\), under5 mortality rate is 141 per one thousand to mothers of age under 20, 108 per one thousand during age 20-29 years, 122 per one thousand during 30-39 and 163 per one thousand to mothers of age ranges from 40-49 years. This finding suggests than under5 mortality is high to mothers of younger and of older ages. In a related study of Biswas et al. (2000)\(^{29}\), it is revealed that children born to women under the age 20 have higher mortality than those to women age 35 and over in general, have higher mortality risks than those born to women age 20-34 years. As suggested by Rutstein (2000)\(^{20}\), increase in the percentage of births to mother under 18 year of age is associated with higher neonatal mortality but lower toddler, childhood and under 5 mortality. An increase in the percentage of births to women aged greater than 35 years is associated with
higher neonatal and infant mortality rates. Similar study of Griffiths et al. (2001)\textsuperscript{(47)}, has found that the infant mortality rate is less to mothers of age 20-30 year as compared with other age groups and relatively child mortality is less in those mothers of the same age group.

In a study of Berger et al. (2002)\textsuperscript{(48)}, among time-varying effects of covariates of under5 mortality, maternal age plays an important role. The benefit of greater maternal age at birth is particularly apparent in the second year of life.

Mahy (2003)\textsuperscript{(23)} in his study on child mortality in developing countries based DHS data, it is observed that the relationship between mother's age at birth and level of mortality risk exhibits a U-shaped curve for most countries. When women give birth at a young age, they are at increased risk of complications, and the child is at increased risk of low birth weight and prematurity. There are also potentially adverse social and economic consequences for these women. When women give birth at an older age, they are more likely to have pregnancy complications, and the baby is more likely to have congenital anomalies, which increases the risk of dying in early childhood. In addition, risk to older women is often increased because of higher parity. This finding is also in agreement with the findings of Bishai et al. (2003)\textsuperscript{(37)}, Iyer & Monteiro (2004)\textsuperscript{(38)} and Adair (2004)\textsuperscript{(58)}.

The proportion of infants surviving is highest in 20-29 age group as suggested by Syamala (2004)\textsuperscript{(35)}. It is also seen that the percentage of infants surviving is lowest among those born to younger mothers of less than 20 years of age. The percentage of children surviving was 88.4 for the younger mothers in 15-19
age groups, whereas for the older mothers the corresponding percentage was 93.8, showing a higher risk for children born to the younger women. Further, when age at delivery increased from less than 19 to 20-29, the survival chances of their children increased by 9.21%. When the age of women at time of birth increased to at least 30 years the survival chances increased further by 5.26%.

In NFHS-3 report of India\(^{(42)}\), it is also found that the maternal age at birth shows a U-shaped relationship with infant and child mortality rates. The infant mortality rate is lowest for mother’s age of 20-29 years (50) and is substantially higher for mother’s age less than 20 years (77) and 40-49 years (72). Similar age differentials are seen in neonatal mortality, post-neonatal mortality, and child mortality (at age 1-4 years).

**Parity**

From the past research findings, it is known that parity (birth order) is associated with infant and child mortality. Hobcraft et al. (1985)\(^{(12)}\) indicate that beyond the first year of the morality of first born children is on average slightly lower than for children of birth orders 2 or 3. The mortality associated with births of high orders may predominantly be caused by other factors, possibly the spacing pattern and perhaps education of mother. During infancy, birth order has highly significant effect on mortality but it seems to be invisible during children age of between 1 to 5 years as suggested by Majumder et al. (1997)\(^{(17)}\). Moreover, in a study of Pandey et al. (1998)\(^{(18)}\), demographic characteristics have substantial adjusted effects on mortality before age five. The unadjusted effects are not very different from the adjusted effects except in the case of birth order and mother’s age at childbirth meaning that these two demographic factors have highly and
substantially influenced on under5 mortality. But, adjusted neonatal mortality decreases with increasing birth order, whereas adjusted post-neonatal and child mortality increase with increasing birth order and the same finding is also observed by Biswas et al. (2000)\textsuperscript{29}. Gerger et al. (2002)\textsuperscript{48} report in this working paper that there is an interaction effect of birth order and gender of newly born baby on mortality. And child mortality in developing world: a review of evidence from the DHS\textsuperscript{23} reports that women at high birth order have poorer child survival outcomes. First births and high-order births have poor outcomes compared with other birth orders. However, not all of the association is due to birth order. Maternal age is also associated with differentials in mortality by birth order. Typically, younger women have had fewer births than older women. In addition, there is often a correlation between short birth intervals and high-order births because women who have had many children are more likely to have had short birth intervals on the way to high parity.

As suggested by Syamala (2004)\textsuperscript{35}, the risk of dying during the first year of life is higher among children of lower and higher order births. The proportion of children surviving in the first year of life is lower among the first order births and it improves up to fourth order births and then declines for the births of order five and above. In both the cases, the pattern of infant mortality by age of the mother at the time of delivery as well by birth order exhibited a U shaped relationship. Balhotra & Soest (2005)\textsuperscript{41} also report the same finding of the relationship between neonatal mortality and birth order exhibited U-shaped. An interesting finding from India’s NFHS-3 report\textsuperscript{59} highlights that the first births are more likely to be delivered in an institution than births at higher birth orders and hence first birth children are likely
less chance of death than higher birth order due to unavailability of health care facility.

**Age at marriage**

Marriage is a social union or legal contract between people called spouses that establish rights and obligations between the spouses, between the spouses & their children, and between the spouses & their in-laws. And this social union has significant role on the fate of their future children. According to Claeson et al. (1999)\(^{(56, 57)}\) the high risk of post-neonatal mortality reflects the early age of marriage.

In a study of Bhuyan (2000)\(^{(34)}\), it provides the evidence that increasing the level of education of mother, economic condition of parents, number of earning members in the family and age of mother at marriage, the child mortality level can be reduced. However, among high parity women economic condition does not have any significant impact. Differential impacts of age of female spouse at marriage are observed among mothers of different parity level.

Griffiths et al. (2000)\(^{(47)}\), from their study, it suggests a direct association between maternal autonomy and infant and child mortality does not operate at the individual level, or that, if it does, its operation is not captured by the ‘mother-in-law’ variable or any of the other proxies such as watching television, or knowledge of the minimum legal age at marriage for women that were tried. Those mothers having knowledge of the minimum legal age at marriage have fewer chances of their child deaths.
A study of Burstrom & Bernhardt (2001)\(^{(60)}\) on social differentials in the decline of child mortality in nineteenth century Stockholm, it is suggested that in 1885 the absolute mortality rate of children born out of wedlock was 89 per 1,000 compared to 35 per 1,000 for children born in marriage. By 1910 the absolute mortality rate among children born out of wedlock had declined to 33 per 1,000 and that of children born in marriage to 16 per 1,000. The risk of death among children born out of wedlock was higher than among children born in marriage in all years studied. The relative risk of death for children born out of wedlock was highest in 1885. In 1891 and 1910 the risk of death for children born out of wedlock was twice the risk of children born in marriage.

As suggested by Ashtekar et al. (2004)\(^{(61)}\), the child mortality rate is high among those children of mother who had married before 19 years of age and most of women married before legal age of marriage. Syamala (2004)\(^{(35)}\) also suggests that the postponement of female age at marriage to 20 years with a view to delay the onset of childbearing and proper spacing of births would have noticeable effect in bringing down the level of infant mortality and thereby improving the health of the women.

Birth spacing, fertility selection and child survival: analysis using a correlated hazard model \(^{(55)}\), there are significant positive externalities to such a process – an increase in the age at marriage and reduction in fertility rates and an increased investment in child quality, it reduces child mortality.
According to NFHS-3\textsuperscript{(62)} report, the median age at first marriage is 22 years among women age 25-49 and is 25-27 years among men age 30-49 years in Manipur, India. Thirteen percent of women age 20-24 years got married before the legal minimum age of 18 and 12 percent of men age 25-29 years got married before the legal minimum age of 21. The infant mortality rate for teenage mothers is three times as high as the infant mortality rate for mothers in the age group 20-29 years.

**Fertility**

Fertility is the actual number of child bearing while fecundity is the capacity of bearing children. As a measure, "fertility rate" is the number of children born per couple, person or population. The relation between fertility and child mortality is at the core of historical and modern demographic transitions.

As highlighted by Ben-Porath (1976)\textsuperscript{(63)}, the demand for children is not just a matter of completed family size; the children's ages at different stages of the family life cycle may also be an important dimension. The nature of the preferred life cycle reflects the motives for having children and the external conditions. The implications of mortality on fertility where the preferred life cycle is assumed to be independent of child mortality or it can take into account the possibility that the preferred life cycle and family size depend on child mortality. He distinguishes two types of response to child mortality, hoarding and replacement. Hoarding is the response to expected mortality, and replacement is the response to experienced or prior mortality. There might be a learning process in a sequential framework when experienced mortality affects expected mortality.
As indicated by Gaacia (1983)\(^{(45)}\), the reduction of fertility and the increase of pregnancy spacing, can have a collateral effect which will contribute to the decline of excessive infant mortality and high infant mortality can have in maintaining and also high fertility.

In a study of Knodel & Hermalin (1984)\(^{(46)}\) it is observed that the pattern of rising infant mortality by sibship size—particularly noticeable among families with nine or more births—arises from the interplay of fertility and mortality. Mothers with a large number of births will tend to have shorter birth intervals and a number of other characteristics, such as shorter breast-feeding and more pressure on limited resources that contribute to higher infant and child mortality. At the same time, those women with biological and behavioral characteristics that lead to unsuccessful outcomes will experience more rapid childbearing and a larger number of births. Thus, women with the largest number of births are highly selected for characteristics that contribute to high levels of mortality among their offspring.

Some characteristics of children are related to mother’s fertility behaviour, such as mother’s age at childbirth, child’s birth order, and previous and following birth intervals. These characteristics are known to affect neonatal, postneonatal, infant, and child mortality in developing countries (Hobcraft et al. (1985)\(^{(12)}\)). First-born children and children of high birth orders are known to experience higher mortality than children of birth orders two to four. Children born to women under age 20 and over age 35 are known to have higher mortality than those born to mothers’ age 20–34, most likely because a woman’s physical condition is most favorable to childbearing during her twenties and early thirties. As suggested by
Basu & Basu (1991)\textsuperscript{(14)}, the biological relationship between fertility and mortality would be more relevant for infant mortality, whereas behavioural factors are probably more important than biological ones in the association between women's employment and child mortality, given that education and employment both tend to lower fertility and still seem to have opposite effects on child survival; even the biological relationship between fertility and child mortality is far from clear, and although working women have lower fertility, their child mortality experience is higher.

Infant and child mortality in India, a report of NFHS-2 (1998)\textsuperscript{(18)}, indicates that a decline in fertility, by reducing the proportion of higher-order births, will tend to lower the overall level of child mortality. At the same time, the overall level of neonatal mortality may rise because a larger proportion of all births will be high-risk first births. This potential increase in neonatal mortality can be avoided, however, by encouraging women to wait until age 20 to start having children. Further, Bhuyan (2000)\textsuperscript{(34)} agreed the above findings and suggests that the upward trend in child mortality is significantly and positively associated with fertility, thus higher fertility levels are associated with higher probabilities of child deaths.

As indicated by Rutstien (2000)\textsuperscript{(20)}, the fertility behaviour is represented by the demographic characteristics like birth order, mother's age at birth, and length of birth intervals. An increase in the percentage of births that are of first birth order was associated with higher mortality rates among post-neonatal infants and toddlers but not with changes in other mortality rates. An increase in the percentage of births of fourth or higher order was associated with a decrease in mortality for all mortality rates. Increase in the percentage of births to mothers under age 18 was associated
with higher neonatal mortality but lower toddler, childhood, and under-5-years-of-age mortality. An increase in the percentage of births to women aged 35 years was associated with higher neonatal and infant mortality rates. Decreases in the occurrence of short birth intervals, those of <24 months, reduced post-neonatal and infant mortality. This finding is also in agreement with the finding of child mortality in rural India reflected in discussion paper of World Bank (2004)\textsuperscript{(11)} and Adair (2004)\textsuperscript{(58)}. And, the probability of continued fertility is decreasing in the number of surviving children, but more rapidly in the number of surviving boys. Also, if the family has no surviving boys, the probability of having another child is much larger than if there is no surviving girls as stated by Balhotra & Soest (2005)\textsuperscript{(41)}.

Maitra & Pal (2007)\textsuperscript{(55)} suggest that high fertility is often associated with high child mortality, especially in low-income countries; though addressing the effects of fertility on child mortality is more complex than it first appears. This is because of the two-way causality between these two decisions. NFHS-3 of India (2008)\textsuperscript{(42)} reports that the component of fertility i.e., mother’s age at birth, birth order, and the interval between births have a strong influence on infant and child mortality and suggests parents can increase the chances of their children’s survival by controlling these proximate determinants.

**Type of birth**

There is a limited number of literatures which deals with child mortality and type of births. However, this is also one of the biological factors that plays a role in the survival of infants and, in some cultures, plays a role in the care of the child is whether the child was part of a multiple birth. As suggested by Mahy (2003)\textsuperscript{(23)},
children of multiple births are often not fully developed in the womb, resulting in low birth weight. In addition, complications at delivery and competition for resources after birth often result in greater risk of dying for multiple births. In some developing countries, beliefs of bad luck and misfortune are associated with twins, and can lead to neglect and higher mortality for multiple births. This is supported by the finding of Ashtekar et al. (2004)\(^{61}\), and they state that there is high risk of child survival during multiple births because of complicity at time of delivery.

In a study of Balk et al. (2005)\(^{64}\), it is found that the children born as a multiple birth (e.g., twins or triplets) to be more underweight, even in this age range, given the strong association exhibited by this variable on childhood mortality and evident that twins tend to be more underweight than other children. Consequently, there is high chance of child death due to multiple births. Vos et al. (2005)\(^{65}\), have observed that multiple delivery increases the probability of less healthy born infants and hence increase in probability of infant mortality.

It is also stated by Makepeace & Pal (2006)\(^{53}\), that twins are a natural outcome and birth of a twin imposes strain on parental resources which in turn is likely to affect posterior spacing of the current child (i.e., younger sibling’s prior spacing). Parental allocation of resources is further complicated if parents are characterized by the pro-male bias. And the mortality rates are higher when the child is one of the twins.

**Sex of child**

In a study of Gaecia (1983)\(^{45}\), it is observed that, in most of third world countries, male mortality is greater than female mortality. While to regard the
survival condition, the advantage that females held over males with respect to survival up to the first month and first year of life. If total number of births is considered, the difference between the sexes is more marked in neonatal than in post-neonatal mortality. In contrast to this, it is reported by Koenig & D’Souza (1986)(66) on the study of sex differences in childhood mortality in rural Bangladesh, that female mortality begins to systematically exceed male mortality during the second half of the first year of life and thereafter this differential becomes increasingly more pronounced. The sex differentials in childhood mortality reflect the fact that female children are victims of widespread intentional neglect or even abused by parents, given the extremely strong preferences for sons in culture such as those found in much of South Asia. That, there may be some pervasive and deeply-rooted cultural practices which favour male children.

Basu & Basu (1991)(14), indicate the sex differential in childhood mortality in South Asia and probably the Middle East seems to contradict information from other parts of the world that girls are physiologically hardier than boys and therefore have a better chance of surviving early childhood. Moreover, there has been no automatic reduction in the female disadvantage in survival in these areas with development and with declines in the absolute level of child mortality. The South Asian region is large and diverse and disaggregation of the unit of analysis provides interesting information on some of the crucial cultural and socio-economic variables which influence the sex ratio of child death rates. In India, the north Indian states show a higher sex differential in childhood mortality than the southern part of the country. Indeed, the regional contrast is probably sharper than it appears; suggests a higher underreporting of dead daughters in the northern states, which means that
female child mortality is underestimated and therefore so does the sex differential in child mortality. For all states, neonatal mortality, of which endogenous causes are a large component, is significantly high for boys and hence the post-neonatal mortality disadvantage to girls is greater than an all-inclusive figure of childhood mortality implies.

As indicated by Chowdhury et al. (1995)\textsuperscript{(16)} in a study of Bangladesh, it is reported that the association between risk of death and sex of child is found to be statistically significant. The female child has 2.08 times higher odds ratio than the male child. In the same study of Majumder et al. (1997)\textsuperscript{(17)} in Bangladesh, they suggest that sex of child has higher impact on child mortality and the direction of differential with respect to sex is reversed, with female children having a high mortality rate.

A report of NFHS-2 \textsuperscript{(18)} by Pandey et al. (1998) on infant and child mortality in India, indicates that sex differentials in infant and child mortality reflect strong son preference in many states of India. Most states exhibit excess male mortality during the neonatal period but excess female mortality during childhood. In India as a whole, female child mortality is 40 percent higher than male child mortality. The sex differentials in infant and child mortality suggest that son preference and discrimination against female children are very strong in northern states and minimal and even nonexistent in southern states. In a study of Arnold et al. (1998)\textsuperscript{(67)}, it is observed that India is a country with a pervasive preference for sons and one of the highest levels of excess child mortality for girls in the world (child mortality for girls exceeds child mortality for boys by 43 per cent). The
demographic effects of family composition are estimated with hazard models. The analysis indicates that son preference fundamentally affects demographic behaviour in India. Family composition affects fertility behaviour in every state examined and son preference is the predominant influence in all but one of these states. The effects of family composition on excess child mortality for girls are more complex, but girls with older sisters are often subject to the highest risk of mortality. Claeson et al. (1999)\textsuperscript{(28, 56)} are also agreed with the findings of Pandey et al. (1998)\textsuperscript{(18)} and Arnold et al. (1998)\textsuperscript{(67)} and concluded that girls experience a higher level of child morbidity and mortality than do boys from the age of one month to five years and they receive less health care.

A study of Griffiths et al. (2001)\textsuperscript{(47)} in three contrasting states of India, Maharashtra and Tamil Nadu there were no significant differences in mortality by sex at ages 1–23 months, whereas in Uttar Pradesh females were significantly more likely to die at ages 9–23 months than males. This again suggests that females in Uttar Pradesh are experiencing higher mortality patterns than would be expected given the level of male mortality, after controlling for the other explanatory factors. This excess mortality in the post-neonatal and early childhood periods contributes to the unusual population sex ratios found in many areas of India, and is almost certainly related to the low status attached to females.

Child mortality in developing countries by Mahy (2003)\textsuperscript{(23)} indicates that, on an average, boys are 28 percent more likely to die in the first month of life. During the remainder of the first year they are 6 percent more likely to die. However, for ages 1 to 4, there is no real difference in the average risk of mortality for girls and
boys. Sex differences in mortality exist between age 1 and 4 in some countries like India, Pakistan, Turkey, Nepal and Vietnam. In a study of Blakely et al. (2003)\(^{(68)}\), it is reported that the sex of the child is strongly associated with mortality but it is not associated with household socioeconomic position. It is also agreed by Vos et al. (2005)\(^{(65)}\) and Hossain (2005)\(^{(69)}\), comment that male infants have to survive less than female infants in the first year of life. It is also reported from NFHS-3 of India (2008)\(^{(42)}\) that infant and under5 mortality rates are higher for females in rural areas and are higher for males in urban areas. But even in urban areas, mortality is higher among females than males in the post neonatal period and at 1-4 years of age. Exception in post-neonatal period, male mortality is higher than female till 5\(^{th}\) birthday of their life in Manipur as reported by NFHS-3 (2008)\(^{(62)}\).

**Biological/breastfeeding factors**

**Birth weight**

A low birth weight is defined as birth weight of a liveborn infant of less than 2,500 g (5.5 pounds) regardless of gestational age. In a study of Victoria et al. (1987)\(^{(70)}\) based on cohort study in Southern Brazil, it is found a strong inverse association between birth-weight and neonatal and post-neonatal mortality. Preterm infants with an adequate weight for their gestational age, despite being slightly heavier than small-for-dates, show an IMR which is twice as large as the latter. There is an interaction between birth-weight and socioeconomic status, with the relative risk of mortality associated with low birth-weight being much larger among rich than among poor infants.
As highlighted by Fauveau et al. (1990)\(^{(71)}\), among neonate’s, complications of small size at birth is the leading cause of death, followed by neonatal tetanus, complications of birth trauma, respiratory infections, and a group of other neonatal infections. Further it is suggested by Majumder et al. (1997)\(^{(17)}\) that the maternal depletion theory holds that closely spaced pregnancies constitute a cumulative drain on the mother’s nutritional status, which ultimately leads to premature or low birth-weight babies or other pregnancy complications, thus putting the new-born at a higher than average risk.

Shrimpton (2003)\(^{(72)}\) on his study “Preventing low birth-weight and reduction of child mortality” suggests that there is an association between birth-weight and neonatal mortality, with the least risk of neonatal death occurring in children born weighing more than 3.5 kg. An increase of 100 g in mean birth-weight is associated with a 30-50% reduction in neonatal mortality. A study on birth-weight and risk of overall and cause-specific childhood mortality by Li et al. (2003)\(^{(73)}\), children with lower birth-weights had a greater risk of childhood mortality than children with a birth-weight of 3000-3499 g. These lower birth-weight children have increased risks of childhood deaths from infectious diseases, congenital anomalies, central nervous system diseases and heart disease, but not of deaths resulting from accidents, cancer, suicide or homicide. The magnitude of these risks differed somewhat by age. It is suggested that birth-weight exerts important influences on children's risk of age-specific and cause-specific mortalities, particularly those with a strong biological component.
A study of Wei et al. (2004)\(^{(24)}\) in Tanzania on HIV-1 infected mothers, it is found that the low birth weight was strongly related to neonatal mortality. The association with post-neonatal mortality was modified by child's HIV status. Among infants who were either negative or indeterminate at 6 weeks of age, low birth weight was associated with a 3-fold increased risk of mortality (relative risk, 3.16; 95\% confidence interval, 1.36-7.37). In the positive infants, however, the association was no longer significant.

NFHS-3 of India (2008)\(^{(42)}\) reports that the birth weight has a substantial effect on infant and child mortality rates. The infant mortality rate is 49 for an average or large size baby, but it is 62 for a smaller than average baby and 129 for a very small baby. The risk of mortality is particularly high for small babies during the neonatal period. When compared with an average size baby, the neonatal mortality rate is 30 percent higher for a small than average baby and 183 percent higher for a very small baby.

**Breastfeeding**

The impact of breastfeeding on the survival status of child may be considered in two ways i.e., its effect to the mother and to the child. In the report “Infant and child mortality in the third world” (1983)\(^{(45)}\), it has been observed that greater survivorship, and therefore lower infant mortality, is associated with the breastfeeding, absence of reproductive losses and mother's educational level. In the finding of Palloni & Millman (1985)\(^{(75)}\), there is little doubt that breastfeeding effects are important within the first year of life. Without considering the first month, there is a significantly uncovered significant mortality reduction attributable
to breastfeeding. However, there is also a strong evidence supporting the nation that those effects were over time and are much more important among subgroups which are socially and economically deprived; not only do countries experiencing higher mortality rates show the most important contributions of breastfeeding, but the corresponding effects are exposed to higher levels of resource scarcity. In their study, Fauveau et al. (1990)\(^{71}\) and Sandiford et al. (1991)\(^{76}\) observe important causes of death among infants aged 1 to 5 months are severe malnutrition usually due to lack of breastfeeding.

A report “The recent evolution of child mortality in developing world” (1997)\(^{77}\) suggests that breastfeeding promotion might be expected to have its largest effect on infant mortality, as it might enhance child spacing more. A similar finding is reported in India by Pandey et al. (1998)\(^{18}\) on infant and child mortality in India based on NFHS-2 data and also by Claeson et al. (1999)\(^{56}\). And it is also reported by Bhuyan (2000)\(^{34}\) that duration of breastfeeding and age of mother at marriage have influences in reducing mortality level of children. In a study of Rutstein (2000)\(^{34}\), suggests that an increase in the duration of breastfeeding is associated with a fall in post-neonatal mortality. A rise in the percentage of children aged 7-9 months who were both breastfed and getting solid foods is associated with decrease in both post natal and infant mortality rates. Biswas et al. (2000)\(^{29}\) also reported in their study on impact of some biosocial variables on infant and child mortality that breastfeeding appeared to be prime factor influencing infant, second year (12-23 months) and early child (24-59 months). The effect of preceding birth interval is not significant in the presence of breastfeeding and next pregnancy interval although have expected sign. Further they suggest breastfeeding more than
one year appears to have greatest potential for reducing infant and childhood mortality. As highlighted by Griffiths et al. (2001)\(^{(47)}\) the magnitude of the association is greatest for breastfeeding behaviour and early child mortality.

In a study on dynamic modelling of child mortality in developing countries: application for Zambia by Berger et al. (2002)\(^{(48)}\) based on micro data from the 1992 demographic and health survey, Bayesian dynamic logit model for discrete time survival data and Markov-Chain Monte Carlo methods are used and find that there are several variables, including the age of the mother and the breastfeeding duration whose effects exhibit distinct age-dependencies. In the case of breastfeeding, this age dependency is intimately linked with the reasons for stopping breastfeeding. Mahy (2003)\(^{(78)}\) indicates that the vertical transmission of HIV occurs in approximately 32 percent of births to HIV infected mothers in countries where breastfeeding is prevalent and it will directly affect on childhood mortality.

Effective breastfeeding and appropriate complementary feeding promotion strategies will improve child health and consequently achieve the millennium development goal of UN to reduce under5 mortality by two-third by 2015.

**Environment and sanitation**

**Source of drinking water**

The household sanitary conditions like provision of water supply and waste disposal are important factor that are outstanding and determinant in child mortality in several of the previous studies, although not in all of them. Infant and child mortality in the third world (1983)\(^{(45)}\) reports that there is a tendency for the category
of high mortality to diminish with improvement in water supply. On the other hand, there is an increase in moderately high mortality in communities with some but not complete water supply. It is also observed that there is a positively association between drinking water supply and infant survival. In a study of Roth & Kurup (1989)(13), it is highlighted that unsafe drinking water and poor public sanitation systems may constitute a more important preventive aspect of child mortality. In a study of Kabir & Amin (1993)(15), the multivariate regression analysis is used to identify the determinants of infant and child mortality in Bangladesh. This analysis shows that both water supply and availability of sanitary facilities have a strong association with child mortality ever after controlling the effects of the socio-economic and geographical variables. The regression analysis suggests that the most important factors are the source of water supply and availability of safe drinking water. In Malawi and India, the same result is observed by Baker (1999)(19) and Claeson et al. (1999)(56) & Bhuyan(2000)(34) respectively. In contrast to the above findings, Rutstein (2000)(20) finds that the environment health factors i.e., water supply, type of toilet and type of flooring are not statistically significant for child mortality. Moreover, a study of Klaauw & Wang (2004)(47) in rural India, it is observed that the reduction in neonatal, infant and child mortality rates due to source of drinking water is small and insignificant.

A report of World Bank on Child mortality, poverty and environment in developing countries (2006)(27) reports that the housing variables were used as a proxy for access to water and sanitation and found to be inconsistent in explaining morbidity in the analysis. These findings support the hypothesis that environmental
factors particular to the region, such as long-term agricultural chemical exposure, may help to explain high mortality rates.

An extensive study was conducted by Datta & Guha (2006)\textsuperscript{(52)} on the relationship between piped water supply and child mortality in Madhya Pradesh and West Bengal, India, based on NFHS-2 data it is highlighted that even after controlling some known indicators of child mortality such as parity, education of mother, preceding birth interval etc, piped water supply significantly reduces child deaths in case of West Bengal. But it does not exert similar effect on child loss in the state of Madhya Pradesh. In both the selected states child loss is quite high in case of women who do not have access to piped water compared to those who have access to piped water.

**Toilet facility**

Access to a flush or pit toilet is potentially a very important determinant of infant and child mortality in developing countries. Children in households that lack such access could have higher exposure than other children to diseases such as tetanus and digestive disorders.

In a related study of Roth & Kurup (1989)\textsuperscript{(13)} suggests that good public sanitation systems may constitute a more important preventive aspect of child mortality. In the latter study of Kabir & Amin (1993)\textsuperscript{(15)} in Bangladesh also highlights that the households with sanitary latrines have low risks of child mortality. The similar finding is reported by Pandey et al. (1998)\textsuperscript{(18)} on their study of infant and child mortality in India, a subject report of NFHS-2 and they have
mentioned that access to a flush or pit toilet households have substantial and often statistically significant adjusted effects on infant and child mortality. The adjusted effect on mortality of household access to a flush or pit toilet is strongest for the neonatal period and becomes weaker at later ages. The adjusted effect tends to be statistically significant in states with relatively high levels of neonatal mortality: Uttar Pradesh, Orissa, West Bengal and Assam. This pattern suggests that the lack of access to a flush or pit toilet is associated with increased risk of neonatal tetanus.

On the other hand, Baker (1999)\(^{(19)}\) in his study on differential in child mortality in Malawi, in contrast to the above findings observes that access of pit latrine does not have a significant effect on child mortality in the country. The same finding is witnessed by Rutstein (2000)\(^{(20)}\) in developing countries.

As highlighted by Klaauw & Wang (2004)\(^{(11)}\), access to toilet facility can reduce under-five mortality rate significantly in rural areas of India as a whole. In urban Kenya, access to modern sanitation facilities (flush toilets) reduces diarrhea prevalence in urban areas and ultimately reduce the child mortality, Mutunga (2004)\(^{(40)}\). In a study of Balk et al. (2005)\(^{(64)}\), the principal component analysis is used to combine the correlated variables which influence on mortality. From their analysis it is found the mortality is correlated positively with the complete lack of toilet facilities and negatively with access to flush toilets.

It is also suggested by Vos et al. (2005)\(^{(65)}\) that the availability of better sanitation will decrease the probability of infant death since better sanitation and
drinking water access of the household should positively improve hygienic and health conditions for all members.

NFHS-3 (2008)\(^{(42)}\) reports that fifty-three percent of urban households have an improved toilet facility compared with only 18 percent of rural households. Nationally, 45 percent of households have any toilet facilities, up from 36 percent at the time of NFHS-2.

**Cooking fuel**

The type of cooking fuel used in a household could affect infant and child mortality in two ways. First, if children spend a great deal of time where cooking takes place, the use of a cooking fuel that emits harmful smoke could elevate their risk of respiratory disease and hence morbidity and mortality. If this is an important hazard, then the effect of cooking fuel on infant and child mortality should be substantial, even after controlling for other socioeconomic variables. Secondly, the type of cooking fuel used may be an indicator of a household’s general economic status. If this is the case, then we would expect to see a strong unadjusted relationship between the type of cooking fuel used and infant and child mortality, but the adjusted effect would be substantially reduced.

A subject report of NFHS-2 on infant and child mortality in India, Pandey et al. (1998)\(^{(19)}\), mention that electricity, gas, biogas, coal, charcoal, and kerosene are clean cooking fuels, and wood and dung are considered as unclean cooking fuels. They observe that after controlling the effects of other variables, use of a clean cooking fuel does not appear to have a strong effect on mortality of under5. The
results vary widely, however, by child’s age and by state. Curiously, for India as a whole, use of a clean cooking fuel appears to have the strongest effect on mortality during the neonatal period. The unadjusted neonatal, post-neonatal and child mortality are lower for children in households that use a clean cooking fuel, both in India as a whole and in all states. This result is statistically significant for India and for all states except few states of India. Controlling for the effects of other variables reduces the effect of clean cooking fuel in most states. The adjusted effects remain statistically significant only for India and for few states.

In a study of Claeson et al. (1999)\(^\text{56}\) on reducing child mortality in India, suggests that most urban-rural differences in infant and child mortality are due to factors related to use clean cooking fuel, and have access to better sanitation. Klaauw & Wang (2004)\(^\text{11}\) suggest that the rural households using clean cooking fuels reduces infant mortality. These estimates are based on NHFS-2 data and are found to be statistically significant.

NFHS-3, India (2008)\(^\text{42}\) reports that the smoke from solid fuels poses a health hazard when inhaled. The proportion of households relying on solid fuels for cooking range from a low in Delhi (9 percent) to a high of over 85 percent in four states: Chhattisgarh, Orissa, Jharkhand and Bihar. Other states with particularly low use of solid fuels are Mizoram and Goa, where only one-third of households rely on solid fuels for cooking. In fact, with the exception of Delhi, in all other states, at least one in three households relies on solid fuels for cooking. The study finds the smoke from solid hazards on child health and subsequently leads to high mortality.
Knowledge and practice of health care services

Prenatal and antenatal care

Diseases that directly lead to child health are phenomena of biological nature at the individual level. But, the disease process in a community is often and primarily determinates by historic characteristics of the social formation in which the child is born and living. By many mechanisms these characteristics define the material conditions of life at the home and the care given to child. On the other hand, social policies particularly health policies which affect the frequency of diseases and death, are also subjected to a social determination.

Antenatal care (ANC) refers to pregnancy-related health care, which is usually provided by a doctor, an ANM, or another health professional. Ideally, antenatal care should monitor a pregnancy for signs of complication, detect and treat pre-existing and concurrent problems of pregnancy, and provide advice and counseling on preventive care, diet during pregnancy, delivery care, postnatal care and related issues. In India, the Reproductive and Child Health (RCH) programme aims at providing at least three antenatal check-ups which should include a weight and blood pressure check, abdominal examination, immunization against tetanus, iron and folic acid prophylaxis as well as anemia management. The availability of antenatal and prenatal care and access of these facilities by parent are immensely important to keep their children healthy. Many researchers suggested that prenatal care of mother and antenatal care of children and number of prenatal/antenatal visits is associated with the survivorship of child. It is reported in a study of infant and child mortality in third world (1983)\textsuperscript{45} that perinatal mortality is low when prenatal care has been applied.
A maternity care programme that includes antenatal care, attendance at deliveries by qualified midwives, systematic postpartum home visits, and an effective referral system could reduce both maternal mortality and early neonatal mortality. As highlighted by Pandey et al. (1998)\textsuperscript(18), a very sharp decline in unadjusted neonatal mortality as the number of antenatal-care visits increases. The adjusted effect is much smaller, but it remains statistically significant. A similar pattern in unadjusted neonatal mortality is observed in all states except Jammu region and Maharashtra. The unadjusted effects of number of antenatal-care visits are statistically significant for India and for 10 of the 19 states. It is not surprising that the adjusted effects on neonatal mortality are much smaller and less often statistically significant than the unadjusted effects. This is because antenatal-care visits are likely to be correlated with socioeconomic background variables such as urban/rural residence and mother’s literacy, which are included in the model for adjusted effects.

In a study of Claeson et al. (1999)\textsuperscript(56, 57) based on NFHS-2 data of India, it is found that the mortality from ages one to four also differs significantly by antenatal care and delivery care. The infant mortality rate was 97 with mothers of no antenatal care, 64 with mothers either antenatal or delivery care, and 44 of those mothers receiving both antenatal and delivery cares. Similarly, the under5 mortality rate is highest among the mothers who have no received antenatal care with 146 per 1000 and it is followed by those mothers receiving either antenatal care or delivery care with 85 per 1000 and those mothers receiving both the cares with 57. This suggests that the antenatal care is significantly effect on survival of child in all ages. In developing countries during 1990s, Rutstein (2000)\textsuperscript(20) suggests that an increase in
prenatal care is associated with decrease in mortality among those under-five. Three of the maternal care factors (prenatal medical care, medical assistance at delivery, and delivering in a place where health facility available) are significantly correlated with mortality among those under 5 years of age in the expected directions. A study of Griffiths et al. (2001)⁴⁷ was carried out on infant and child mortality in three culturally contrasting states of India e.g., Uttar Pradesh, Maharashtra and Tamil Nadu. From this study it is observed that one of the greatest impacts on mortality is whether the mother received antenatal care during pregnancy in Uttar Pradesh, but this impact is not significant in Maharashtra and Tamil Nadu. Educational effect on child mortality was studied by Kravdal (2003)⁵⁰ in India and he has taken “whether mother received antenatal care from a health worker” as one of the covariates and it is found to be statistically high significant with child mortality. In a study of Uddin et al. (2008)⁵⁶, the two statistical techniques viz., the cross-tabulation and the multiple logistic regression have been used to estimate the predictors of child mortality. The findings in both techniques, maternal health care as timing of first antenatal check has momentous effect on child mortality.

Availability of health care service

In a related elsewhere study of Fauveau (1990)⁷¹ it is examined the impact of mortality of a child survival strategy, mostly based on preventive interventions viz., advice on contraception and on feeding and weaning babies; distributed ORS, vitamin A tablets for under5 children, and ferrous fumarate and folic acid during pregnancy, immunized children, trained birth attendants in safe delivery and when to refer, treated minor ailments, etc. whatever to be in a health facility in a locality. After 2 years intervention, mortality rate is 17% lower among neonates, 9% lower
among infants aged 1-5 months, 30% lower among children aged 6-35 months and 19% lower among women living in the study area than in those living in the control area. The finding suggests that such measures as interventions are available in the locality, and there will be significantly reduced child mortality. It is also suggested from the study of Sandiford et al. (1991)\textsuperscript{(76)} in Nicarguan, USA, and Pandey (1998)\textsuperscript{(18)}in India that if primary and secondary health facilities are available in the locality will improve health conditions of newly born babies.

The study in Gambia by Rutherford (2009)\textsuperscript{(79)} after controlling for possible confounders, rural place of residence was significantly associated with an increased risk of death before the age of 5 years, but no other traditional measure of access to health care retained statistical significance. However, 10 additional, non-traditional variables, including indicators of social support for the primary caregiver, his/her degree of financial autonomy and his/her source of revenue for health-care expenses, were significantly associated with child death. These findings have important implications for the design of new interventions against child death in the Gambia and other developing countries and present new avenues for further research.

Schoeps et al. (2011)\textsuperscript{(80)} observe that the walking distance was significantly related to both infant and child mortality, although the shape of this effect varied distinctly between the 2 age groups. Overall, under-5 mortality, adjusted for confounding, was more than 50% higher at a distance of 4 hours compared with having a health facility in the village. The region of residence was an additional determinant for under-5 mortality. The findings of this study emphasize the importance of geographic accessibility of health care for child survival in sub-
Saharan Africa and demonstrate the need to improve health-care access to achieve the Millennium Development Goals (MDGs). Kadobera et al. (2012)\(^{(80)}\) found that children who lived in homes with networked distance >5 km experienced approximately 17% increased mortality risk (HR=1.17; 95% CI =1.02–1.38) compared to those who lived <5 km networked distance to the nearest health facility. Death of a mother (HR=5.87; 95% CI=4.11–8.40), death of preceding sibling (HR=1.9; 95% CI=1.37–2.65), and twin birth (HR=2.9; 95% CI=2.27–3.74) were the strongest independent predictors of child mortality.

**Place of delivery**

Children delivered at place where medical facility available (health care centre) are likely to experience lower mortality than children delivered at home because such facilities usually provide a sanitary environment and medically correct birth assistance. In the former s, if complications develop during childbirth, medical professionals can attend to the problem immediately. In a developing country such as India, however, most women who deliver their children at a health care centre enjoy a high socioeconomic status as measured by the indicators used in this analysis. Poor women only deliver their children in a health care centre if they anticipate a complication. In this situation, delivery in a medical facility would be expected to reduce neonatal mortality when measured independently, but after adjusting for socioeconomic variables, the effect would be expected to disappear or to reverse direction.

In a study of Pandey et al. (1998)\(^{(18)}\), they have observed that unadjusted neonatal mortality is lower for children delivered in a health care centre than for
children delivered at home for India as a whole. The adjusted values show the opposite effect and it indicates that the apparent advantage of delivering in a medical facility is due mostly to the influence of other socioeconomic variables, with place of delivery acting as a proxy. After controlling for the effects of variables such as mother’s literacy and household economic status, neonatal mortality is actually higher for children delivered in a medical facility than for children delivered at home. Both unadjusted and adjusted results are statistically significant. Similar study of Claeson et al. (1999)\textsuperscript{56,57} also suggest that social, cultural, and health conditions related to the low status of women in India clearly have a negative impact on child survival. Improving female education, female nutrition, and increasing the use of health services during pregnancy and delivery are essential to achieving a reduction in child mortality.

Rutstein (2000)\textsuperscript{20} also observe place of delivery where medical attendance is available have strong relations with the trend in under5-years-of-age mortality. Areas where there have been large decreases in mortality have had increases in the use of these maternal services that are threefold to fourfold greater than in areas where there has been an increase in mortality. In contrast, the place of delivery is not associated with neonatal mortality in three culturally contrast states of India namely Uttar Pradesh, Maharashtra and Tamil Nadu as highlighted by Griffiths et al. (2001)\textsuperscript{47}.

In a study of Bang et al. (2002)\textsuperscript{31}, under-5 mortality rate is found to be low in those villages having primary health centres (PHC) in the same village with 18.2 per 1000 as compared with villages far away 0.1-5.0 km. from PHC with 19.8 per
1000 and villages far away more than 5 km with 22.9 per 1000. Mahy (2003)[23] also suggests that the residence indirectly affects child mortality in developing countries by determining a woman’s access to health care facilities. It affects a woman’s ability to find transportation to a health facility, her ability to have cash to pay for medicines, her opportunities for education, and her ability to allocate household resources for her children’s health. Ashteker et al. (2004)[61] in their study on child mortality in three backward districts of Maharashtra, it is suggested that these backward districts are found high in child mortality as compared with other districts as well as other developed countries because of its lack in place of delivery within the same villages. In the study of under-five mortality in Nigeria by Ogunjuyigbe (2004)[39], the under-five mortality is very high when childbirth took place by traditional healer at home (47.3 per 1000 births) as compared with childbirth at hospital/health care centre (21.4 per 1000 births).

Although, place of delivery is an important determinant associated with under-five mortality, according to NFHS-3 report (2008)[42], less than 40 percent of births in India take place in health care centres. More than half take place in the woman’s own home and 9 percent take place in the parents’ home. Births in health care centres are about equally divided between those that take place in a private health care centre and those that take place in public institutions (such as government-operated district, tehsil/taluk, town, or municipal hospitals, and Primary Health Centres). Two-thirds of deliveries in urban areas and 29 percent of deliveries in rural areas take place in health care centres.
A study in Bangladesh by Mondal et al. (2009)\(^{(81)}\) report that many children die owing to the lack of safe delivery facilities, untrained dais, relatives and neighbours attend most of the deliveries, a practice that presents risk to both the mother and the newborn baby. The survival is higher among children born in proper health facilities and attended by professional doctors than those born at home attended by untrained dais. It is clearly shown that neonatal, post-neonatal and child mortality are higher whose delivery places are home (92.1% neonatal, 93.8% post-neonatal and 98.5% child mortality levels at home) than those delivery places are hospital & clinic (6.2 and 1.5% respectively). These results may imply that more and better antenatal care services during pregnancy may increase the children’s chances of survival.

In a recent study impact of place of delivery on neonatal mortality in rural Tanzania by Ajaari et al. (2012)\(^{(82)}\), suggest that the place of delivery is a significant predictor of neonatal mortality. Pregnant women need to be encouraged to deliver at health care centres and this should be done by intensifying education on where to deliver. Infrastructure, such as emergency transport, to facilitate health facility deliveries also requires urgent attention.

**Immunization**

Babies are born with protection against certain diseases because antibodies from their mothers were passed to them through the placenta. After birth, breastfeeding babies get the continued benefits of additional antibodies in breast milk. But in both cases, the protection is temporary. Immunization (vaccination) is a
way of creating immunity to certain diseases by using small amounts of a killed or weakened microorganism that causes the particular disease.

Microorganisms can be viruses (such as the measles virus) or they can be bacteria (such as pneumococcus). Vaccines stimulate the immune system to react as if there were a real infection—it fend off the infection and remembers the organism so that it can fight it quickly should it enter the body later.

In a report of UNICEF/WHO, it is mentioned that Edward Jenner demonstrated the value of immunization against smallpox in 1792. Nearly 200 years later, in 1977, smallpox was eradicated from the world through the widespread and targeted use of the vaccine. In 1974, based on the emerging success of smallpox, the World Health Organization (WHO) established the Expanded Programme on Immunization (EPI). Through the 1980s, UNICEF worked with WHO to achieve Universal Childhood Immunization of the six EPI vaccines (BCG, OPV, diphtheria, tetanus, pertussis, and measles), with the aim of immunizing 80% of all children by 1990. Progress has continued since then: by 2011, 107 million children were vaccinated with three doses of diphtheria-pertussis-tetanus (DPT3) vaccine and global immunization rates are at 83%. Of the world’s 22.4 million children are not immunized with DPT3, among them more than 70% live in 10 countries.

In a study of child mortality levels and patterns from Southern Sudan by Roth & Kurup (1989)(13), it is witnessed that the increase in child survival may be reflected by the control and/or eradication of communicable disease by modern medical technology. The maternal education and immunization of children are the most significant determinants of child survival. According to Kabir & Amin
(1993), health interventions such as immunization programmes might have had an effect on lowering infant and child mortality in Bangladesh.

In a study of Aaby et al. (1993), mortality is significantly lower in children vaccinated at 6-8 months than at 9-11 months. As vaccination was provided in semi-annual or annual campaigns it is unlikely that age at vaccination reflected a selection bias. Improved survival after early immunisation was not related to better protection against measles infection. With a Cox multivariate regression model to adjust for age, sex, season at risk, season at birth, measles infection, region and children vaccinated at 4-8 months has a mortality ratio of 0.61 compared with children vaccinated at 9-11 months. Reimmunised children tended to have lower mortality than children who received only one. They suggest that standard measles vaccination before 9 months is not associated with higher childhood mortality then is the currently recommended strategy of immunising from 9 months, and it may reduce mortality. This has implications for measles immunization strategy in developing countries.

A subject report of India’s NFHS-2 by Pandey et al. (1998), in India as a whole, mother’s tetanus immunization has a substantial effect on unadjusted and adjusted neonatal mortality. Both unadjusted and adjusted effects are statistically significant, reflecting the importance of the protection conferred by tetanus immunization. The unadjusted effect of mother’s full tetanus immunization reduces neonatal mortality in all states except Jammu region. This effect is statistically significant in 12 states. The adjusted effect is smaller in most of the states and is statistically significant in only six: Uttar Pradesh, Orissa, West Bengal,
Assam, Maharashtra and Tamil Nadu. The adjusted effect is substantial, but not statistically significant, in Delhi, Haryana, Punjab, Rajasthan, Bihar, Gujarat, Andhra Pradesh and Kerala. In Himachal Pradesh, adjusted neonatal mortality is slightly higher for children whose mothers received full tetanus immunization than that for other children. Finally, the adjusted effect of mother’s full tetanus immunization on neonatal mortality is statistically significant in India as a whole and is either statistically significant or substantial in 14 of the 19 states, including most of India’s populous states with high mortality. These findings suggest that immunizing pregnant women against tetanus is an important programme intervention for reducing neonatal mortality in India.

Claeson et al. (1999 & 2000)\(^{56, 57}\) in their study based on NFHS-2 data indicate a positive relationship between coverage of key child health interventions (such as ORT, ARI, and immunization rates) and the reduction in under-five mortality. They also suggest that maternal and child health program interventions have contributed to a reduction in child mortality rates in India. Effective interventions could result in a rapid reduction in the perinatal and neonatal mortality rates and therefore in the overall IMR (infant mortality rate) and U5M (under5 mortality). A study of Rutstein (2000)\(^{20}\) on factors associated with trends in infant and child mortality in developing countries during the 1990s suggests that a change in the percentage vaccinated during pregnancy with tetanus toxoid did not explain the change in mortality for children aged less than 1 year. An increase in the percentage of children vaccinated against measles was associated with declines in infant mortality and with mortality at ages greater than 1 year. An increase in the
percentage of children receiving medical attention for diarrhoea, acute respiratory illness and fever declines in child mortality.

According to Griffiths et al. (2001)\(^{(47)}\), measles immunization was also found to be an important predictor of mortality in the early childhood period (9–23 months). Immunization against measles not only reduces the child’s vulnerability to catching the disease and hence secondary infections that might cause death, but also shows that the child belongs to a household that is prepared to access Western medical care. This will increase the child’s chances of survival. Kravdal (2003)\(^{(36)}\) in his study on child mortality in India: exploring the community level effect of education, consider mother’s own health, preventive efforts she makes, the use of supplementary nutrition, the child’s disease risk and mother’s care for a sick child as proximate determinants of child survival based on NFHS-2 data. From his study, it is reported that these proximate determinants have statistically significant effect on child survival.

DHS (demographic health survey) comparative report of childhood mortality in developing countries (2003)\(^{(23)}\), it is observed that the age distribution of childhood deaths is influenced by the causes of death in a community. For example, in communities where deaths due to congenital anomalies, birth complications, or infections at birth (such as tetanus) are common, infant mortality constitutes a greater part of under-five mortality. In communities where immunization coverage and malnutrition are problems, child mortality constitutes the majority of under-five mortality. The ratio of infant mortality to under-five mortality can thus provide insight into the causes of childhood death in a country. We would expect that as
countries develop, improvements in under-five survival will occur first among children age 1 to 4 because of improved immunization coverage against preventable childhood diseases. Improvements in the survival of children less than one year of age come later, with the capacity to treat ailments affecting children during the earliest months of life. Neonatal deaths are usually less easily addressed by contextual (environmental) improvements. Determining the age patterns of mortality helps to focus interventions on the appropriate age groups and causes.

According to Houweling et al. (2005)\(^\text{[84]}\), the effects of public spending for child immunization and care etc., differ strongly and significantly between poor and rich, showing stronger effects on the mortality level among poor children. Health care use among the poor is significantly more strongly associated with levels of public spending on health than health care use among the rich.

In a study of Vos et al. (2005)\(^\text{[65]}\), coverage of immunization is also very significantly related to lower prevalence of infant mortality. For each 1% increases in the coverage of immunization, infant mortality goes down by about 1.1%. The effectiveness of this preventive action stands out. The simulations analysis also show that reaching full coverage of the immunization program or the expansion of the free maternity program targeted at the poor by themselves are not sufficient to reach the MDG targets for infant mortality. The expansion of the immunization program would reduce infant mortality to 20.1 per 1,000 live births by 2015. As the immunization program is universal and initial coverage does not differ much across population groups, this policy would reduce infant mortality for all, but would not narrow differences between poor and non-poor or indigenous and non-indigenous.
As highlighted by Uddin et al. (2008)\textsuperscript{(36)}, tetanus toxoid during pregnancy has momentous effect on child mortality in Bangladesh.

Children are considered fully immunized if they receive one BCG injection to protect against tuberculosis, three doses each of diphtheria, pertussis and tetanus (DPT) and polio vaccines, and one measles vaccine. In India, according to NFHS-3 report (2008)\textsuperscript{(42)}, only 44 percent of children age 12-23 months are fully vaccinated, and 5 percent have not received any vaccinations. Less than one-third of children are fully vaccinated in Nagaland, Uttar Pradesh, Rajasthan, Arunachal Pradesh and Assam. At the other end of the spectrum, at least three-quarters of children have received all the recommended vaccinations in Tamil Nadu, Goa and Kerala. Immunization coverage has improved substantially since NFHS-1, when only 36 percent of children were fully vaccinated and 30 percent had not been vaccinated at all. There is a very little change, however, in full immunization coverage between NFHS-2 (42 percent) and NFHS-3 (44 percent).

**Mother’s exposure to mass media**

In a subject report of NFHS-2 by Pandey et al. (1998)\textsuperscript{(18)}, a mother’s exposure to radio and television may reduce the mortality of her children because women who are exposed to mass media are likely to have access to information on health-care services and ways of enhancing maternal and child health. They assume that a woman is considered to be exposed to mass media if she listens to radio or watches television at least once a week. It has been found that unadjusted neonatal mortality exhibits the expected relationship: it is higher for children whose mothers are not exposed to mass media in India as a whole and in all states except Rajasthan.
These results are statistically significant for India and for 11 states. After adjusting for other socioeconomic factors, the effect of mother’s mass media exposure is much smaller and is not statistically significant in India or in most states. The only state where mother’s exposure to mass media has a statistically significant adjusted effect in the expected direction is Himachal Pradesh. In Rajasthan and Tamil Nadu, the adjusted effect is statistically significant but in the unexpected direction: neonatal mortality is higher for children whose mothers are exposed to mass media. In India, the relatively low child mortality is associated with women’s autonomy through mass media as indicated by Kravdal (2003)(50).

In the study of child hunger in the developing countries by Balk (2005)(64), it is also observed that children in households that were electrified and had radios were less likely to be underweight, although there was no effect based on television ownership.

Child mortality study in two states of India, Dutta & Guha (2006)(52), highlight that child loss is more among women who are not exposed to mass media. Child loss is more by ten percentage points in case of Madhya Pradesh if women have no exposure to mass media – 29 percent in case of no exposure and 19 percent in case of any exposure. The effect of mass media in reducing child mortality is less in West Bengal where it reduces by 5 percentage points (16 to 11 percent) in case of those having exposure to mass media compared to the non-exposed group.

According to NFHS-3 report of India (2008)(42), 35 percent of women and 18 percent of men age 15-49 are not regularly exposed to any media (read a newspaper
or magazine, watch television, or listening radio or go to cinema once a month). Thus, not only one in three women not regularly exposed to media, there is a large gender differential in media exposure evident from these data. This differential is also evident for each of the different types of media. Further, this report suggests that women exposure to mass media is highly correlated with child mortality.

1.6 Chapterisation

The first chapter under the caption of ‘Introduction’ comprises the general introduction, objectives, methodology, review of literature and brief description of study area. The second chapter ‘Determinants of under5 mortality which consists of six sub-sections namely socio-economic determinants of under5 mortality, environment and sanitation determinants of under5 mortality, exposure to mass media, demographic determinants of under5 mortality, breastfeeding determinants of under5 mortality and health care determinants of under5 mortality. In third chapter is under the caption ‘Logistic regression analysis on under5 mortality. The fourth chapter of the thesis is with the heading ‘Construction of life table. The last chapter entitled ‘Summary and conclusion’. It summarizes the overall results of the study with some suggestions.

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