Chapter 1

Introduction: Theoretical Framework and Review of Literature
Chapter-I
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1.1 Introduction:
The infant and child mortality rates are considered to be sensitive indicators of socio-economic and health conditions prevailing in a community. They are often used to reflect the state of public health, environmental sanitation, socio-economic development and the people’s attitude towards the value of human life itself in a country.

For demographic and statistical purposes, all children under one year of age are considered infants, and so, the term “infant mortality” refers to mortality among children of less than one year of age. The study of infant mortality has been attracting nation wide attention because of considerable depletion of population during the stage of infancy, which has a major contribution of reducing life expectancy of the population.

After infancy, Childhood is the most favourable period for survival over the entire life span. Decreases in the risk of mortality in succeeding age periods during infancy continue beyond the first birthday. Child death rate is the age specific death rate under age five per 1000 children in the same age group in a given year. The child death rate is a more refined indicator of the social situation in a country than infant mortality rate. It reflects the adverse environmental health hazards (e.g. malnutrition, poor hygiene, infections and accidents) including economic, educational and cultural characteristics of the family (Park and park, 1970). Childhood mortality consists of deaths occurring among children from birth until exact age five. The age distribution of childhood deaths is influenced by the causes of death in a community. In communities where immunization coverage and malnutrition are problems, child mortality constitutes the majority of under-five mortality. The ratio of under five mortality can thus provide insight into the causes of childhood death in a country.
Infant and child mortality rates are unacceptably high in many developing countries and need to remain the focus of public policy to gain improvement in infant and child survival. Infant and child mortality rates are used as summary indicators of social development, quality of life, overall health, child health, maternal health and welfare. During the last quarter of the past century major focus has been on reducing infant and child mortality. Neonatal mortality is the largest burden comprising nearly two thirds of infant mortality. In the past decade the number of children dying worldwide has fallen by 2.2 million, or by 18 percent, infant deaths have been reduced from 25 percent to 7 percent i.e. more than half (Ahmad & Lopez, 2000). Reduction in infant and child mortality is not only a major goal but also an important strategy to achieve health for all.

The International Conference on Population Development (ICPD, 1994) focused on reproductive health with the objective of enabling women to go safely through pregnancy and childbirth and providing couples with the best chance of having healthy infants. The Millennium Declaration in 2000 by the United Nation (September, 2000) has set eight Millennium Development Goals, one of them being reduction in child mortality with the target of reducing it by two-thirds, between 1990 and 2015.

Assam is a state with various social, religious and ethnic groups. Their living standards, food habits, literacy level, sanitary conditions, nutritional status, utilization of health services and the pattern of child bearing and rearing are rooted in their social values and norms. Although a lot of inputs have been given in health sector to reduce the high infant mortality, no significant achievements have been made till now. Since the Infant mortality rate is a pooled average value experienced by various cultural groups and communities, it is quite possible that there may be such areas and communities having high infant mortality rate, which may be keeping the overall infant mortality rate of a community at higher level.

Table 1. World Trends in Infant Mortality, 1960-1999

<table>
<thead>
<tr>
<th>Year</th>
<th>High income countries</th>
<th>Middle income countries</th>
<th>Low income countries*</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>35</td>
<td>120</td>
<td>167</td>
<td>165</td>
</tr>
<tr>
<td>1970</td>
<td>26</td>
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<td>1980</td>
<td>13</td>
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<td>117</td>
<td>119</td>
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<tr>
<td>1990</td>
<td>8</td>
<td>46</td>
<td>97</td>
<td>86</td>
</tr>
<tr>
<td>1995</td>
<td>7</td>
<td>39</td>
<td>89</td>
<td>69</td>
</tr>
<tr>
<td>1999</td>
<td>6</td>
<td>31</td>
<td>77</td>
<td>71</td>
</tr>
<tr>
<td>% annual rate of change over the period</td>
<td>-3.7</td>
<td>-2.8</td>
<td>-1.6</td>
<td>-1.7</td>
</tr>
</tbody>
</table>

Source: (World Bank, 1998 and 2001)

*Excluding India and China

Every year about 11 million children die, of which 10 million are in the developing world and nearly 2 million in India alone (UNICEF, 1999). Table 1 shows the infant mortality rates for three broad economic regions of the world and India. India’s experience is fairly typical of low income countries. There has been a steady reduction in mortality resulting in a halving of the rate in just over thirty years. So, whilst there has been a reduction, the level of mortality remains high and the rate of reduction is insufficient to achieve the Millennium Development Goal of reducing infant and under five mortality in the 25 years between 1990 and 2015.

The massive decline in infant mortality rates in the 20th century was one of the major causes of the population increase. Whereas in earlier centuries many infants would have died before reaching their first birthday, which operated as a strong check on population, in the 20th century immense gains were made to prevent infant mortality.

The crucial role of infant and child mortality as a summary indicator of the level of living and socio-economic development must be recognized in Assam. But, till now, no such
study has been conducted in this state. In order to tackle the problem of high infant mortality in the state, it is essential to assess and monitor its levels in different parts of the state, to better understand the different causes of both neonatal and post neonatal mortality and to realize the environmental goal of recording all births and deaths.

1.2 Definitions of Infant Mortality and Related Terms:

The infant mortality rate may be defined as the number of infant deaths that occur per thousand live births in any population in one calendar year. From the very definition, it is obvious that the infant mortality rate does not take into account either to foetal death or still birth, but only live births and infant deaths. The following formulations are used to calculate different measures of infant mortality.

\[
\text{Infant mortality rate (IMR)} = \frac{\text{Number of infant death during the year}}{\text{Number of live birth during the year}} \times 1000
\]

Infant mortality rate comprises of two parts viz. neo-natal mortality rate and post neonatal mortality rate. The neo-natal mortality rate also comprises of two parts viz. early neo-natal mortality rate and late neo-natal mortality rate. Neonatal mortality is the probability of dying in the first month (28 days) after the birth and post-neonatal mortality is the probability of dying after the first month of birth but before completion of one year. Therefore focusing on infant mortality as a single measure, disguises the unequal share of neonatal and post-neonatal mortality. According to one estimate, 50-60 percent of infant deaths i.e. nearly 5 million neonates die each year in the world, of which 96 percent are in developing countries (WHO, 1996). Effective reduction of such high neonatal mortality burden is an important national goal in India. These are defined as:

\[
\text{Neo-natal mortality (NMR)} = \frac{\text{Number of infant death of less than 29 days during the year}}{\text{Number of live birth during the year}} \times 1000
\]


**Early neo-natal**

\[
\text{Mortality rate} = \frac{\text{Number of infant death of less than 7 days during the year}}{\text{Number of live births during the year}} \times 1000
\]

**Late neo-natal**

\[
\text{Mortality rate} = \frac{\text{Number of infant death of more than 7 days to less 29 days during the year}}{\text{Number of live births during the year}} \times 1000
\]

**Post neo-natal**

\[
\text{Mortality rate} = \frac{\text{Number of infant death of more than 29 days to less than one year during the year}}{\text{Number of live births during the year}} \times 1000
\]

\[
\text{(PNMR)}
\]

**Peri-natal**

\[
\text{Mortality (PMR)} = \frac{\text{Number of still births & infant deaths of less than 7 days during the year Rate}}{\text{Number of live births and still births during the year}} \times 1000
\]

\[
\text{Still birth rate (SBR)} = \frac{\text{Number of still births during the year}}{\text{Number of live births and still births during the year}} \times 1000
\]

### 1.3 Literature Review:

The study of infant mortality has been attracting nationwide attention because of considerable depletion of population during the stage of infancy, which has a major contribution on reducing life expectancy of population\(^4\). Research on various aspects of infant mortality has been going on for quite some time throughout the world, and many of the proximate variables that affect it have been identified. As a first step in conducting further research, it is necessary to learn from previous researches and then pool together the research findings to bring out their policy and program implications.
In a preliminary analysis of data collected from nine districts in the three divisions of Gujarat state, Gandotra and Das (1982) showed the importance of demographic and socio economic factors on infant mortality. They found that:

1. Infants born to mothers below twenty and above thirty-five years of age have relatively high infant mortality compared to babies of women aged twenty to twenty-four.
2. The risk of infant mortality is highest for the first order birth, least for the birth order 2–4 and increases again thereafter.
3. Infant mortality is highest when the preceding birth interval is less than 18 months and is reduced substantially when the spacing is more than thirty months.
4. The mother education influences level of infant mortality.
5. Infant mortality is higher where calorie intake of the mother is less than 1500 and protein intake is less than 50 grams.
6. Infant mortality is higher among the scheduled caste population than the general population.
7. The socio-economic status of couples is negatively associated with infant mortality.

Prior studies on this problem of infant mortality with reference to levels, trends, differentials and determinants in India have been carried out by a large number of demographers and social scientists for the different states of the country and some of them are given below with their findings:

1. The level of female literacy does not have any direct effect on IMR; however, the higher the level of female literacy, the greater is the possibility that the program input variables would operate increasingly and effectively and yield a low rate of infant mortality (Roy and Srivastava, 1979).

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2. Caldwell (1979) described that an educated mother is better able to judge the gravity of an illness, to understand the capabilities of modern medicine and therefore to seek appropriate care for a sick child at the right time.

3. The higher figures in IMR for the backward SC and ST population seem to have affected the total figures of the state of Gujarat. At the household level, the socio-economic status, mother’s education, lack of medical care and other environmental conditions surrounding the mother and the child may be the significant determinants of high IMR. While probing the cause of death in infancy, the infectious and parasitic, respiratory and gastroenteritis diseases had been the important causes of neonatal and post-neonatal death (Gandotra and others, 1982).

4. The relative significance of socio-economic factors and specifically the factors like female literacy and work participation in Karnataka were important factors of IMR, as cited by Ram and others in 1983.

5. The important investigation on the high IMR in Orissa is that it seems to be associated with the non-availability of safe drinking water, antenatal care of the mother and housing conditions (Kanitkar, 1984).

6. Mosley and Chen (1984) analysed about two proximate determinants like “maternal characteristic” and “environmental contamination” which may make little contribution on explaining the greater impact of mother’s education in the differential survivals of boys and girls.

7. Mahadevan et al. (1986) argue that the bio familial factors are the predominant causes of infant mortality and familio-environmental factors are the important causes of child mortality and also classified the determinants of infant mortality under 12 groups.
8. Visaria (1986) mentioned about the infant and child mortality situation of India over the years starting from the beginning of the last century. Her study covered the levels and differentials of mortality situations of infant and children across the states by sex and place of residence.

9. The level of development in general and the agricultural development in particular, is expected to reduce the level of infant mortality in Andhra Pradesh (Prasad, 1984).

10. Orissa ranked second in rural child mortality rate in (0-4) year age group i.e. 46.5 in 1986 followed by Madhya Pradesh. The importance of the utilization of MCH services, maternal and socio-economic factors have been emphasized for the survival of the newborn (Sinha, 1989).

11. The social amenities seem to have a bearing on the IMR in the more developed areas. But in less developed areas, the social amenities may not determine the causal relationship with IMR. In more developed areas, the education and medical facilities contribute substantially in explaining IMR (Prakasan and Murthy, 1989).

12. In metropolitan set-up like greater Bombay, the improved living conditions, wider employment opportunities, healthcare services, literacy and spread of education awareness have been partly instrumental in the decline of IMR to a favorable situation (Chodankar, 1990).

13. Das Gupta (1990) in her study in rural Punjab examined the behavioural factors, biological factors, childcare related variables, household social and economic status, sanitation and hygiene, clustering of child deaths in families, mother’s education, autonomy, which continue for high level of child mortality.

14. Bhuiya and Streatfield (1991) have investigated about the positive effect of mother’s education on child survival by hazard analysis. The five independent variables
included were sex of the children, mother’s education, and mother’s age at the time of birth, household economic condition and the health programme.

15. Alam et.al. (1998) analysed the infant and child mortality in Bangladesh, caused by socio-economic, environmental and demographic factors, like parent’s educational status, husband’s occupation, religion, sanitary facilities, region, place of residence, age at first marriage and household economic condition.

16. Pandey et.al (1998) reported about the determinants of infant and child mortality for India and for individual states. The substantial effects of socio-economic background and demographic characteristics and mother’s health care behaviour are estimated.

17. Rajaretnam (1998) emphasised on the cultural and behavioural aspects of the household and parents than the biological and medical aspects of the child. He classified the determinants of infant mortality under 5 groups, like cultural, environmental, socio-economic, demographic and MCH services.

18. Bhattacharya (1999) discussed about the socio-economic factors, which influence child survival in less developed countries, which include the proximate determinants, like infection, food intake, nutritional status, disease control, maternal factors and injury.

19. Lahiri and Ram (2004) studied about the situation of infant and early childhood mortality in EAG and NON-EAG states in infant and child mortality. They presented the levels, trends and regional variations and analysed the socio-economic and demographic factors influencing deaths in infant and early childhood stages.

The literature review has been organized under the following headings:

A. Demographic factor:
   1. Maternal age
   2. Child’s sex
3. Birth order
4. Birth interval

B. Social-economic factors:
5. Mothers education
6. Housing condition
7. Exposure to mass media

C. Environmental sanitation and hygiene factor:
8. Availability of safe drinking water
9. Toilet facility

D. Medical care factor:
10. Antenatal care
11. Postpartum care
12. Post-natal care
13. Delivery care
14. Place of delivery
15. Immunisation of the child

E. Other factors:
15. Urban and Rural Differentials
16. Family Planning and Infant and Child Mortality

1.4 Determinants of Infant Mortality:
The factors that determine the neonatal and post neonatal mortality rate are considered to be different, while maternal nutrition, antenatal care, place and type of attendance at delivery, intake of iron tablets, breast-feeding (colostrum contents) practices, certain general factors are considered to influence the neonatal mortality rate. The environmental factors like (a) sanitation and safe drinking water supply, (b) nutrition of the child, (c) protection against infection through immunization are important for reducing neo-natal mortality rate and some factors like (a) female literacy, (b) socio-economic conditions, (c) age at marriage, (d) births interval are affecting post-natal mortality rate.

Sandhya (1991) opined that socio-cultural factors like caste, type of family, education and occupation of parents, socio-economic status of the family, child birth practices, prenatal care and the type of medical attention at the time of birth determine the level of infant mortality and child mortality.

The maternal and the child health (MCH) programme under the National Health Policy emphasize:

a) protecting the children against Vitamin A deficiency, which can cause night blindness
b) promoting oral rehydration is a simple tool for preventing deaths caused by the dehydration following diarrhea, and
c) Supplementary feeding, through balwadis and anganwadis, of children whose physical growth reflected in weight gain falls below the norm.

According to Leela Visaria of these three, only the oral rehydration scheme is likely to have some influence on post neo-natal mortality, because the other two programmes really covers children aged one and above.

The “United States Report on Infant Mortality” in the course of discussion of demographic and biological factors associated with early wastage of life sums up the situation admirably as:

> The biological factors at many times may be modified by changing social and economic conditions. For example, infant mortality has been found to vary with the order of birth, which is a biological factor, the highest mortality being found among first order of births and the highest order of births. A reduction in the size of families and therefore in the proportion of births and higher order of births obviously may have some effect upon infant mortality. The size of family however often varies inversely with the degree of social and economic advancement, the largest family being found in the underdeveloped areas of the world.

In this study the literature review has been done under the following heads:

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1.4.1 Demographic factor:

The demographic factors includes maternal age, child’s sex, birth order and birth interval

1.4.1.1 Mother’s Age at Birth:

Babies who have an increased risk of dying before their first birthday fall into two broad categories: those born to very young mothers and those born to women past their prime childbearing years.

Births to adolescents: Many adolescent women, especially in poor countries, are physically immature, which increases their risk of suffering from obstetric complications. For example, malnourished young women may not have developed sufficiently for the baby’s head to be able to pass safely through the birth canal. Teenage mothers also have an increased risk of giving birth to an infant who is premature or low-birth-weight—conditions that reduce the resilience and stamina babies need to overcome infection or trauma early in life. Additionally, pregnant adolescents are less likely than older women to receive good prenatal care and skilled medical care at delivery, and to be able to provide adequate care for an infant.

A very young mother is biologically not fully matured, so that the probability of pregnancy related complications are high. Also young mothers, being inexperienced, may not be able to take proper care of young infants, even though in the Indian setting, they receive considerable support from there kin groups. Beyond the age of thirty, the risk of pregnancy complications apparently increases because of the increasing inflexibility of the female reproductive organs.

This effect may be found to be large in societies, like India, where women are giving birth to children at extremely young ages. Children born after a short interval to the previous birth, generally present higher mortality rates. The key factor determining this relationship is the physical and nutritional depletion of mothers (Boerma and Bicego, 1993). The complex relationship between birth order and mortality is not well understood. In general, mortality is higher among first birth, which is usually explained
by the observation that many mothers have their first child before having reached physical and reproductive maturity (Sullivan, 1994). For children, rather than infants, there is often a higher risk associated with being a higher birth order child. In general, males have higher mortality rates at all ages of childhood. Exceptions to this apparent genetically determined phenomenon have to be taken as the result of behavioural factors (Sullivan, 1994). Exceptions are indeed commonly observed in Asia, including India, as a result of a preference for male children (Croll, 2001).

**Births to older women:** At the other end of the reproductive spectrum, many poor women in their 40s suffer from anemia, malnutrition, damage to their reproductive systems from earlier births and the sheer physical depletion associated with frequent childbearing—all conditions known to increase the likelihood of having a baby at increased risk of dying. The average infant mortality rate among women giving birth in their 40s is 94 per 1,000 live births is much higher than the rate among women in their 20s and 30s and almost as high as the rate among teenage mothers. As with adolescent mothers, high infant mortality rates among babies born to women in their 40s occur in countries at every income level.

The higher mortality of children born to old mothers may be the result of a deterioration of the reproductive system with age, while the higher child mortality at very young maternal ages may occur because mothers have not fully developed to manage a birth (Pebley and Strupp, 1987). It is an accepted fact that the IMR shows U shaped or a J shaped relationship with the age of mother as well as with parity. The two variables are of course usually highly correlated. The underlying factors might be both biological and behavioral (social and cultural practices). The biological factors are likely to be more important during the neo-natal period whereas the behavioral factors are likely to predominate during the post neo-natal period\(^8\).

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In addition, strong family and community values and norms in some countries perpetuate the idea that girls should marry very young and begin childbearing soon thereafter. As a result, many women in the developing world marry and give birth while they are still teenagers. It will take time to increase awareness of the potentially negative impact of these long-established norms and to effect changes.

1.4.1.2 Birth Interval:
Another factor that compounds the effect of age and parity on infant mortality is the length of the preceding birth interval. The shorter the birth interval the higher the rate of infant deaths (Yerushalmy et al., 1956; Wyon and Gordon, 1962; Wolfers and Scrimshaw, 1975; Swenson, 1977; Gondotra et al., 1982; Khan, 1988).

Infant Mortality risks increase sharply as the length of the birth interval decreases. Infant mortality is more than three times as high for infants with a preceding birth interval of less than 24 months, as compared for children with a preceding interval of 48 months or more (130 compared to 42/1000 of live births). Lengthening the birth interval from less than 24 months to 24-47 months has a much stronger association with the child survival than does to lengthening the interval from 24-47 months to 48 months or more.

Using results from 39th World Fertility Survey, Hobcraft, McDonald and Rustein (1985) highlight that child spacing is clearly associated with infant and child mortality, while high orders and high ages of mothers at birth show little such association. Thapa and Retherford (1986) support strong inverse relationship between infant mortality rate and length of previous surviving birth interval in their findings from the study of infant mortality trends and differentials in Nepal.

The role of birth spacing as an important determinant of child survival is increasingly emphasized. A better understanding of these mechanisms will help assess the health benefit of family planning, and would require the effect of birth interval to be analyzed separately for the neo-natal and the post neonatal mortality rates. Khan, Ramanujum, and Gondotra and Das have done this. These authors show that both the neonatal and post
neonatal mortality rates decrease with an increase in the length of the preceding birth interval. The effect of birth spacing on neonatal mortality operates through both biological factors (such as low birth weight and prematurity) and behavioural factors (such as breast-feeding). The effect operating through the biological factors is likely to be much more pronounced than that operating through behavioural factors, because the probability of being breast-fed may itself depend upon the birth weight. Although low birth rate may decrease the probability of being breast-fed, it may also independently reduce the chances of survival through the first month. If these premises are correct, short birth intervals should be associated with a higher risk of neonatal mortality irrespective of the order of birth. The results presented by Gandotra and Das (1988) demonstrate this mechanism.

Women of any given age can have high parity birth only if the interval between births is short. Thus the higher risk of infant deaths with fourth or higher parity birth in comparison to second and third parity birth among women in their twenties can be a cause of short birth intervals.\(^9\)

Miller et al (1992) analyzing data of Bangladesh and the Philippines demonstrated that children who are born within 15 months of preceding birth are 60 to 80 percent more likely than other children to die in the first two years of life.

Note that although the length of the proceeding birth interval is likely to affect mortality risks directly a substantial portion of the total association between birth interval and mortality risk may affect other risk factors that are correlated with birth intervals. For example, shorter interval are likely to occur in larger families, and larger families tends to come from lower socio-economic groups and also are more likely to reside in rural areas, where medical facilities and other survival enhancing resources are less readily available.

1.4.1.3 Birth Order:
In general infant mortality rates described a U-shaped or reversed J-shaped curve in relation to birth order (Omran and Standley, 1976, Khan, 1988). It is high for the 1st order birth, declines slowly up to the third birth order and then again takes an upward turn. According to Khan an analysis of the neonatal and post-neonatal mortality at various birth orders reveals that it is again the neonatal mortality level which decreases with increase in birth order and brings about a decline in overall infant mortality. The changes in the post neonatal mortality level are not of the same order of magnitude.

Kanitkar and Murthy (1988) also found the typical U shaped relationship between birth order and mortality rate during infancy, neonatal, post-neonatal periods. They found that the infant mortality rate corresponding to the first birth order decreased sharply for mothers aged below 20 years from the mothers aged 20-29.

1.4.1.4 Birth Size:
Birth size or the baby weight at the time of birth is another very important determinant of infant mortality. The weight of a baby at birth which often reflects both the mother nutritional status and the gestation period is an important determinant of neo-natal mortality. In general a baby with weight of 2500 grams is considered to be average size in Indian case. The NFHS data shows that the infant mortality is very high in case of small birth weight (table 2.17) which is 132. This factor may be attributes to the malnutrition condition of mother, which is due to wide spread poverty in our country. If the size of the baby is larger than the average, than it does not affect the infant mortality to a great extent because large size babies are born of very well nourished mother. So, it becomes quite clear that small size of birth leads to high rate of infant deaths in India.

1.4.1.5 Childs Sex:
The existing literature suggests that there seems to be a consensus among all on the issue of taking levels of infant and child mortality as a single most important indicator for assessing the quality of existing health care and socio-economic conditions of a population (Bhat et. al.1991) tried to explore the relations between fertility decline and
the net manifestation of the sex bias as well as evidence that this bias has increased in India. They also examined whether regional patterns in sex bias have changed, in view of the sharp regional differentials in the pace of fertility decline. The relationship between the sex differentials in the nutritional status of the young children has been explored and which have additional importance because they further clarify the nature of the relation between malnutrition, morbidity and mortality (UN, 1998). The research on the sex differentials in the nutritional status of the young children has been carried out and has been found that nutritional status of young infants is less likely to depend on differential in treatment by sex than that by older children, any favourable treatment of girls is expected to become more manifest as children grow older (Sommerfelt and Fred, 1998). Has this problem of excess of girl infant and child mortality has anything to do with the decline in mortality levels or linked to the socially perceived neglect of girl child?

The plight of the girl child is a significant research and policy issue. The World Declaration on the Survival, Protection and Development of children adopted at the World Summit for children in 1990 and the programme of action adopted at the International Conference on Population and development (ICPD) in 1994 both calls for efforts to eliminate all forms of discrimination against the girl child. ICPD programme of action calls for the elimination of excess mortality of girls where it exists, and for special education and public information efforts to promote equal treatment of girls and boys with respect to nutrition and health care.

Mortality rates for boys are systematically above those of girls in the developed world. In low-income group countries and historically in some European countries, however female child mortality rates are often experienced at the higher level. Girls appear to be biologically more resistant to health risks than boys. In the absence of female infanticide, excess female mortality can be attributed to either: a) strictly biologically causes: girl’s greater vulnerability to various illnesses that are important causes of deaths b) social factors: discrimination in nutrition and health care or other types of behaviour that differentiating the exposure of girls and boys to health risks (Banerjee-1998).

Reasons for differential treatment:

Difference in treatments of sons over daughters can lead to differentials in vulnerability to health risks. Research primarily on Asia and the Middle East has highlighted the importance of economic value of children (sons and daughters) to their families, mother's
educational attainment, the sex composition of older siblings in the family, place of residence, cultural and religious attitudes and perceived differences in the needs of boys and girls as factors underlying parent's decisions to discriminate in the treatment of their children (Population Bulletin, 1995). Assam is no exception to this. The commitment made in the national policy, which flows from the directive principles of Article 39 of the constitution on India, got further momentum when Government of India endorsed all the child survival goals for the year 2000 agreed by the World Summit for Children in 1990.

The mortality declined primarily due the improvements in public health infrastructure and advancement in medical services. But the sex differentials in infant and child mortality still exist and its visual form is widely prevalent, which is highlighted by the highly imbalanced sex ratio of India's population. The ratio in India in the year 2001 was 933 females per thousand males denoting the deficit of 67 females. The higher mortality among females in comparison to males is considered to be the main reason behind a higher deficit of females in India. As high as 38 percent of the total deaths in India occur among the children below age 5 and hence higher mortality among girls is a matter of serious concern. Male fetus is considered to be biologically weaker than the female fetus and this biological disadvantage is reflected in the higher mortality among male mortality in the first year of life in most of the population in the world. In India, male mortality is 14 percent higher than female mortality during the neonatal period. But the post neonatal mortality is 19 percent higher for girls than for boys. Combining neonatal and post neonatal mortality, infant mortality shows a little difference by sex. Also, the child mortality is 40 percent higher for girls. On this back drop the issue of sex differentials in Infant and Child mortality assumes greater importance and this paper tries to explore this in detail.

Women are the most disadvantaged members of the Indian population and comprise the largest portion living in absolute poverty. This status is reflected in indicators such as low literacy rate, a significant gender gap in primary education, high prevalence of a number of forms of violence against women, and lack of access to financial resources. Worsening
environmental conditions and the absence of basic services, also deprive women access to healthy and productive lives.

In India, almost twice as many girls die before the age of five as boys; Only 50 percent of Indian women are literate compared to 64 percent of Indian men; 44 million children, of which, two-thirds are girls, are out of school; Many Indian women go through life in a state of nutritional stress, have little control over their own fertility and reproductive health, and face violence inside and outside the family; Working longer hours than men, and carrying the major share of household and community work, the work of many women is unrecognized, unpaid and invisible; and In many cases, women are under represented in government and decision-making positions, and are legally discriminated against in land and property rights. They are thus denied opportunities to realize their potential, and live with self-respect and dignity. Assam is also not exception to this situation.

1.4.2 Socio-economic factors:

In the past, a decline in infant mortality usually accompanied economic improvement and this was so marked that the infant mortality has been looked upon as the most sensitive index of level of living and sanitary condition.\(^{10}\)

Further declines achieved by most of the western countries seem to show that in a modern urban industrial society, a point may be reached, when the significance of infant mortality as the index of socio economic status is greatly minimized. In such society a majority of infant deaths occur during the first month of life. They are due to biological factors associated with process of gestation and birth rather than socio economic factors. The remaining infant deaths that occur after one month of birth and within the first one year of life are due to environmental factors and continue to be inversely related to socio economic status. Successful public health measures and improved effectiveness of medical techniques go further to reduce post-natal deaths, whose fact greatly weakens the inverse relationship between the infant mortality and socio-economic status.

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1.4.2.1 Mothers Education:

Among the various socio-economic factors, mother's education is one of the most important factors in determining the infant mortality rate. A negative relationship between the level of education of mothers and infant mortality has been observed in many developing countries including India\textsuperscript{11}.

These are numerous studies showing that maternal education plays an important role in determining the level of infant and child mortality. Pollani found in Latin America that about 80 percent of the variability in the risk of dying before the age of two was accounted for by mother's educational level\textsuperscript{12}. The revolution in women lives has implication for infant survivorship because of the effect of women's social and economic on these determinants of infant well-being (Mason 1984). Factors such as the education of women and the opportunity costs of child bearing promote contraceptive use, which lengthen birth interval (Wolfers and Scrimshow, 1975; Cochrane, 1983). It has also been, hypothesized that more educated mother are less influenced by traditional practices inimical to modern health care and are more capable of dealing with modern in situation, especially health services (Schultz, 1980).

Ignorance is more deadly foe to young children than poverty, though these two so often go together. Besides low infant mortality, one of the main factors that distinguish Kerala in India, Srilanka and China from other low-income areas is the extent of mass education, particularly of women. As regards to the influence of maternal education on infant mortality and childhood mortality, Caldwell concluded from Nigerian data that the step from primary to secondary level was twice as important as that of literacy to primary schooling. He separated out the effect of other socio-economic factors, such as father’s education and occupation, family structure and so forth, by examining the mother’s level of education within each sub category. In every case, her schooling was found to have a strong, indeed a prominent, independent effect\textsuperscript{13}.

In the context of African countries, Cadwell (1979) has postulated that education has an effect on:

a) The powers balance between the spouses and between the generations such that an educated mother has a say in devoting greater resources to children as opposed to parents and grandparents.

b) The degree of fatalism with respect to children’s ill health, and

c) A confidence in the human capacity to manipulate the world, through knowledge of the location of facilities as well as to access and utilization of them.\(^{14}\)

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**Figure 1.1:** How variables may contribute to a statistical association between education and child Mortality

*Note: Community Variables are written in capital letters. The figure includes blocks of variables, but all variables within a block do not necessarily operate through the indicated arrows.*


Oystein Kravdal (2004) has very successfully shown the possible determinants of education and various causal channels that education may operate through in affecting mortality, are illustrated in Figure 1.1. He opines the account should not be seen as exhaustive however. Other factors may also play a role, the variables that are mentioned may have additional effects, and it is possible to argue for alternative directions of causality.

According to the Kravdal (2004) the variables actually included in the statistical models, reflecting to a large extent the availability of data, are illustrated in Figure.

![Diagram](image)

**Figure 1.2: How covariates used in the association between education and child mortality in India are assumed to be linked with education, health, health care and mortality**

*Note: Community Variables are written in capital letters. The possible effects of various socio-economic and cultural background factors on women's autonomy are not central to the analysis, and therefore not included.*

Kravdal's (2004) is of the opinion that in addition to being the key determinants of mortality, education is itself a result of many different factors at the community level and individual level that may also have a bearing on mortality. His determinants of education can be summarized as below:

a) Educational institutions are more likely to have been established if the community is relatively rich.

b) The degree of Urbanisation may also be important determinants. Having a large population in a small area facilitate educational expansion and typically produce a labour market in which education is more of an asset than it would be otherwise.

c) Political and religious attitudes may be important determinant of the willingness to invest in schools.

d) Another important determinant of education is the woman's autonomy, which may be loosely defined as their responsibilities, rights and freedom to act as they choose compared to men. Poor parents typically see little need to educate their daughters if community norms about women's position do not allow them to make use of the education for paid work anyway, and if their in-laws perhaps will appropriate any income they might earn.

At the same time, as women's educational levels increase, so does their desire to postpone marriage and childbearing. But the longer women delay marriage, the more likely they are to become sexually active before marriage. If women are to obtain the full benefits of increased education, they must have access to contraceptive services to avoid unintended and probably high-risk premarital pregnancies. In many developing countries, however, it is not considered appropriate for contraceptive services to be made available to single women, or for them to be sexually active.

1.4.2.2 Exposure to mass media:
There is also some debate about which types of mass media are most effective for use by in developing societies for public health campaigns. The consensus is that the radio might be the most effective mass media weapon. Arguments in support of the radio point out
that its use of oral communication reduces access barriers arising from illiteracy. Low production costs for radio transmission and programming and the radio receiver's affordability and portability also enhance radio media's ability to penetrate poor societies. The television is also expected to be a powerful medium because it overcomes problems of illiteracy in part because its visual images support vicarious interaction and consumption. But the high costs of television transmission and programming and the television set's expense and limited portability restrict access and relevance to elite and urban groups. Print media have some visual appeal but they are disadvantaged by their limited interactive power, the huge demands made on literacy, and their high production costs. Print media may be the most limited of the three major mass media in developing country settings as mechanisms for transmitting public health information (Faria and Potter 1999).

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1.4.2.3 Women Employment:
Women employment has contradictory influences on infant and child mortality. Women's work may be associated with enhanced individual autonomy and improved
family incomes, both of which are thought to be beneficial for infant survival. On the other hand, women's work in developing nations often involves long hours and poor working condition, which lessen the ability or mothers to care for their children. Restrictions on their ability to breastfeed may be critical in this regard (Hogan and Kertzer, 1986; Hobcraft et al., 1984).

1.4.2.4 Relative Risk of diarrhea with house type:

As mentioned in methodology by the NFHS, the houses are divided into three types—kuccha, semi-pucca, and pucca. Kuccha and semi-pucca have been merged together (NFHS-2). Coming to the mother's education, NFHS find that even though the mother is literate but prevalence is more in kuccha house. The relative risk is also more in kuchcha house if the mother is illiterate. Single room, with kuccha house occupies highest prevalence (13.26%) of diarrhea. The relative risk in single room’s kuchcha house is 1.39. This denotes that diarrhea is more susceptible in kuccha house than pucca house. In the same way if the mother is exposed to media the chances of diarrhea is more in kuccha house. One important aspect is type of residence, even though the residence is in urban area but in case of kuchcha house the relative risk is more. In same way, we can analyze that the risk is more in working mother and schedule caste with respect to type of house.

Thus, we can conclude that as like unsafe water, kuccha houses are more susceptible to diarrheal morbidity. Now question comes here, what are the problems with kuccha houses? A number of factors may be there like exposure to dust or bad floor, or mixing of tiny soil particle with liquid food (water etc.). Hence, unsafe water and kuccha house these have been found most important.

1.4.3 Environmental sanitation and hygiene factor:
1.4.3.1 Safe Drinking water and infant and child mortality:

Puffer and Serrano (1973) studied infant and child mortality in several Latin American cities and found that a high proportion of households reporting infant deaths lacked adequate water sources. In a study of regional variation of infant and child mortality in Sri Lanka, Patel (1981) found that the supply of well-water and presence of latrines explained substantial regional variation in mortality.
The importance of provision of safe drinking water in reducing the infant and child mortality levels cannot be over emphasized (Jam. 1983). Piped water, tap water and water drawn from the hand pump, tube wells are considered to be relatively safe drinking water. Khan (1983) had found that in U.P., the level of infant mortality comes down by 18 per cent when the source of drinking water changes from well or tube well to pipe water. Similarly, Kanitkar (1983) also noticed in her Rajasthan study that safe drinking water shows independent effects on the infant mortality rate.

In a study on the mortality variation in urban Brazil, Merrick (1985) found that access to piped water in a household is likely to be of most direct benefit in lowering child mortality by reducing exposure to water-borne diseases, particularly diarrhea.

1.4.3.2 Diarrhea and infant and child mortality:
Epidemiological data from small area studies have long demonstrated the importance of diarrhea illness and its contribution to both mortality and morbidity among the children. The nation wide study of children in 1978 by the RGI (Registrar General of India), identified diarrhea as a major killer and cause of illness. NICD-WHO sponsored diarrhea morbidity and mortality survey conducted in 1984-85 also revealed that diarrhea disease caused roughly 25 per cent of childhood mortality.

In India, as like other developing countries, diarrhea and respiratory infection are the first and second most common causes of illness and death among children under five years (Viswanathan and Rohde, 1990).

Indian Government has launched a special programme ORTP (Oral Rehydration Therapy Programme). This shows the importance of diarrhea on child’s health and mortality in India. In the present study an attempt is made to identify the major factors which are influencing the prevalence of diarrhea. This will help to strengthen the existing diarrheal control Programme in India.
According to the NFHS-I about 10% of all children under 4 years had diarrhea in the two weeks immediately preceding the survey. Although existing information are used to examine the influence of the factors on diarrhea, but many other important factors like seasonality, regionality etc are not been considered due to unavailability of data. Table 6 presents the prevalence of diarrhea in the two weeks preceding the survey according to different background characteristics. There is not substantial difference by the sex of child. Children below two years are more susceptible to diarrhea. Among children below 2 years, prevalence is highest among the children age 6-11 months. Diarrhea is more likely among higher birth order children. This may be due to tendency to take less care of the child in the higher birth order. Water quality is an important aspect in prevalence of diarrhea. It is clear in the table that in unsafe water the prevalence of diarrhea is more. Prevalence of diarrhea is more among children of people who are living in kuchcha house than pucca house. The prevalence is 18.62% more in Kuchcha house than Pucca houses. Number of rooms in the house also affects it, as the number of room’s increases there is decrease in occurrence of diarrhea. From single rooms to more than three rooms the prevalence is 18.9% less. The prevalence of diarrhea is not much significant with mother’s education, working status and exposure to mass media. If the mother is working then the chances of diarrhea has been found more, this may be due to several causes like less care, change in feeding practices etc. In the urban area, the prevalence is 15.38% less than the rural areas. This may be due to better medical care or more exposure to mass media or more knowledge about diarrhea. So in conclusion of the above discussion one can say that the prevalence of diarrhea is more in single room’s house, Kuchcha house, unsafe water, rural residence, working status of mother and no knowledge about ORS. Prevalence is slightly higher in case of schedule caste than the others.

1.4.3.3. Relative risk of diarrhea with water quality:

The results show that water and house type is the main crucial factor. Source of water is alone not sufficient to analyze the prevalence but when other variables are controlled such, number of rooms in the house, house type, mother’s education type of residence water quality becomes significant. If the water quality is unsafe, the relative risk is more
even though the house is pucca. The prevalence of diarrhea is more in kuccha house with unsafe water. Number of rooms in the house is also an important aspect, because in case of single room’s house relative risk is much more high then 2-3 and above three room’s house. This may be analyzed as better care and sanitation in those houses, which have more number of rooms. Mother’s education alone is not sufficient to interpret the differential in diarrhea, but mother’s illiteracy with unsafe source of drinking water increases chance of diarrhea among children. Exposure to mass media is important, because there should be less cases with good exposure, but the results interprets that the relative risk is high with unsafe water although, the mother of the child is well exposed to mass media. Although working status of mother is making a difference in prevalence of diarrhea, but if they get safe water the difference will be negligible. In the previous table urban rural differentials are noticed, but water quality is controlled, urban-rural people with unsafe water are showing the similar prevalence rate. Again, the prevalence is slightly higher in case of schedule caste with unsafe water. In case of mother’s knowledge about ORS packets rates are lower for those children whose mother had heard about ORS. However, once again the risk is more with unsafe water among those women also who had heard about ORS. So, over all picture comes here that unsafe source of drinking water with kuccha house, single room, illiterate mother, working mother, rural residence, are conducive to occurrence of diarrhea.

1.4.4. Medical Care Factors:
A major determinant of the survival of infant seems to be their access to health care. This is one of the main causes for rural–urban differentials of infant mortality. Less developed countries that have substantially lowered their infant mortality rates after the Second World War, are distinguished by an even distribution of health services throughout their population.

Orubuloye and Caldwell (1979) in Nigeria reported that the existence of public health services in small traditional villages undoubtedly reduced infant mortality. The decline in infant mortality in Nigeria between 1965 and 1975 was basically as a result of availability
of rural health center, which carried out rigorous programs in maternal and child health, health education and environmental sanitation.\textsuperscript{15}

Since independence, despite the substantial improvement in the coverage of rural India through primary health center and sub-centers, the facilities are still lacking for delivery care and sick child. In most of the rural areas, the parents by tradition and custom tend to discriminate against daughters in providing health facilities. This is reflected in the higher IMR for female children in several years. Leela Visaria in her study found persistent and higher IMR for female than male in northern states of Haryana, Himachal Pradesh, Orissa, Punjab, Rajasthan and Uttar Pradesh. In Assam, Karnataka, Kerala, Maharastra and Tamil Nadu, the excess of female IMR over the male is small and not consistent.\textsuperscript{16}

\textbf{1.4.4.1 Antenatal Care:}

Antenatal care (ANC) refers to pregnancy related health care provided by a doctor or a health worker in medical facility or at home. The Safe Motherhood Initiative proclaims that all pregnant women must receive basic, professional antenatal care (Harrison, 1990). The Reproductive and Child Health Programme recommends that as part of antenatal care, women should receive two doses of tetanus vaccine, adequate amounts of iron folic tablets or syrup to prevent and treat anemia, at least three antenatal check-ups that include blood pressure checks and other procedure to detect pregnancy complications (Ministry of Health Family Welfare, 1997; 1998).

In the scenario of demographic development, the very assurance of safe motherhood has got its prime position in terms of the Indian family welfare programme strategy at present. The central purpose of antenatal care is to identify “high risk” cases as early as possible from a large group of antenatal mothers and arrange for them skilled care. According to NFHS-2 more than 130,000 women die each year from causes related to pregnancy and childbirth. One of the goals set by the National Population Policy- 2000,


\textsuperscript{16} Leela Visaria, \textit{(1988), \"Level Trends and Determinants of Infant Mortality in India\"}, in Anurudh K.Jain and Pravin Visaria (eds.) in Infant Mortality in India, Differential and Determinants, p. 91.
for the year 2010 is to reduce the maternal mortality ratio to 100 maternal deaths per 100,000 live births. The majority of deaths due to maternal cases are avoidable if pregnant women receive adequate antenatal care during pregnancy, having deliveries in hygienic condition with the assistance of trained medical practitioners. In the context of India NFHS-2 reveals that there has been almost no change since NFHS-1 in the proportion of mothers who received antenatal checkup (62.3%) in NFHS-1 and (65.4) NFHS-2. In southern states of Kerala, Tamilnadu and Andhra Pradesh the proportion of received antenatal care has increased.

Obermeyer (1993) stated that status of women in a society and level of female education are associated with pattern of health care use, but her study suggest that infrastructure, socioeconomic features and access to health care services are important factors that account for difference in maternal health care use.

Bhatia and Cleand (1995) in their study in a region of South India found that education and economic status lead to the seeking of ANC services from private health centers, particularly women living in rural areas, belonging to lower class and those having higher pregnancy of order, were found to have lower level of antenatal check up. Audinarayana (1997) inferred that education and awareness through mass media may lead to better utilization of maternal care. Khan et al (1997) in stated that female education and parity having significance positive relationship with the women’s acceptance of the ANC services. Another study has been done by Nanda and Niranjan (1999) who stated that women’s education at least up to high school and above has an association with the ANC availability from health worker at home and for health worker outside home.

1.4.4.2 Neonatal Tetanus:
Delivery practices are important because the newborn, unless protected by certain immunities, is susceptible to certain infections, such as neonatal tetanus. Neonatal tetanus is caused by potent toxin produced by clostridium tetani, the tetanus bacillus. The usual site of infection among the infants is the umbilical stump. The toxin of clostridium tetani acts directly on the central nervous system and causes muscle spasms and seizures. The
symptoms appear two to 14 days after birth and death follows rapidly. However, if the pregnant women is administered two doses of tetanus toxoid at least one month prior to delivery, the immunity passed on to the newborn offers nearly 100 percent protection against neonatal tetanus.\(^\text{17}\)

1.4.4.3. Childhood Immunization and Infant and Child Mortality:
The developing countries are following the WHO recommended guidelines that all children receive a BCG vaccination against tuberculosis, three doses of DPT vaccine for the prevention of diphtheria, Pertussis (whooping cough), and tetanus; three doses of Polio vaccine before the first birthday of child.

1.4.4.4 Malnutrition and Infant and Child Mortality:
One of the many causes of illness and death among infants, malnutrition is recognized to be the one of the most important factor in India and other tropical countries. It is well known that malnutrition, apart from its direct effect on general health, also exerts an indirect deleterious effect by lowering the distance to infectious diseases.

High infant and child mortality rates and associated malnutrition remain a serious problem for a large percentage of India’s population. More than 73 million young children are underweight, and chronic maternal malnutrition is widespread. One-third of India’s population lacks adequate food. Nearly one-fourth of child deaths are due to diarrhea. Poor access to health care, a high illiteracy rate, and poor nutrition and health practices, complicated by high fertility and short birth intervals, are causative factors for the high mortality rates.

Malnutrition in India among children is rampant. One in every three of the world’s malnourished children lives here and about 50 per cent of all childhood deaths in India are attributable to malnutrition (UNICEF). The proportion of low birth weight babies remains high at one third of all births. The promotion of early and exclusive breast feeding is a well recognized strategy for child survival. It is estimated that in India 28%\(^{17}\)

of mothers initiate breast feeding within one hour of delivery and only 39.7% practice exclusive breast feeding till 6 months (WHO, 2005).

1.4.4.5 Place of Delivery:

Same of the important factors causing high neonatal mortality in India, and particularly in rural areas of the country are the place of delivery, the type of attendant and practice followed with respect to the care of the new born. Therefore it is essential that delivery be conducted under proper hygienic conditions with the assistance of a trained medical practitioner.

The links between pregnancy-related care and maternal mortality are well recognized, and over the last decade national programmes and Plans have stressed the need for universal screening of pregnant women and operationalising essential and emergency obstetric care. Proper antenatal care ensures at the end of pregnancy, a healthy mother and a healthy baby, but the coverage of antenatal care in India remains inadequate (WHO, 2005).

The distribution of skilled attendants and institutional deliveries by states reveals an inverse relationship with NMR and IMR. Though there has been an increase in institutional deliveries, around 65% deliveries are conducted at home. Nationally, among women who underwent a non-institutional delivery in the three years prior to investigation, only 17 per cent obtained a postpartum check-up within two months, and only 2 per cent obtained a check-up within two days of birth. Of these, just one-third reported an abdominal examination (35 per cent), and around two-fifths reported receiving breast-feeding advice and baby care advice (43 per cent and 46 per cent respectively); even fewer (27 per cent) were counseled about family planning (IIPS and ORC Macro, 2000).

1.4.4.5 Breastfeeding and Other Practices:

*Breastfeeding is an unequalled way of providing ideal food for the healthy growth and development of the infant; it is also an integral part of the reproductive process with important*
implication for the health of the mothers. As a global public health recommendation, infants should be exclusively breastfed for the first six months of life to achieve optimal growth, development and health. Therefore, to meet their evolving nutritional requirements, infants should receive nutritionally adequate and safe complementary food while breastfeeding continues for up to 2 years of age or beyond. 


Breast milk produces the necessary nutritional need for infants and also transmits certain antibodies from mother to child. During the first two or three days after the baby is born, the breast does not secrete milk but yield a yellowish fluid called colostrum, which is good for the baby as it takes care of its first hunger. The colostrum contains less fat but is richer in protein, and has a higher concentration of antibodies which protect against infections. It is also a richer source of zinc and vitamins, which can be stored in the infant liver. Zinc and vitamin A are known to contain immunological properties, which help to resist infections. But not putting the infant to the breast immediately after delivery, the infant is denied of that benefit.

According to the Food and Nutrition Board, Dept of Women and Child Development of Ministry of Human Resource Development and Dept. of Family, Ministry of Health and Family Welfare, “breast feeding is an unequalled way of providing ideal nutrition for healthy growth and development of infants. The correct norm for infant feeding are a) the initiation of breast feeding immediately after birth, preferably within 30 minutes, b) exclusive breast feeding for the first six months i.e., the infant receive only breast milk and nothing else no other milk, food, drink and water, c) appropriate and adequate complementary feeding from six month of age while continuing breast feeding, d) continued breast feeding up to the age of two years or beyond. According to them

advantages of breast feeding for children are a) breastfeeding stimulates all the 5 senses—sight, smell, hearing, taste, and touch, b) breastfed child is more intelligent and may have an IQ of 8 point higher than a non-breastfed baby, c) breastfeeding enhances brain development and learning ability, d) breastfeeding prevents diseases like neonatal sepsis, diarrhoea, pneumonia, e) breastfeeding is capable of saving 13% of all under 5 child death. Not only the child but also the mothers get advantages from the breastfeeding. The advantages of breast feeding for mothers are a) early initiation of breastfeeding lowers the mothers risk for excess post-partum bleeding and Anaemia, b) exclusive breastfeeding boosts mothers immune system, delay next pregnancy and reduces the insulin need of diabetic mothers, c) breastfeeding can help and protect mother from breast and ovarian cancers and osteoporosis (brittle bones), d) breastfeeding helps a mother to shed extra weight gained during pregnancy. The World Breastfeeding Week is celebrated from 1-7 August every year to spread the awareness about the advantages of the breastfeeding.

To promote maximum development of the child, it is essential to gradually wean away from breast by the age of 6 months by giving some solid food. However many mothers continue to keep their babies on their own milk till the age of one or two years. This process has sometimes been referred to as “starving at the breast”20. The practice of breast-feeding in India is believed to be almost universal and prolonged; yet, the level of infant mortality is high. Two reasons that contribute to this fact might be the practices related to the delay in the initiating breast-feeding, and delay in introduction of supplementary food.

The “Innocents declaration on the protection and support of Breast-feeding (1990)” and WHO working group on infant feeding (World Health Organization, 1991) have made several recommendations on feeding of infant and young children. These international recommendations state that infant should be given breast milk up to 4-6 months of age. Aside from breast milk, on other food or liquid is needed during this period. At the age of

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4-6 months, adequate and appropriate complementary foods should be added to the infant diets in order to provide sufficient nutrients for optimal growth. It is recommended that breast-feeding should continue along with complementary foods, up to the second year of life. It is further recommended that feeding bottle with nipple should not be used at any age, for reasons having to do mainly with sanitation and the prevention of infection. In addition, the “Baby Friendly Hospital Initiative”, launched by WHO recommends the early initiation of breast feeding after child birth.\(^{21}\)

The initiation of breast-feeding immediately after childbirth is important because it benefits both the mother and infants. As soon as the infant starts sucking at the breast, the hormone oxytocin is released, resulting in uterine contractions that facilitate the expulsion of placenta and reduce the risk of post partum hemorrhage. Breast milk is sufficient for the new born infant and it is not necessary to give the infant anything else; when the neonate is given anything else, contamination may cause infection, leading to diarrhoea.

It is recommended that the first milk should be given to the child rather than squeezed from the breast and discarded because it contains colostrums, which provides natural immunity to the child.

1.4.5 Other Factors:

1.4.5.1 Urban and Rural Differentials:
Urbanization leads to concentration of economic power and new types of problems associated with modernization. This also gives rise to new kind of spatial interactions. Urbanization is regarded as an index of the level of socio-economic development of the country. Urbanization produces a new type of civilization and a new culture quite distinct from those of rural societies.\(^{22}\)

Important variations in the level of infant mortality are evident for different sub groups of the population even in the same country. For instance, the rural areas and urban areas of the same country have widely different infant death rates in addition to infant morality differentials by geographical residence; differential due to other demographic and socio-economic factors may also be observed within the boundary of a particular country. Such factors include conception, female work participation rate, female literacy rate, income level, etc\textsuperscript{23}.

In most of the developing countries, infant mortality is higher in rural areas in comparison to urban areas; it may be because of easy access to the medical facilities, safe drinking water supply, higher rate of female literacy, higher standard of living in urban areas\textsuperscript{24}.

1.4.5.2 Family Planning and Infant and Child Mortality:
Efforts to reduce overall infant mortality rates by enabling women to control the timing of their births through the use of modern contraceptive methods have benefits beyond saving infant lives.\textsuperscript{25} Societies with high infant mortality rates also have high fertility rates, in part because couples try to compensate for the infant deaths they have witnessed or experienced. Large families, in turn, reduce the ability of poor parents to invest adequately in the health and education of each child. Thus, a reduction in infant mortality can create an environment in which couples feel less compelled to maintain high fertility levels to ensure the survival of at least some children. As a result, families will eventually grow smaller, and even at existing low income levels, parents will be able to invest more in each child.

Moreover, women who can delay childbearing until their 20s enhance their chances of staying in school. The positive effects of increased education on women's status, their


ability to find paying jobs, and the welfare of their children and families have been well documented. Higher educational levels, especially for women, are also closely associated with lower infant mortality rates. Better-educated women are more likely than less-educated women to understand the importance of prenatal care, hygienic child care practices and good nutrition for themselves and their babies. They are also more likely to know where to go for health care and to be able to afford such care. Finally, enabling women in their 40s to avoid becoming pregnant would reduce the number of unwanted births occurring in developing countries, given that most women this age have already attained their desired family size.

Improved access to and use of family planning methods would enable women to reduce closely spaced births, limit childbearing to their 20s and 30s, and thereby reduce their chances of having a baby who dies in infancy.

1.6 Objectives of the Study:

Following are the main objectives of the study:

➢ To assess the relative position of Assam in comparison to India and the major states regarding the present level of infant and child mortality.

➢ To study the spatial and temporal trend of infant and child mortality in Assam.

➢ To find out the socio-economic conditions of the people and their relationship with infant and child mortality in the district of Dhubri and Jorhat.

➢ To find out the factors which determine the medical care factors?

1.7 Research Questions:

The following research questions emerge from the review of the literature and need to be examined further in detail.

➢ Is there a sex difference in the neonatal and post-neonatal, infant and child mortality in Assam?

➢ To what extent female literacy is related with the infant and child mortality in Assam?

➢ How mass media is important in reducing infant and child mortality?
What are the factors which determine the medical care factors?

What are the factors due to which infant and child mortality is very highest in Dhubri and very lowest in Jorhat in the same states?

How standard of living plays an important role in child survival?

Framework of the Study

1.8 Methodology of investigation of determinants of Infant and Child mortality:

According to K. Srinivasan (Srinivasan, 1988) the methodology of investigation of determinants includes a sequence of seven steps shown in the Figure.
Steps in Research on determinants of IMR

Step I
Development of a conceptual model based on theory or some empirical observation

Step II
Selection and operationalisation of predictor variable and the dependent variable

Step III
Compilation of necessary data on the variable through experimental studies, retrospective or prospective studies on sample areas

Step IV
Statistical analysis of collected data

Step V
Test of validity of the model

Step VI
If model is valid, estimation of effects of predictors variables

Step VII
If model is invalid, revision of the model with new variables or modified relationship among the predictor variables in the existing model
1.9 Proximate determinants of infant and child mortality:
The underlying factors behind the causes of infant and child death have been divided into five broad categories: demographic factors; economic factors; environmental sanitation and hygiene factors; nutrient availability factors; and medical care factors in this study.

A. Demographic Factor:
   1. Maternal age
   2. Child sex
   3. Birth order
   4. Birth interval

B. Socio economic factors:
   5. Mother’s education
   6. Household conditions

C. Environmental sanitation and the hygiene factors
   7. Availability of safe drinking water
   8. Housing condition
   9. Toilet Facility
   10. Source of fuel and lighting

D. Nutrient availability factors
   11. Calorie intake of mother
   12. Breast feeding and other practices
   13. Food intake during pregnancy

E. Medical care factors
   14. Prenatal care of the mother including immunisation against tetanus during pregnancy
   15. Postnatal care including immunization of children against the DPT, BCG and polio.
   16. Treatment seeking behavior
1.10 Methods and tools of data analysis:
In this study, the women of reproductive age group are taken as the unit of analysis. The dependent and independent variables are categorical in nature. An attempt has been made to apply the best measures to analyse the data. Chi-square test and binary logistic regression have been used for the analysis. The detailed explanations of these techniques are given below:

\[
\text{Chi square} = \sum \frac{(O_i - E_i)^2}{E_i}
\]

Where \(O_i\) = Observed frequencies and \(E_i\) = Expected frequencies

Null Hypothesis:
There is no significant difference between the background characteristics and the response variables under study.

Alternative Hypothesis:
There is consistent and predictable relationship between background characteristics and response variables under study.

Decision rule:
Accept the null hypothesis, if calculated value is less than or equal to tabulated value and if calculated value is greater than tabulated value then reject the null hypothesis with \((c-1)(r-1)\) degree of freedom at given level of significance.

Logistic regression:
Since the dependent variables under study are categorical in nature so that logistic regression is applicable for the best explanation. In this study binary logistic regression has been used.
Binary Logistic Regression:

In binary logistic regression, the response variables contains two categories like true and false etc. mathematical form of binary is given as:

\[
P = \frac{1}{1 + \exp(-Z)}
\]

Where, \(P\) = estimated probability
\(Z\) = predictor

But for multivariate case, \(Z\) can be expressed in terms of linear combination of other predictors variables as \(Z = b_0 + b_1X_1 + b_2X_2 + \ldots + b_nX_n\) then the logistics function reduces to the form

\[
P = \frac{1}{1 + \exp[-(b_0 + b_1X_1 + b_2X_2 + \ldots + b_nX_n)]}
\]

The ratio of probability of success and not success is also known as odds ratio

\[
Odds = \frac{P}{1-P}
\]

Hence the binary logistic function reduces to the form

\[
\text{Logit } P = b_0 + b_1X_1 + b_2X_2 + \ldots + b_nX_n
\]
Logistic regression can also be expressed as in probability form

\[
\text{Exp} \left( b_0 + b_1 X_1 + b_2 X_2 + \cdots + b_n X_n \right)
\]

\[
P (x) = \frac{1}{1 + \text{Exp} \left( b_0 + b_1 X_1 + b_2 X_2 + \cdots + b_n X_n \right)}
\]

**Odds ratio:**
Odds ratio has been used to compare the relative change in the response variable with respect to predictor variables. The odds ratio 33.3 percent is given by

\[
\Omega^* = \frac{\Omega^*}{\Omega} = \text{Exp} \left( b \right)
\]

Where, \( \Omega \) has its usual meaning.

**1.11 Research Design:**
The study, "Socio-economic determinants of infant and child mortality in Assam: A case study of Jorhat and Dhubri districts" is divided into five chapters:

Chapter-I: Introduction: Theoretical Framework and Review of Literature
Chapter-II: Geographical Framework: People, Economy and Society of Assam
Chapter-III: Spatial and Temporal Trends of Infant and Child Mortality of Assam and Major States
Chapter-IV: A Comparative Study of Socio-Economic Determinants of Infant and Child Mortality in Jorhat and Dhubri Districts
Chapter-V: Finding and Conclusion
The first chapter-I "Introduction: Theoretical Framework and Review of Literature" is introductory in nature and throws light on theoretical framework and review of literature. This chapter deals with the researches on various aspects of infant and child mortality based on literature survey. This chapter also attempts to find out the important determinants of infant mortality as focused by different authors.

The chapter-II is "Geographical Framework: People, Economy and Society of Assam" which gives a detail idea about the geography, society, economy and demographic conditions of the Assam and specifically about Dhubri and Jorhat Districts.

This chapter-III is "Child Spatial and Temporal Trends of Infant and Child Mortality of Assam and Major States". This chapter deals with spatial and temporal trends of Infant and child mortality in Assam and major states of India. In this chapter attempts has been made to analyse the trends differentials and determinants major of neonatal, post neonatal, infant and child mortality in the last 30 years in Assam. Presently, neonatal mortality constitutes over 67 percent of all infant deaths. Reduction in infant and child mortality is a major goal of the strategy to achieve health for all. The proximate determinants to neonatal mortality, as revealed through different conceptual and empirical studies, are reviewed. The importance of demographic factors like birth interval and birth order, education of mother etc. to neonatal mortality are emphasized.

This study also shows that our population much more exceed than the Population serving capacity of our health centers i.e. Primary Health centre and Community Health centres. This is one of the main causes of not getting proper health facility, particularly by mother and child in those health centers and may be thus one of the main causes of infant mortality in India. The study calls for an urgent need to focus on neonatal mortality for any further reduction in infant mortality with special emphasis on factors that operate at the level of mothers.

The chapter-IV is "A Comparative Study of Socio-Economic Determinants of Infant and Child Mortality in Jorhat and Dhubri Districts" based on primary data collected from the field survey from the Dhubri and Jorhat districts.
In this chapter the role of place of residence, type of house, standard of living, level of education of the respondents, mass media exposure, survival status of the child, age of the respondents, age at death of the child, place of delivery, type of attendance during delivery, intake of iron and folic tablets during pregnancy, tetanus injection during pregnancy, immunisation of the child (BCG, DPT, Polio and Measles), antenatal care, postpartum care etc has been discussed in relation to child survival.

This study suggests scope for further research where the inclusion of the biological variables, like birth weight, may be better able to explain the relationship of socio-economic and demographic variables with infant and child mortality.

The Chapter-V is "Conclusion and findings". This chapter discusses details about the causes of failure and success of different government programmes and policies in reducing infant and child mortality in the district of Dhubri. This chapter has given some suggestion regarding how to improve the overall condition of infant and child in Assam.