Neonate and Infant Mortality Rate; A Review

A Thesis is submitted to the Department of Pharmacy, East West University, Bangladesh, in partial fulfillment of the requirements for the degree of Masters of Pharmacy.

Submitted By

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DEPERTMENT OF PHARMACY

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This thesis paper

is dedicated

to my beloved Parents…

DECLARATION BY THE CANDIDATE

I, Ismat Jahan, hereby declare that this dissertation, entitled **"Neonate and Infant Mortality Rate;a Review"**submitted to the Department of Pharmacy, East West University, in partial fulfillment of the requirement for the degree of Masters of Pharmacy, is a genuine and authentic research work carried out by me under the guidance of Ms. FarhanaRizwan, Supervisor, Assistant Professor, Department of Pharmacy, East West University, Dhaka. The contents of this dissertation, in full or in parts, have not been submitted to any other institute or University for the award of any Degree of Fellowship.

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This is to certify that the thesis Neonate and Infant Mortality Rate;a Review is submitted to the Department of Pharmacy, East West University, Aftabnagar, Dhakain partial fulfillment of the requirement for the degree of Masters of Pharmacy was carred out by Ismat Jahan **(**ID-2014-3-79-001).Under my guidance and supervision and that of the thesis has been submitted for any other degree.I further certify that all the thesis of information, laboratory facilities availed of this connection is dully acknowledged.

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Contents

List of Table

List of Figure

List of Abbreviation

WHO	World Health Organization
FIMRs	Fetal and Infant Mortality Reviews
SIDS	Sudden Infant Death Syndrome
OHIR	Office of Health Information and Research
RDS	Respiratory Distress Syndrome
OR	Odds Ratio
CI	Confidence Interval
NIHCE	National Institute for Health and Care Excellence
BDHS	Bangladesh Demographic and Health Survey
MDG4	Millennium Development Goal 4.
ICDDR,B	International Centre for Diarrhoeal Disease Research, Bangladesh
NDHS	Nigeria Demographic and Health Survey
HR	Hazard Ratio
DHSs	Demographic and Health Surveys
TTI	Tetanus Toxoid Injections
IGME	Inter-agency Group for Child Mortality Estimation
IMR	Infant Mortality Rate
NMR	Neonate Mortality Rate
U5MR	Under 5 Years Mortality Rate
VA	Verbal Autopsy
ARI	Acute Respiratory Infection

ABSTRACT

Childhood mortality, particularly in the first 5 years of life, is a major global concern and the target of Millennium Development Goal 4.Globally 7.6 million children died in 2010 before reaching their fifth birthday and 40% of these deaths occur in the neonatal period. Timely measurements of levels and trends in under-5 mortality are important to assess progress towards the Millennium Development Goal 4 (MDG 4) target of reduction of child mortality by two thirds from 1990 to 2013, and to identify models of success. To implement evidence-based interventions for the reduction of neonatal mortality, it is important to investigate factors associated with neonatal mortality. The aim of the current study was to identify determinants of neonatal mortality.To generated updated estimates of child mortality in early neonatal (age 0–6 days), late neonatal (7–28 days), postneonatal (29–364 days), childhood (1–4 years), and under-5 (0–4 years) age groups for some countries from 1970 to 2013. To quantify the contribution of these different factors and birth numbers to the change in numbers of deaths in under-5 age groups from 1990 to 2013.The study showed that the infantmortality rate (IMR), neonate mortality rate (NMR)& under five mortality rate (U5MR) for singleton live born infants between 1990-2013.Neonatal mortality has declined in all world regions. Progress has been slowest in the regions with high neonate mortality rates(NMRs). Global health programs need to address neonatal deaths moreeffectively if Millennium Development Goal 4 (two-thirds reduction in child mortality) is to be achieved.

CHAPTER # 1

INTRODECTION

1. Background

Deaths of newborns within 28 days of birth are a major barrier to improving the survival of children aged less than five years (under-five children) in developing countries. Neonatal deaths now account for more than two-thirds of all deaths in the first year of life and for about half of all deaths in under-five children(Darmstadt, Lawn & Costello,2003 and Lawn, Cousens &Zupan, 2005). Bangladesh has a neonatal mortality rate of 41 per 1,000 livebirths, and neonatal deaths account for about half of deaths of under-five children.Therefore, appropriate interventions are crucial for improving the health of under-five children in Bangladesh and to help achieve the global target of reducing under-five mortality by two-thirds. Information on the timing and causes of neonatal deaths can help direct appropriate interventions.

According to the World Health Organization (WHO) 2005, preterm birth accounts for 30% of global neonatal deaths, sepsis or pneumonia for 27%, birth asphyxia for 23%, congenital abnormality for 6%, neonatal tetanus for 4%, diarrhoea for 3%, and other causes for 7% of all neonatal deaths(Lawn, Cousens &Zupan,2005 and Bryce, Boschi-Pinto & Shibuya, 2005).

However, these estimates are based on limited datasets as most births and neonatal deaths occur in the home or outside formal health settings in developing countries(Bryce, Boschi-Pinto&Shibuya, 2005). In this regard, verbal autopsy (VA) can be an appropriate and cost-effective tool as it uses a retrospective interview of family members about the circumstances of a death to ascertain the cause of death. The tool has been used successfully in many developing countries for generating reliable epidemiological data on mortality(Fauveau,2006).

Fig-1:Pregnant Women.

1.1Neonate and infant mortality rate

Perinatal mortality comprises the combination of fetal deaths and neonatal deaths. In the United States in 2005, the fetal mortality rate for gestations of at least 20 weeks (6.2 fetal deaths per 1000 live births and fetal deaths) (MacDorman and Kirmeyer,2009)was similar to the infant mortality rate (6.9 infant deaths per 1000 live births) (Mathewesand MacDorman,2008). Depending on the definition used, fetal mortality contributes to approximately 40% to 60% of perinatal mortality. Understanding the etiologies of these events and predicting risk begins with accurately defining cases; the collection and analysis of reliable statistical data are an essential part of in-depth investigations on local, state, and national levels (MacDormanand Kirmeyer,2009;Mathewes and MacDorman,2008).

Fetal and infant deaths occur within the clinical practice of several types of health care providers. Although obstetric practitioners report fetal deaths, certain situations can occur during a delivery in which viability or possibility of survival is unclear; the pediatrician or neonatologist may attend the delivery to assess the medical condition of the fetus or infant, assess previable gestational age, provide care as indicated, and report a subsequent infant death, if it occurs. Incorrectly defining and reporting fetal deaths and early infant deaths may contribute to misclassification of these important events and result in inaccurate fetal and infant mortality rates (MacDorman, Martin, and Matthews,2005).

Within this context, the American Academy of Pediatrics provides definitions and reporting requirements of fetal death, live birth, and infant death in an effort to emphasize that neonatologists and pediatricians play an important role in recording accurate and timely information surrounding these events.This role includes making the determination of the specific vital event during delivery, recording information surrounding the event on the appropriate certificate or report in compliance with state-specific requirements, and ensuring completeness and accuracy of the information, including the underlying cause of death when known. Although guidance for these definitions is provided elsewhere,it may not be readily available to pediatricians in the delivery room(MacDorman, Martin, and Matthews, 2005).

Both the collection and use of information about fetal, infant, and perinatal deaths have been hampered by lack of understanding of differences in definitions, statistical tabulations, and reporting requirements among providers and state, national, and international bodies. Distinctions can and should be made between the definition of an event and the reporting requirements for the event. The definition indicates the meaning of a term (eg, live birth, fetal death). A reporting requirement is that part of the defined event for which reporting is mandatory(MacDorman, Martin, and Matthews, 2005).

1.2 Definitions

A fetus is defined from 8 weeks after conception until term while in the uterus. An infant is live born and younger than 365 days of age. Challenges in consistent definitions of fetal and infant death mostly stem from perception of viability, which should not change the definition of the event. In other words, an extremely preterm infant born at 16 weeks' gestation may be defined as a live birth but is not currently viable outside of the womb. On the basis of international standards set by the World Health Organization,2006 the National Center for Health Statistics of the Centers for Disease Control and Prevention defines live birth, fetal death, infant death, and perinatal death as follows(Mahy, 2003; Martin &Hoyert, 2002).

1.2.1 Live Birth

The complete expulsion or extraction from the mother of a product of human conception, irrespective of the duration of pregnancy, which, after such expulsion or extraction, breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles, regardless of whether the umbilical cord has been cut or the placenta is attached. Heartbeats are to be distinguished from transient cardiac contractions; respirations are to be distinguished from fleeting respiratory efforts or gasps(Mahy, 2003; Martin &Hoyert,2002).

1.2.2 Fetal Death

Death before the complete expulsion or extraction from the mother of a product of human conception, irrespective of the duration of pregnancy, that is not an induced termination of pregnancy. The death is indicated by the fact that, after such expulsion or extraction, the fetus does not breathe or show any other evidence of life such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles. Heartbeats are to be distinguished from transient cardiac contractions; respirations are to be distinguished from fleeting respiratory efforts or gasps. For statistical purposes, fetal deaths are further subdivided as "early" (20–27 weeks' gestation) or "late" (≥28 weeks' gestation). The term "stillbirth" is also used to describe fetal deaths at 20 weeks' gestation or more. Fetuses that die in utero before 20 weeks' gestation are categorized specifically as miscarriages(Martin &Hoyert,2002).

1.2.3 Infant Death

A live birth that results in death within the first year (<365 days) is defined as an infant death. Infant deaths are further subdivided as early neonatal (<7 days), late neonatal (7–27 days), neonatal (<28 days), or postneonatal (28–364 days)(Martin &Hoyert,2002).

1.2.4. Perinatal Death

Perinatal death is not a reportable vital event, per se, but is used for statistical purposes. Perinatal deaths refer to fetal deaths and live births with only brief survival (days or weeks) and are grouped on the assumption that similar factors are associated with these losses. Three definitions of perinatal deaths are in use: (Martin &Hoyert,2002)

- Perinatal death, definition I, includes infant deaths that occur at less than 7 days of age and fetal deaths with a stated or presumed period of gestation of 28 weeks or more.
- Perinatal death, definition II, includes infant deaths that occur at less than 28 days of age and fetal deaths with a stated or presumed period of gestation of 20 weeks or more.
- Perinatal death, definition III, includes infant deaths that occur at less than 7 days of age and fetal deaths with a stated or presumed gestation of 20 weeks or more(Martin &Hoyert,2002).

From national and international perspectives, perinatal deaths have important implications for both public health and clinical interventions. However, the interpretations of these definitions vary globally on the basis of cultural perspectives, clinical definitions of viability, and availability of information. The National Center for Health Statistics currently classifies perinatal deaths according to the first 2 definitions. Definition I is used by the National Center for Health Statistics and the World Health Organization to make international comparisons to account for variability in registering births and deaths between 20 and 27 weeks' gestation(Martin &Hoyert,2002). However, definition II is more inclusive and, hence, is more appropriate for monitoring perinatal deaths throughout gestation, because the majority of fetal deaths occur before 28 weeks' gestation(Martin &Hoyert,2002).

1.2.5Neonatal death

Babies die after birth because they are severely malformed, are born very prematurely, suffer from obstetric complications before or during birth, have difficulty adapting to extrauterine life, or because of harmful practices after birth that lead to infections (Mahy&Calverton, 2003).

Around 1% of infants have a major congenital anomaly. These anomalies are more common in developing than in developed countries, especially those caused by diseases such as syphilis, or by nutrient deficiency, which leads to neural tube defects and cretinism (Mahy, 2003).

Low birth weight has long been debated as one of the causes of neonatal deaths.It is associated with the death of many newborn infants, but is not considered a direct cause. Around 15% of newborn infants weigh less than 2500 g, the proportion ranging from 6% in developed countries to more than 30% in some parts of the world. The main “culprit” is preterm birth and the

complications stemming from it, rather than low birth weight per se. There is, however, no doubt that maternal health and nutrition at conception are important determinants of weight at birth, neonatal health and frequency and severity of complications, and that maternal infections such as malaria and syphilis contribute to adverse pregnancy outcomes and thus to mortality(Mahy,2003).

Complications during birth, such as obstructed labour and fetal malpresentation, are common causes of perinatal death in the absence of obstetric care. Birth asphyxia and trauma often occur together and it is, therefore, difficult to obtain separate estimates. In the most severe cases, the baby dies during birth or soon after, due to damage to the brain and other organs. Less severe asphyxia and trauma will cause disability. Modern obstetric practices have almost eliminated birth trauma. Conversely, where modern obstetric care is not available, intrapartum or early postnatal deaths are very frequent. It is estimated that in developing countries asphyxia causes around seven deaths per 1000 births, whereas in developed countries this proportion is less than one death per 1000 births.The majority of deaths occur soon after birth, some just before birth. Prolonged labour or prolonged rupture of membranes causes infections in mothers and babies. However, babies are more susceptible than mothers and infections in infants are more difficult to detect. It is estimated that 26% of newborn infants who die do so as a result of infections that occur around birth (Mahy, 2003).

Although during pregnancy the uterus protects the baby from environmental infections, some infections break through the safety barrier and affect the fetus. The most common are syphilis and HIV. In countries where maternal syphilis is prevalent, many babies are stillborn, die soon after birth or are infected themselves (Mahy, 2003).

Neonatal tetanus has been, and remains, a common cause of neonatal death in settings where lack of hygiene at birth and inadequate cord care are prevalent, as many women are not immunized against tetanus and cannot protect the baby at birth. The majority of deaths from neonatal tetanus occur between the seventh and tenth day of life. Through massive tetanus toxoid immunization efforts, neonatal tetanus has been almost eliminated from many countries. There are, however, over 50 countries where, in some districts, the proportion of cases of neonatal tetanus is 1 per 1000 births (Mahy, 2003).

After the first week of life, infections are the main cause of neonatal death in many countries. These are mostly acquired either in hospital as a complication of treatment for other perinatal conditions, or at home. Preterm infants are at greatest risk of becoming ill and dying. Harmful cord care practices cause neonatal tetanus if the mother is not protected by immunization; poor feeding practices cause diarrhoea and poor growth; an unhygienic environment causes sepsis. The relative contribution of each of these factors varies according to the health of the pregnant woman and the prevalence of endemic diseases such as syphilis or malaria,but mostly according to the availability of adequate care during pregnancy, childbirth and the neonatal period. Early neonatal deaths are mostly due to complications during pregnancy or childbirth, preterm birth and malformations; late neonatal deaths are due to neonatal tetanus and infections acquired either at home or in hospital, when complications in special neonatal care occur (Mahy, 2003).

1.2.6Stillbirth

Stillbirth is a professional and lay term that refers to a deadborn fetus .Intrauterine death occurs either before onset of labour (antepartum death) or during labour (intrapartum death). Fetuses may die intra utero, before onset of labour, because of pregnancy complications or maternal diseases; however, no special reason can be found for many antepartum intrauterine deaths. Complications arising during birth are the main cause of death among almost all infants who were alive when labour started, but were born dead. It is therefore important to know at what point before birth the baby died, so that appropriate interventions can be planned accordingly. It is relatively easy to determine, in the context of childbirth care, approximately when the death occurred. The proportion of babies that die intrapartum is, therefore, a very important indicator enabling health personnel to take the most appropriate measures to prevent such deaths. Where women receive good care during childbirth, intrapartum deaths represent less than 10% of stillbirths due to unexpected severe complications (Mahy, 2003).

While national and international attention, statistics and interventions focus on liveborn infants, stillborn infants have largely been overlooked. However, these deaths matter too – they matter to the mother and the family, to the society and to the health care system(Mahy, 2003)

1.2.7Stillbirth rate

The number of stillbirths per thousand total births (Martin &Hoyert,2002).

1.2.8Low birth weight

Weight at birth under 2500 g(Martin &Hoyert,2002).

1.2.9 Neonatal and Postneonatal

Over the last 50 years, the major improvements in Infant Mortality Rate (IMR) in the U.S. have resulted from successful reduction in postneonatal deaths that are not birth-weight-dependent and, more recently, from innovations that have dramatically improved birth-weight-specific survival. Neonatal intensive care units play a crucial role in providing the care and therapies necessary to sustain premature and otherwise fragile newborns. Other strategies include:

•Improve access to risk-appropriate care via regionalized perinatal systems to assure that neonates are born in or transported to facilities with the highest level of care needed to assure their survival (Martin &Hoyert,2002).

• Educate parents about placing infants to sleep on their backs to prevent SIDS and about theimportance of reducing secondhand exposure to smoke (Martin &Hoyert,2002).

•Conduct Fetal and Infant Mortality Reviews (FIMRs), which bring together clinicians, public health officials and policy makers to examine causes of infant death and learn about preventable strategies to reduce the risk of perinatal death (Martin &Hoyert,2002).

1.2.10 Infant and fetal mortality

Compared to other age groups, mortality (death) during fetal and infant periods occurs because of a relatively small number of causes. The leading causes change, however, depending upon the precise time period that is considered. In order to understand discussions of infant and fetal mortality, it is important to know how researchers define each time period (Malloy &Freeman,2000).

Infancy is the period beginning at birth and spanning up to 12 months of age. The neonatal period begins at birth and spans the first four weeks (28 days) of life. During the neonatal period, death is most common among children that were born preterm and/or having low birthweights and arises from complications of these conditions. The postneonatal period begins at four weeks of age and spans the rest of infancy. During the postneonatal period, death is most commonly due to Sudden Infant Death Syndrome (SIDS), a poorly understood situation in which other, more obvious causes of death have been excluded. The second most common cause of death for both the neonatal and postneonatal periods are conditions arising from congenital malformations or chromosomal abnormalities with which the child was born (Malloy & Freeman, 2000).

The perinatal period begins during pregnancy before the child is born; it begins once 28 weeks of pregnancy have been completed and spans until seven days following birth (note that by this definition, the perinatal and neonatal periods overlap). There are a few reasons why researchers find it useful to consider this as a distinct period for study. First, when a fetus or infant dies around the time of labor and delivery, it is not always clear whether to classify this event as a live birth (and therefore a neonatal death) or a fetal death. Diagnostic ability for detecting signs of life, such as respiratory effort or heartbeat, umbilical cord pulse, or voluntary movement after delivery may vary between obstetrical facilities (Malloy & Freeman, 2000).

Most often, perinatal death occurs among children that have not grown sufficiently during pregnancy, although frequently the cause is unexplained. It is important to note that death during this period is an important contributor to overall mortality, occurring much more often, for example, than SIDS does during the period of infancy (Malloy & Freeman, 2000).

1.3Infant Mortality

1.3.1Measure of infant mortality

Infancy is defined as the period beginning at birth and ending at age 12 months. Infant mortality, therefore, is any death occurring during the period of infancy. In California, staff at the Office of Health Information and Research (OHIR) screen mortality records for any death prior to the age

of 12 months. These death records are then matched to birth records on the basis of all identifying information in the record to ascertain that the infant was born in California and that no deaths are counted more than once (duplicate records). This matching allows OHIR to construct a cohort file with which researchers can consider mortality for infants grouped according to when they are born (Vahratia, Buekens& Alexander, 2006).

1.3.2Important of infant mortality

Since mothers and infants are among the most vulnerable members of society, infant mortality is a measure of a population's health. In addition, disparities in infant mortality by race/ethnicity and socioeconomic status are an important measure of the inequalities in a society(Vahratia, Buekens& Alexander, 2006).

1.3.3Exposure and Risk of infant mortality

The leading causes of infant death include:

- Congenital abnormalities
- Pre-term/low birth weight
- Sudden Infant Death Syndrome (SIDS)
- Problems related to complications of pregnancy
- Respiratory distress syndrome (Hoyert, & Xu, 2012).

Risk factors that may increase a woman's chance of fetal loss include:

- Pre-pregnancy obesity
- Lower socioeconomic status
- Non-Hispanic black race
- Older age
- Exposure to pesticides(Hoyert, & Xu, 2012).
-

1.3.4 Reduce infant mortality rate

Health care providers should tell their patients what they can do to have a healthy pregnancy such as:

- Quit smoking
- Stop illegal drug and alcohol abuse
- Eat well
- Reduce stress
- Get prenatal care
- Manage chronic illness and other medical problems

In practical terms, infant mortality can be addressed by focusing on critical periods in the health of women and their infants and adopting a series of interventions that target specific risks. Because the factors that underlie infant death are multiple and complex, there is no single "magic bullet" to reduce infant mortality. It is important to note that while most interventions focus on women, we must also recognize the critical role of male partners in supporting the health of women and their infants. Further,the focus on the biological and medical pathways should not be interpreted as relieving society of the need to address underlying social inequalities. Finally, reducing infant mortality requires a "life course"approach to the health of women (Hoyert, & Xu, 2012).

1.3.5Causes of Infant Mortality

The most common causes of death in children under-five are:

1. **Birth asphyxia**, failure to initiate and sustain breathing at birth, which accounts for about a quarter of all newborn deaths across the world. Effective resuscitation at birth can prevent a large proportion of these deaths(Hoyert&Xu, 2012).
2. **Pneumonia**, the prime cause of death in children under five. The major risk factors include malnutrition and indoor air pollution. Measures to prevent it include vaccination and breastfeeding, and children who suffer from pneumonia need access to antibiotics and oxygen(Hoyert& Xu, 2012).
3. **Pre-term birth complications** – pre-term birth is rising in most countries, and is now the second leading cause of death globally for children under five, after pneumonia. Low-birth-weight babies are more likely to survive if they are kept warm by skin-to-skin contact with the mother(Hoyert& Xu, 2012).
4. **Diarrhoeal diseases**, which are a major cause of sickness and death among children in developing countries. Breastfeeding helps prevent diarrhoea among young children and treatment with oral rehydration salts combined with zinc supplements is safe, cost-effective, and saves lives(Hoyert& Xu, 2012).
5. **Malaria**, which kills one child every minute. Insecticide-treated bed nets prevent transmission and increase child survival(Hoyert& Xu, 2012).
6. **Measles**, which is a leading cause of childhood mortality. Measles can be completely prevented with two doses of a safe, effective and inexpensive vaccine but in many developing countries, poverty, poor health systems and a lack of information can make itdifficult for families to secure preventative vaccinations for each of their children(Hoyert& Xu, 2012).
7. **Malnutrition**, which makes children more vulnerable to severe diseases, is an underlying factor in about one-third of all child deaths(Hoyert& Xu, 2012).

The causes of infant mortality in the United States have changed somewhat over the past several decades. In 1980, birth defects, SIDS, preterm birth/low birth weight, and pregnancy complications were among the top five causes of death, as they are now. At that time, respiratory distress syndrome (RDS), instead of accidents, was also on the top-five list (Lozano,Naghavi, Foreman, et al., 2012). However, with the development of treatments for RDS, deaths from this cause have declined significantly (Lozano, Naghavi, Foreman, et al., 2012).

Globally, the top five causes of infant death in 2010 (the most recent year for which data were available) were the following:

1. Neonatal encephalopathyor problems with brain function after birth. Neonatal encephalopathy usually results from birth trauma or a lack of oxygen to the baby during birth.
2. Infections, especially blood infections
3. Complications of preterm birth
4. Lower respiratory infections (such as flu and pneumonia)
5. Diarrheal diseases(Lozano,Naghavi, Foreman, et al., 2012).

This ranking is an average for all infant mortality from birth to age 1 year. It does not reflect the fact that the major causes of death in older infants are different from those in younger infants. For example, birth defects are a top cause of death worldwide in the days just after birth, but not among older infants. In contrast, malaria is a top cause of death around the world in infants older than 1 month of age, but not in younger infants(Lozano, Naghavi, Foreman, et al., 2012).

1.3.6Contributing Factors of Infant Mortality

Most often, there is no single factor that causes the death of an infant less than one year of age. The death of an infant is most often the result of a number of contributing factors with varying levels of influence on a birth outcome. The complex interactions between these factors, and the varying effects they have on the health of the mother and infant, present challenges in identifying successful approaches to reducing infant mortality (St. Paul, 2009).

The situation is even more complex for Populations of Color and American Indians, because the relationships among contributing factors that often hold true overall and for White infants, donot necessarily follow the same patterns for Populations of Color and American Indians, leading to sometimes contradictory findings and recommendations. Without a better understanding of the complexity of underlying causes of an infant death among these groups, eliminating these racial/ethnic disparities will remain an elusive goal (St. Paul, 2009).

This section organizes contributing factors into three distinct groups: individual (e.g.maternal behaviors), environmental/community (e.g. housing and income) and systems factors(e.g.health care infrastructure and policies), and provides data that illustrate factors that placein fantast a greater risk for infant mortality. While multiple factors are often present in the event of an infant death, this section describes the fundamental relationship between a risk factor and an infant death in order to understand how even one risk factor can contribute to infant death. In addition to presenting this information for the overall population, this section also compares contributing factors for Populations of Color and American Indians and Whites where there are differences in the findings(St. Paul, 2009).

Individual factors: Are the characteristics or behaviors that have an impact on the health of the mother or the infant. Individual factors that impact birth outcomes include maternal characteristics such as age, maternal behaviors including tobacco use, and infant characteristics such as birth weight(St. Paul, 2009).

Environmental and community factors:Include factors relating to the physical environment(e.g. living and working conditions), the social environment (e.g.cultural and social cohesion), and the economic environment (e.g.income, insurance and affordable health care)(St. Paul, 2009)

Systems factors: Related to infant mortality include the health care delivery system, and the state and local public health system *(*St. Paul, 2009).

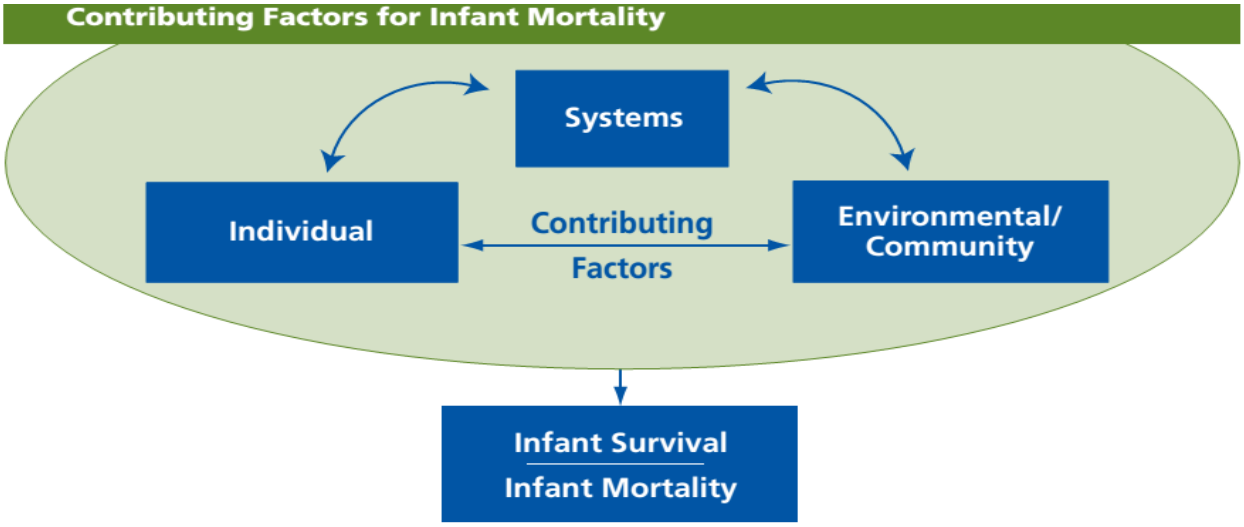

Fig.2: Contributing Factors for Infant Mortality

1.4Fetal Mortality

1.4.1 Cause of fetal Mortality

There are a number of known causes of fetal death. Sometimes more than one of these causes may contribute to the baby's death. Common causes include:

Birth defects: About 15 to 20 percent of fetal deaths have one or more birth defects. At least, 20 percent of these have chromosomal disorders, such as Down syndrome. Others have other birth defects resulting from genetic, environmental or unknown causes (Willinger, Ko, & Reddy,2009).

Placental problems: Placental problems cause about 25 percent of fetal deaths. One of the most common placental problems is placental abruption. In this condition, the placenta peels away, partly to almost completely, from the uterine wall before delivery. It results in heavy bleeding that can threaten the life of mother and baby. Sometimes it can cause the fetus to die from lack of oxygen. Women who smoke cigarettes or use cocaine during pregnancy are at increased risk of placental abruption(Willinger,Ko, & Reddy,2009).

Poor fetal growth: Fetuses who are growing too slowly are at increased risk of death. About 40 percent of fetal deaths have poor growth. Women who smoke cigarettes or have high blood pressure are at increased risk of having a baby that grows too slowly. An ultrasound examination during pregnancy can show that the fetus is growing poorly, allowing health care providers to carefully monitor the pregnancy.(Willinger,Ko, & Reddy,2009).

Infections: Infections involving the mother, fetus or placenta appear to cause about 10 to 25 percent of fetal deaths. Infections are an important cause of fetal deaths before 28 weeks of pregnancy. Some infections may cause no symptoms in the pregnant woman. These include genital and urinary tract infections and certain viruses, such as fifth disease (parvovirus infection). These infections may go undiagnosed until they cause serious complications, such as fetal death or preterm birth (before 37 completed weeks of pregnancy).(Willinger,Ko, & Reddy,2009)

Chronic health conditions in the pregnant woman: About 10 percent of fetal deaths are related to chronic health conditions in the mother, such as high blood pressure, diabetes, kidney disease and thrombophilias (blood clotting disorders). These conditions may contribute to poor fetal growth or placental abruption(Willinger, Ko, & Reddy,2009).

Umbilical cord accidents: Accidents involving the umbilical cord may contribute to about 2 to 4 percent of fetal deaths. These include a knot in the cord or abnormal placement of the cord into the placenta. These can deprive the fetus of oxygen(Willinger, Ko, & Reddy,2009).

Other causes of fetal death: Trauma (such as car accidents), postdate pregnancy (a pregnancy that lasts longer than 42 weeks), Rh disease (an incompatibility between the blood of mother and baby), and lack of oxygen (asphyxia) during a difficult delivery. These causes are uncommon(Willinger,Ko, & Reddy,2009).

1.4.2Risk Factors for Fetal Death

- Maternal ageover35
- Maternalobesity
- Maternal Diabetes

- Maternal Drug/Alcohol/Tobacco Use during pregnancy
- Multiple gestation (twins or more)
- African-American ancestry(Willinger, Ko, & Reddy,2009).

1.4.3 The reasons are similar to why some women have a higher risk for fetal death

Race and ethnicity: A Black baby is 1 ½ times more likely to be premature than a white baby, both in the U.S. and in Maryland. The premature birth rate in Maryland is highest for Black infants (17.1%), followed by Hispanic infants (12.5%), and then white infants (11.3%). The national premature birth rates for both Black (18.1%) and white (11.5%) infants are higher than those in Maryland (Willinger,Ko, & Reddy,2009).

Mother's age: The chance of having a premature baby is greatest for the youngest and the oldest mothers.Premature birth rate is highest for women 40 and older, followed by teens under age 20 (Willinger, Ko, & Reddy,2009).

Multiple births: When a woman is carrying two or more babies, the chance of delivering prematurely is increased. About 10% of single babies are born prematurely, compared to 60% of twins and over 90% of triplets. The number of multiple births has increased dramatically in the past 2 decades with the increased use of medical treatments for infertility (Willinger, Ko, & Reddy,2009).

1.4.4 Treatable or avoidable risks of premature births and fetal death**Infections**: including urinary tract infections, vaginal and sexually transmitted infections, infections of the membranes around the baby, and even tooth or gum disease (Willinger, Ko, & Reddy,2009).

Other medical problems: such as high blood pressure, diabetes, or clotting problems; also being underweight or obese (Willinger, Ko, & Reddy,2009).

Stress: such as social, financial or health problems; domestic violence, including physical, sexual or emotional abuse (Willinger, Ko, & Reddy,2009).

1.5 Risk of Infant and Fetal Mortality

Different population groups in the United States and California experience different burdens of infant and fetal mortality. Disparities in any health outcome sometimes provide clues regarding the causes of disease; perhaps more importantly, they enable us to understand patterns of health outcomes as social justice issues(Blabey, Gessner,2008; Hessol, Fuentes-Afflick,2005; Malloy,2004).

Death in the neonatal period is mostly associated with conditions surrounding birth, such as prematurity and growth retardation.Discusselsewhere, substantial disparities exist in California regarding how risk for prematurity and growth retardation vary by race/ethnicity and class, and these disparities are also seen for neonatal mortality. Distressingly, disparities in postneonatal mortality are also evident, even when conditions such as prematurity and growth retardation are held constant(Blabey, Gessner, 2008; Hessol, Fuentes-Afflick, 2005; Malloy, 2004).

Several striking associations of air pollution levels with infant mortality calculated in this way have been noted, however. Peaks in measured levels of carbon monoxide, sulfur dioxide, nitrogen dioxide, and particulates have been associated with increases in neonatal mortality, postneonatal mortality, and SIDS on the days immediately following. (Dales, Burnett, &Smith-Doiron, et al.,2004; Hajat, Armstrong,Wilkinsonet al.,2007;Knobel, Chen, Liang, 1955). Other studies consider longer time periods of exposure, such as the first two months of life or the entire lifespan of the infant, suggest similar associations of mortality with exposure.(Kaiser, Romieu, Medina, et al., 2004; Klonoff-Cohen, Lam, Lewis,2005 & Woodruff, Parker, Schoendor ,2006).

1.6 Neonatal Mortality

1.6.1Measure of neonatal mortality

The neonatal period is defined as the period beginning at birth and ending at 28 days of age. Neonatal mortality, therefore, is any death occurring during the neonatal period. In California, staff at the Office of Health Information and Research (OHIR) screen mortality records for any death that occurs during infancy. These death records are then matched to birth records on the basis of all identifying information in the record to ascertain that the infant was born in

California and that no deaths are counted more than once (duplicate records). This matching allows OHIR to construct a cohort file with which researchers can consider mortality for neonates grouped according to when they are born (Vahratian, Buekens, Alexander, 2006).

1.6.2Causes of neonatal mortality

The proportional distribution of the major causes of neonatal deaths in our study differed somewhat from the WHO-derived global estimates, with important public-health implications. Birth asphyxia accounted for a far larger proportion (45%) of neonatal deaths in Matlab compared to the global average of 23-29%. The recent survey in Bangladesh referred earlier also showed a higher proportion (39%) of deaths due to this cause (Mercer, Haseen et al., 2006).Another nationwide perinatal survey in South Africa, conducted during 1999-2003, also reported that asphyxia-hypoxia was responsible for about one-third of neonatal deaths (Velaphi&Pattinson, 2007).

This higher rate of deaths due to birth asphyxia in this study in Bangladesh and in similar developing countries reflects the lack of appropriate resuscitation care for newborns at birth where the great majority of deliveries are conducted in the home with no skilled birth attendance. Also, the high proportion of births that are low weight/premature in Matlab would have contributed to a higher incidence of birth asphyxia as shown in an earlier study in the country (Yasmin, Osrinet al., 2001).

Yet another factor in the case of neonatal fatalities occurring at health facilities is in relation to the inappropriate use of intravenous medications for augmenting the progress of labour. A recent study in India found that unnecessary administration of oxytocics to augment labour was associated with a three-fold increase [odds ratio (OR)=2.6; 95% confidence interval (CI) 1.9-3.6] in birth asphyxia-related deaths(Bang,Baituleet al., 2005). An earlier study in Bangladesh also indicated that the trial of labour was associated with an increased risk of neonatal death in health facilities in a rural subdistrict of Bangladesh(Bari, Chowdhury,et al., 2007). Results of a recent study in South Africa indicate that inadequate foetal monitoring by health workers is an important avoidable factor associated with birth asphyxia-related deaths(Velaphi, Pattinson, 2007).

1.6.3 Age at neonatal mortality

Of the 365 neonatal deaths, 136 (37.3%) occurred on the day of birth, 279 (76.4%) within the first three days, and 307 (84.1%) within the first week of life .Twenty-six (7.1%) of the deaths occurred during the second week, and the remaining 32 (8.8%) occurred in the third and the fourth week of life. Thus, more than four-fifths of the neonatal deaths occurred in the first week, with a large proportion on the day of birth (Velaphi, Pattinson, 2007).

1.6.4 Calculated of neonatal mortality rate

Most commonly, neonatal mortality rates are expressed as numbers of deaths per 1,000 live births. This is the number of neonatal deaths in a population, divided by the number of live births, multiplied by 1000(Vahratian, Bueken, Alexander, 2006).

In the data on this website, they refer to neonatal mortality rates calculated in this way as "conventional rates." Due to the statistical properties of these numbers, rates based on small populations are subject to uncertainty. The degree of uncertainty for any given rate is represented by its confidence intervals. Researchers utilizing these data may wish to know that they used a common modification of Wilson's approach for the calculation of these intervals.(Vahratian, Bueken, Alexander, 2006).

1.6.5 Limitations of neonate mortality

It should be noted that for many pregnancies the last menstrual period date is not known or not accurately recorded (Vahratian, Bueken , Alexander, 2006), and that such inaccuracies can have substantial impacts on calculated rates and disparities between rates (Wingate, Alexander, et al., 2007). Information such as maternal race and ethnicity or place of residence are generally provided by hospitals and other providers of obstetric services throughout the state. As such, the methods of collecting this information and the categories chosen may vary. Even when geographic residential information is accurate, it may not serve as a reflection of where the mother spends the majority of her time during or after her pregnancy or be useful when inferring exposures to environmental hazards (Wingate, Alexander, et al., 2007).

1.7Stillbirth Death

1.7.1 Causes of stillbirth

- Congenital abnormality
- Haemorrhage, during pregnancy or labour
- Placental insufficiency
- Placental abruption
- Pre-eclampsia
- Obstetric complications
    - Spontaneous premature labour
    - Premature rupture of membranes
    - Polyhydramnios
    - Oligohydramnios
    - Intrapartum asphyxia
    - Birth trauma
- Cord prolapse
- Intra-uterine growth restriction
- Liver disease - obstetric cholestasis, intrahepatic cholestasis of pregnancy
- Diabetes
- Infections during pregnancy. (Glinianaia, Rankin, Sturgiss,et al., 2013)

1.8Risk factors for Stillbirth and Neonatal Death

- **Fetal growth restriction:**
    - The biggest risk factor for stillbirth.
    - A 2012 study of stillbirths in England showed the risk to be significantly higher where the growth restriction was not detected antenatally, suggesting this as an important avenue for reducing stillbirth rates in the future (Gardosi , Madurasinghe , Williams, et al.,2013).It concluded strategy should focus on improving antenatal detection of growth restriction, and subsequent management of pregnancy and delivery.

- **Preterm birth:**
    - This is the biggest risk factor for neonatal death.(Lawn, Kinney, Belizan, et al., 2013)
    - Obstetric and neonatal care can have a major impact on death rates of preterm babies. (For example, antenatal steroids for women in preterm labour, and advanced neonatal intensive care which may not be available in some parts of the world.)
- **Age of mother:**
    - The rate of neonatal death is higher in babies born to women under the age of 25, and women over the age of 40. In the UK, women aged 40 or over are 1.3 times more likely to have a neonatal death compared to women aged 25-29.
    - Stillbirth rates increase with advancing maternal age. The rate increases from 4.6 in the 25- to 29-year age group to 7.6 for mothers aged 40 or over.

Systematic reviews have confirmed advancing maternal age as a risk factor (Flenady, Koopmans, Middleton, et al. 2011). However, the most recent UK-based study of risk factors did not bear this out (Gardosi , Madurasinghe , Williams, et al. , 2013).This may have been because babies with congenital abnormalities, known to occur more often in pregnancies of older women, were excluded from the study (Gardosi , Madurasinghe , Williams, et al. , 2013).Cochrane reviews have demonstrated that induction of labour in women going past term reduces the risk of perinatal death (Gulmezoglu, Crowther , Middleton, et al.,2012).National Institute for Health and Care Excellence (NICE) guidelines therefore recommend that women going past their term dates be induced at 41 weeks. There is discussion ongoing about whether older women should be offered induction earlier, at 39-40 weeks of gestation, in order to reduce the risk of perinatal deaths(Gulmezoglu , Crowther, Middleton, et al., 2012).

- **Maternal health:**
    - Obesity: a mother's BMI ≥30 increases risk of stillbirth and neonatal death, and possibly as much as doubles it(Gardosi, Madurasinghe , Williams, et al., 2013).
    - Smoking: smoking causes increased risk of stillbirth where it leads to growth restriction but not as an independent factor (Gardosi, Madurasinghe ,Williams, et

al.,2013).It increases the risk of neonatal death in a number of ways, including adding to the risk of preterm birth.

- Chronic diseases –e.g, diabetes, renal failure, hypertension, haemoglobinopathy, rhesus disease, thrombophilias, antiphospholipid syndrome. Pre-existing diabetes increases risk of stillbirth significantly, whereas gestational diabetes does not appear to increase risk(Gardosi ,Madurasinghe , Williams, et al., 2013).
- Infection –e.g, erythema infectiosum, varicella, measles.
- Substance abuse, especially cocaine.
- A history of mental health problems increases risk(Skeie,Froen , Vege, et al.,2003).

- **Obstetric complications:**
  - Pre-eclampsia and antenatal haemorrhage increase the risk of stillbirth.
  - Intrapartum complications, such as malpresentation or obstructed labour, confer high risk of perinatal mortality (Skeie, Froen, Vege , et al.,2003).
- **Multiplicity of pregnancy:**
  - The risk of perinatal death is 2-5 times higher for multiple pregnancies compared to singleton pregnancies(Skeie , Froen, Vege , et al., 2003).
  - Stillbirth and neonatal death rates are significantly higher in monochorionic twins than in dichorionic twins (44.2 vs 12.2 per 1,000 births in the North England study of twin and multiple pregnancy) (Gardosi ,Madurasinghe , Williams, et al., 2013).
- **Parity:**
  - Nulliparous women have a higher risk of stillbirth than multiparous women across all ages.
  - Third and subsequent pregnancies have a higher risk than second pregnancies(Gardosi , Madurasinghe , Williams, et al., 2013).
- **Congenital abnormality:**
  - Increases risk of stillbirth and neonatal death.

- In the main not a potentially avoidable risk factor so it is often left out of analyses.(Gardosi, Madurasinghe , Williams, et al., 2013).

- **Low birth weight:**
  - Strongly linked with neonatal death and infant mortality.
  - Inter-related with other factors, such as prematurity, multiple pregnancy, smoking.(Gardosi, Madurasinghe , Williams, et al., 2013).
- **Social factors:**
  - Lack of employment and high deprivation index increase risk of stillbirth.
  - Later antenatal booking appointments past 13 weeks was associated with increased risk of stillbirth(Gardosi ,Madurasinghe , Williams, et al., 2013).
- **Ethnicity:**
  - African and African-Caribbean women have significantly higher risk of stillbirth.
  - Risk is also increased in Indian mothers and first-generation migrants from Pakistan(Gardosi, Madurasinghe ,Williams, et al., 2013).
- **Sex:**
  - Trends show that stillbirth rates are slightly higher among males compared to females(Gardosi,Madurasinghe ,Williams, et al., 2013).

1.9. Uncertainties regarding causes of death

Researchers frequently classify infant and fetal mortality by age at death rather than cause; one of the reasons for this is that causes of death may be difficult to determine or classify. Adverse conditions at birth, such as prematurity or growth retardation, heavily influence the risk of death during infancy, although these may be technically separate from the acute cause of death(Malloy, Freeman,2000).

The classic example of diagnostic uncertainty is SIDS, which is by definition mortality lacking medical explanation. Risk of SIDS appears to peak between the ages of four and 16 weeks and decline thereafter. Rates of documented SIDS cases have been declining in the USA since the "Back to Sleep" campaign in 1991, which was based on the observation that infants sleeping on their backs had a lower risk of SIDS (Malloy, Freeman,2000).

While the “Back to Sleep” campaign appears to have reduced SIDS incidence substantially, some have observed that much of the decline could also be explained by changes in diagnostic practices surrounding SIDS in which a portion of infant deaths may be assigned other categories (Leach, Blair and Fleming,1999; Malloy, 2004; Malloy, MacDorman,2005).Some researchers have compared SIDS to unexpected deaths for which an explanation is found, such as acute infection; they have noted that many of the risk factors for SIDS, such as prematurity or household poverty, are the same for unexpected deaths for which causes are found(Leach,Blair et al., 1999; Malloy, 2004; Malloy, MacDorman,2005).

1.10 Infant Mortality Rate

One of the most terrifying experiences in a new parent's life is to put your sleeping infant to bed and return a few hours later to find him not breathing. Sadly, this happens to many new parents in the United States and across the world due to a combination of circumstances. The definition ofinfant mortality rate is simply the number of infant deaths in a single year out of every 1,000 live births that year. (Fu-Wen Liang, et.al.2015).

In the United States, there are approximately 25,000 infants that die every year before celebrating their first birthday. Experts use the number of infant deaths as a measure of a nation's health and as a basis to determine how effective various factors such as vitamin intake and prenatal care affect an infant for many months after he or she is born. (Fu-Wen Liang, et.al.2015).

Also, babies born too early are often underweight, and this leads to an infant struggling during the most critical moments of his or her life. There may also be complications during the

pregnancy or delivery that causes an injury to the baby that cannot be repaired. (Fu-Wen Liang, et.al.2015).

Last of all, infants can succumb to SIDS, or Sudden Infant Death Syndrome. This is a condition where the infant ceases to breathe for completely unknown reasons, and death will occur if a parent is unable to realize the problem as soon as breathing stops. (Fu-Wen Liang, et.al.2015).

Birth asphyxia , prematurity/low birthweight, sepsis/meningitis,respiratory distress syndrome (RDS), and pneumonia were the top five causes of death .These five causes accounted for 85% of the cases. The other causes included hypothermia, birth injury, sudden infant death, and congenital anomalies. Around 7% of the cases were classified as undetermined as there was no agreement between any of the physicians on the cause assigned. In 1.9% of the cases, the physicians were unable to assign any cause(Fu-Wen Liang,et.al.2015).

1.11Country Comparison: Infant Mortality Rate

Infant mortality rate compares the number of deaths of infants under one year old in a given year per 1,000 live births in the same year. This rate is often used as an indicator of the level of health in a country (Fu-Wen Liang, et.al.2015).

Rank	COUNTRY	(DEATHS/1,000 LIVE BIRTHS)	Date of Information
1	Afghanistan	115.08	2015 est.
2	Mali	102.23	2015 est.
3	Somalia	98.39	2015 est.
4	Central African Republic	90.63	2015 est.
5	Guinea-Bissau	89.21	2015 est.
6	Chad	88.69	2015 est.
7	Niger	84.59	2015 est.
8	Angola	78.26	2015 est.

9	Burkina Faso	75.32	2015 est.
10	Nigeria	72.70	2015 est.
11	Sierra Leone	71.68	2015 est.
12	Congo, Democratic Republic	71.47	2015 est.
13	Mozambique	70.21	2015 est.
14	Equatorial Guinea	69.17	2015 est.
15	Liberia	67.50	2015 est.
16	South Sudan	66.39	2015 est.
17	Zambia	64.72	2015 est.
18	Gambia	63.90	2015 est.
19	Comoros	63.55	2015 est.
20	Burundi	61.89	2015 est.
21	Uganda	59.21	2015 est.
22	Cote d'Ivoire	58.70	2015 est.
23	Rwanda	58.19	2015 est.
24	Congo	57.92	2015 est.
25	Benin	55.68	2015 est.
26	Pakistan	55.67	2015 est.
27	Western Sahara	54.70	2015 est.
28	Mauritania	54.68	2015 est.
29	Cameroon	53.63	2015 est.
30	Guinea	53.43	2015 est.
31	Ethiopia	53.37	2015 est.

32	Laos	52.97	2015 est.
33	Swaziland	52.57	2015 est.
34	Senegal	51.54	2015 est.
35	Sudan	51.52	2015 est.
36	Cambodia	50.04	2015 est.
37	Lesotho	49.03	2015 est.
38	Yemen	48.93	2015 est.
39	Djibouti	48.70	2015 est.
40	Haiti	47.98	2015 est.
41	Sao Tome and Principe	47.88	2015 est.
42	Malawi	46.26	2015 est.
43	Gabon	46.07	2015 est.
44	Namibia	45.62	2015 est.
45	Togo	45.22	2015 est.
46	Bangladesh	44.09	2015 est.
47	Madagascar	43.67	2015 est.
48	Burma	43.55	2015 est.
49	Tanzania	42.43	2015 est.
50	India	41.81	2015 est.
51	Kenya	39.38	2015 est.
52	Nepal	39.14	2015 est.
53	Papua New Guinea	38.55	2015 est.
54	Iran	38.04	2015 est.
55	Timor-Leste	37.54	2015 est.

56	Eritrea	37.53	2015 est.
57	Iraq	37.49	2015 est.
58	Bolivia	37.49	2015 est.
59	Ghana	37.37	2015 est.
60	Turkmenistan	36.82	2015 est.
61	Bhutan	35.91	2015 est.
62	Kiribati	34.26	2015 est.
63	Tajikistan	33.93	2015 est.
64	South Africa	32.99	2015 est.
65	Guyana	32.56	2015 est.
66	Tuvalu	30.80	2015 est.
67	Kyrgyzstan	27.73	2015 est.
68	Suriname	26.17	2015 est.
69	Zimbabwe	26.11	2015 est.
70	Azerbaijan	25.68	2015 est.
71	Indonesia	24.29	2015 est.
72	Trinidad and Tobago	23.90	2015 est.
73	Maldives	23.70	2015 est.
74	Korea, North	23.68	2015 est.
75	Morocco	23.60	2015 est.
76	Cabo Verde	23.45	2015 est.
77	Guatemala	22.73	2015 est.
78	Mongolia	22.44	2015 est.
79	Tunisia	22.35	2015 est.

80	Philippines	22.34	2015 est.
81	Egypt	21.55	2015 est.
82	Micronesia, Federated States	21.18	2015 est.
83	Algeria	20.98	2015 est.
84	Kazakhstan	20.92	2015 est.
85	Marshall Islands	20.66	2015 est.
86	Paraguay	20.05	2015 est.
87	Belize	19.82	2015 est.
88	Nicaragua	19.65	2015 est.
89	Peru	19.59	2015 est.
90	Samoa	19.57	2015 est.
91	Uzbekistan	19.20	2015 est.
92	Venezuela	18.91	2015 est.
93	Turkey	18.87	2015 est.
94	Dominican Republic	18.84	2015 est.
95	Brazil	18.60	2015 est.
96	Vietnam	18.39	2015 est.
97	Honduras	18.18	2015 est.
98	El Salvador	17.86	2015 est.
99	Ecuador	17.38	2015 est.
100	Georgia	16.15	2015 est.
101	Vanuatu	15.70	2015 est.
102	Solomon Islands	15.65	2015 est.
103	Syria	15.61	2015 est.

104	Jordan	15.18	2015 est.
105	Gaza Strip	14.94	2015 est.
106	Colombia	14.58	2015 est.
107	Saint Helena, Ascension, and Tristan da Cunha	14.19	2015 est.
108	Saudi Arabia	14.09	2015 est.
109	Cook Islands	13.87	2015 est.
110	Oman	13.55	2015 est.
111	Armenia	13.51	2015 est.
112	Jamaica	13.37	2015 est.
113	Malaysia	13.27	2015 est.
114	Montserrat	13.17	2015 est.
115	West Bank	13.08	2015 est.
116	British Virgin Islands	12.98	2015 est.
117	Antigua and Barbuda	12.87	2015 est.
118	Albania	12.75	2015 est.
119	Saint Vincent and the Grenadines	12.69	2015 est.
120	Moldova	12.59	2015 est.
121	China	12.44	2015 est.
122	Mexico	12.23	2015 est.
123	Tonga	11.96	2015 est.
124	Bahamas	11.92	2015 est.
125	Libya	11.48	2015 est.
126	Saint Lucia	11.45	2015 est.

127	Aruba	11.37	2015 est.
128	Dominica	11.25	2015 est.
129	Palau	11.15	2015 est.
130	Turks and Caicos Islands	10.65	2015 est.
131	United Arab Emirates	10.59	2015 est.
132	Seychelles	10.49	2015 est.
133	Barbados	10.42	2015 est.
134	Panama	10.41	2015 est.
135	Mauritius	10.30	2015 est.
136	Grenada	10.21	2015 est.
137	Brunei	10.16	2015 est.
138	Fiji	9.94	2015 est.
139	Romania	9.89	2015 est.
140	Argentina	9.69	2015 est.
141	Thailand	9.63	2015 est.
142	Bahrain	9.35	2015 est.
143	Greenland	9.23	2015 est.
144	Sint Maarten	9.05	2013 est.
145	Botswana	8.93	2015 est.
146	Sri Lanka	8.80	2015 est.
147	Saint Kitts and Nevis	8.77	2015 est.
148	Uruguay	8.74	2015 est.
149	American Samoa	8.69	2015 est.
150	Bulgaria	8.66	2015 est.

151	Costa Rica	8.46	2015 est.
152	Cyprus	8.36	2015 est.
153	Ukraine	8.12	2015 est.
154	Nauru	8.07	2015 est.
155	Lebanon	7.76	2015 est.
156	Macedonia	7.70	2015 est.
157	Puerto Rico	7.57	2015 est.
158	Kuwait	7.31	2015 est.
159	Russia	6.97	2015 est.
160	Chile	6.86	2015 est.
161	Saint Pierre and Miquelon	6.78	2015 est.
162	Virgin Islands	6.64	2015 est.
163	Qatar	6.32	2015 est.
164	Gibraltar	6.16	2015 est.
165	Cayman Islands	6.08	2015 est.
166	Serbia	6.05	2015 est.
167	United States	5.87	2015 est.
168	Croatia	5.77	2015 est.
169	Bosnia and Herzegovina	5.72	2015 est.
170	Faroe Islands	5.60	2015 est.
171	Guam	5.41	2015 est.
172	Northern Mariana Islands	5.40	2015 est.
173	New Caledonia	5.37	2015 est.
174	Latvia	5.36	2015 est.

175	Slovakia	5.27	2015 est.
176	Hungary	5.02	2015 est.
177	French Polynesia	4.73	2015 est.
178	Greece	4.70	2015 est.
179	Canada	4.65	2015 est.
180	Cuba	4.63	2015 est.
181	New Zealand	4.52	2015 est.
182	Poland	4.50	2015 est.
183	San Marino	4.45	2015 est.
184	Taiwan	4.44	2015 est.
185	Portugal	4.43	2015 est.
186	Wallis and Futuna	4.43	2015 est.
187	United Kingdom	4.38	2015 est.
188	Australia	4.37	2015 est.
189	Liechtenstein	4.29	2015 est.
190	Isle of Man	4.11	2015 est.
191	Denmark	4.05	2015 est.
192	Slovenia	4.00	2015 est.
193	European Union	4.00	2015 est.
194	Korea, South	3.86	2015 est.
195	Estonia	3.85	2015 est.
196	Lithuania	3.84	2015 est.
197	Jersey	3.82	2015 est.
198	Ireland	3.70	2015 est.

199	Switzerland	3.67	2015 est.
200	Andorra	3.65	2015 est.
201	Netherlands	3.62	2015 est.
202	Belarus	3.62	2015 est.
203	Malta	3.56	2015 est.
204	Israel	3.55	2015 est.
205	Luxembourg	3.46	2015 est.
206	Austria	3.45	2015 est.
207	Guernsey	3.44	2015 est.
208	Germany	3.43	2015 est.
209	Belgium	3.41	2015 est.
210	Anguilla	3.37	2015 est.
211	Spain	3.30	2015 est.
212	Italy	3.29	2015 est.
213	France	3.28	2015 est.
214	Macau	3.12	2015 est.
215	Hong Kong	2.73	2015 est.
216	Czech Republic	2.63	2015 est.
217	Sweden	2.60	2015 est.
218	Finland	2.52	2015 est.
219	Bermuda	2.48	2015 est.
220	Norway	2.48	2015 est.
221	Singapore	2.48	2015 est.
222	Japan	2.08	2015 est.

223	Iceland	2.06	2015 est.
224	Monaco	1.82	

CHAPTER # 2

LITERATURE REVIEW

2.Literature Review

2.1 Infant mortality and causes of infant deaths in rural Ethiopia: a population-based cohort of 3684 births.

BMC Public Health,2015- Vol. 15, Pp.770.

BerheWeldearegawi et al. (2015) in their study thatethiopia has made large-scale healthcare investments to improve child health and survival. However, there is insufficient population level data on the current estimates of infant mortality rate (IMR) in the country. The aim of this study was to measure infant mortality rate, investigate risk factors for infant deaths and identify causes of death in a rural population of northern Ethiopia. Live births to a cohort of mothers under the KiliteAwlaelo Health and Demographic Surveillance System were followed up to their first birthday or death, between September 11, 2009 and September 10, 2013. Maternal and infant characteristics were collected at baseline and during the regular follow-up visit. Multiple-Cox regression was used to investigate risk factors for infant death. Causes of infant death were identified using physician review verbal autopsy method. Of the total 3684 infants followed, 174 of them died before their first birthday, yielding an infant mortality rate (IMR) of 47 per 1000 live births (95 % CI: 41, 54) over the four years of follow-up. About 96 % of infants survived up to their first birthday, and 56 % of infant deaths occurred during the neonatal period. Infants born to mothers aged 15–19 years old had higher risk of death (HR = 2.68, 95 % CI: 1. 74, 4.87) than those born to 25–29 years old. Infants of mothers who attained a secondary school and above had 56 % lower risk of death (HR = 0.44, 95 % CI: 0.24, 0.81) compared to those whose mothers did not attend formal education. Sepsis, prematurity and asphyxia and acute lower respiratory tract infections were the commonest causes of death. The infant mortality rate (IMR) for the four-year period was lower than the national and regional estimates. Our findings suggest the need to

improve the newborn care, and empower teenagers to delay teenage pregnancy and attain higher levels of education.

2.2 Achieving the Millennium Development Goalfor Under-five Mortality in Bangladesh: CurrentStatus and Lessons for Issues and Challengesfor Further Improvements.

J HEALTH POPUL NUTR,2011- Vol.2, Pp.92-102, ISSN1606-0997.

Amir Mohammad Sayem et al. (2011) in their study assessed the achievements in, critically reviewed the relevant issues of, and put forward recommendations for achieving the target of the Millennium Development Goal relating to mortality of children aged less than five years (under-five mortality) in Bangladesh within 2015. To materialize the study objectives, a thorough literature review was done. Mortality of under-five children and infants decreased respectively to 65 from 151 and to 52 from 94 per 1,000 livebirths during 1990-2006. The immunization coverage increased from 54% to 81.9% during the same period. The projection shows that Bangladesh will achieve targeted reduction in under-five mortality and infant mortality within the time limit, except immunization coverage. Neonatal mortality contributed to the majority of childhood deaths. Contribution of neonatal mortality to child mortality was the highest. There were remarkable differences in child mortality by sex, division, and residence. To progress further for achieving the target of MDG(Millennium Development Goal) relating to child mortality, some issues, such as lower use of maternal healthcare services, hazardous environmental effects on childhood illness, high malnutrition among children, shorter duration of exclusive breastfeeding practices, various child injuries leading to death, low healthcare-use of children, probable future threat of financial shortage, and strategies lacking area-wise focus on child mortality, need to be considered. Without these, the achievement of MDG (Millennium Development Goal)relating to child mortality may not be possible within 2015.

2.3 Causes of Early Childhood Deaths in Urban Dhaka,Bangladesh

PLoS ONE, 2009-Vol.4, Iss.12, e8145.

Amal K. Halder et al. (2009) state in their study data on causes of early childhood death from low-income urban areas are limited. The nationally representative Bangladesh Demographic and Health Survey 2007 estimates 65 children died per 1,000 live births. They investigated rates and causes of under-five deaths in an urban community near two large pediatric hospitals in Dhaka, Bangladesh and evaluated the impact of different recall periods. They conducted a survey in 2006 for 6971 households and a follow up survey in 2007 among eligible remaining households or replacement households. The initial survey collected information for all children under five years old who died in the previous year; the follow up survey on child deaths in the preceding five years. They compared mortality rates based on 1-year recall to the 4 years preceding the most recent 1 year. The initial survey identified 58 deaths among children,5 years in the preceding year. The follow up survey identified a mean 53 deaths per year in the preceding five years (SD67.3). Under-five mortality rate was 34 and neonatal mortality was 15 per thousand live births during 2006–2007. The leading cause of under-five death was respiratory infections (22%). The mortality rates among children under 4 years old for the two time periods (most recent 1-year recall and the 4 years preceding the most recent 1 year) were similar (36 versus 32). The child mortality in urban Dhaka was substantially lower than the national rate. Mortality rates were not affected by recall periods between 1 and 5 years.

2.4 Cause-specific childhood mortality in Africa and Asia: evidence from INDEPTH health and demographic surveillance system sites

Glob Health Action 2014-Vol.7, ISSN. 25363.

P. Kim Streatfield et al.(2014) in their study thatchildhood mortality, particularly in the first 5 years of life, is a major global concern and the target of Millennium Development Goal 4. Although the majority of childhood deaths occur in Africa and Asia, these are also the regions where such deaths are least likely to be registered. The INDEPTH Network works to alleviate this problem by collating detailed individual data from defined Health and Demographic Surveillance sites. By registering deaths and carrying out verbal autopsies to determine cause of death across many such sites, using standardised methods, the Network seeks to generate population-based mortality statistics that are not otherwise available. For this study, VA(Verbal Autopsy) archives were transformed into the WHO 2012 VA(Verbal Autopsy) standard format

and processed using the InterVA-4 model to assign cause of death. Routine surveillance data also provided persontime denominators for mortality rates. Cause-specific mortality rates and cause-specific mortality fractions are presented according to WHO 2012 VA(Verbal Autopsy)cause groups for neonatal, infant, 14 year and 514 year age groups. A total of 28,751 childhood deaths were documented during 4,387,824 person-years over 18 sites. Infant mortality ranged from 11 to 78 per 1,000 live births, with under-5 mortality from 15 to 152 per 1,000 live births. Sites in Vietnam and Kenya accounted for the lowest and highest mortality rates reported. Many children continue to die from relatively preventable causes, particularly in areas with high rates of malaria and HIV/AIDS. Neonatal mortality persists at relatively high, and perhaps sometimes under documented, rates. External causes of death are a significant childhood problem in some settings.

2.5 Determinants of neonatal mortality in Indonesia.

BMC Public Health, 2008- ISSN.1471-2458, Vol.8, Pp.232.

Christiana R Titaley et al. (2008) in their study that neonatal mortality accounts for almost 40 percent of under-five child mortality, globally. An understanding of the factors related to neonatal mortality is important to guide the development of focused and evidence-based health interventions to prevent neonatal deaths. This study aimed to identify the determinants of neonatal mortality in Indonesia, for a nationally representative sample of births from 1997 to 2002. The data source for the analysis was the 2002–2003 Indonesia Demographic and Health Survey from which survival information of 15,952 singleton live-born infants born between 1997 and 2002 was examined. Multilevel logistic regression using a hierarchical approach was performed to analyze the factors associated with neonatal deaths, using community, socio-economic status and proximate determinants. At the community level, the odds of neonatal death was significantly higher for infants from East Java (OR = 5.01, p = 0.00), and for North, Central and Southeast Sulawesi and Gorontalo combined (OR = 3.17, p = 0.03) compared to the lowest neonatal mortality regions of Bali, South Sulawesi and Jambi provinces. A progressive reduction in the odds was found as the percentage of deliveries assisted by trained delivery attendants in the cluster increased. The odds of neonatal death were higher for infants born to both mother and father who were employed (OR = 1.84, p= 0.00) and for infants born to father who were unemployed (OR = 2.99, p = 0.02). The odds were also higher for higher rank infants with a short birth interval (OR = 2.82, p = 0.00), male infants (OR = 1.49, p = 0.01), smaller than

average-sized infants (OR = 2.80, p = 0.00), and infant's whose mother had a history of delivery complications (OR = 1.81, p = 0.00). Infants receiving any postnatal care were significantly protected from neonatal death (OR = 0.63, p = 0.03). Public health interventions directed at reducing neonatal death should address community, household and individual level factors which significantly influence neonatal mortality in Indonesia. Low birth weight and short birth interval infants as well as perinatal health services factors, such as the availability of skilled birth attendance and postnatal care utilization should be taken into account when planning the interventions to reduce neonatal mortality in Indonesia.

2.6 Does health intervention improve socioeconomic inequalities of neonatal, infant and child mortality? Evidence from Matlab, Bangladesh

International Journal for Equity in Health 2007-Vol.6Iss.4

AbdurRazzaque et al. (2007) in their study although there are wide variations in mortality between developed and developing countries, socioeconomic inequalities in health exist in both the societies. The study examined socioeconomic inequalities of neonatal, infant and child mortality using data from the Matlab Health and Demographic Surveillance System of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). Four birth cohorts (1983–85, 1988–90, 1993–95, 1998–00) were followed for five years for death and out-migration in two adjacent areas (ICDDR,B-service and government-service) with similar socioeconomic but differ health services. Based on asset quintiles, inequality was measured through both poor-rich ratio and concentration index. The study found that the socioeconomic inequalities of neonatal, infant and under-five mortality increased over time in both the ICDDR,B-service and government-service areas but it declined substantially for 1–4 years in the ICDDR,B- service area. The study concluded that usual health intervention programs (non-targeted) do not reduce poor-rich gap, rather the gap increases initially but might decrease in long run if the program is very intensive.

2.7 Effect of 50000 IU vitamin A given with BCG vaccine on mortality in infants in Guinea-Bissau: randomised placebo controlled trial

BMJ ONLINE FIRST, doi:10.1136/bmj.39542.509444.AE

Christine Stabell Benn et al. (2008) in their study which investigate the effect of high dose vitamin-A supplementation given with BCG vaccine at birth in an African setting with high infant mortality. Bandim Health Project's demographic surveillance system in Guinea-Bissau, covering approximately 90000 inhabitants4345 infants due to receive BCG. Infants were randomised to 50 000 IU vitamin A or placebo and followed until age 12 months. 174 children died during follow-up (mortality= 47/1000 person-years). Vitamin A supplementation was not significantly associated with mortality; the mortality rate ratio was 1.07 (95% confidence interval 0.79 to 1.44). The effect was 1.00 (0.65 to 1.56) during the first four months and 1.13 (0.75 to 1.68) from 4 to 12 months of age. The mortality rate ratio in boys was 0.84 (0.55 to 1.27) compared with 1.39 (0.90 to 2.14) in girls (P for interaction=0.10). An explorative analysis revealed a strong interaction between vitamin A and season of administration. Vitamin A supplementation given with BCG vaccine at birth had no significant benefit in this African setting. Although little doubt exists that vitamin A supplementation reduces mortality in older children, a global recommendation of supplementation for all newborn infants may not contribute to better survival.

2.8 Determinants of neonatal mortality in Nigeria:evidence from the 2008 demographic and healthsurvey.

BMC Public Health, 2014- ISSN1471-2458, Vol.14, Pp.521.

Ezeh et al.(2008) in their study that nigeria continues to have one of the highest rates of neonatal deaths in Africa. This study aimed to identify risk factors associated with neonatal death in Nigeria using the 2008 Nigeria Demographic and Health Survey (NDHS). Neonatal deaths of all singleton live-born infants between 2003 and 2008 were extracted from the 2008 NDHS. The 2008 NDHS was a multi-stage cluster sample survey of 36,298 households. Of these households, survival information of 27,147 singleton live-borns was obtained, including 996 cases of neonatal mortality. The risk of death was adjusted for confounders relating to individual, household, and community level factors using Cox regression. Multivariable analyses indicated that a higher birth order of newborns with a short birth interval ≤ 2 years (hazard ratio [HR] = 2.19, confidence interval [CI]: 1.68–2.84) and newborns with a higher birth order with a longer birth interval > 2 years (HR = 1.36, CI: 1.05–1.78) were significantly associated with neonatal

mortality. Other significant factors that affected neonatal deaths included neonates born to mothers younger than 20 years (HR = 4.07, CI: 2.83–5.86), neonates born to mothers residing in rural areas compared with urban residents (HR = 1.26, CI: 1.03–1.55), male neonates (HR = 1.30, CI: 1.12–1.53), mothers who perceived their neonate's body size to be smaller than the average size (HR = 2.10, CI: 1.77–2.50), and mothers who delivered their neonates by caesarean section (HR = 2.80, CI: 1.84–4.25). Our study suggests that the Nigerian government needs to invest more in the healthcare system to ensure quality care for women and newborns. Community-based intervention is also required and should focus on child spacing, childbearing at a younger age, and poverty eradication programs, particularly in rural areas, to reduce avoidable neonatal deaths in Nigeria.

2.9Determinants of neonatal mortality in Pakistan: secondaryanalysisof Pakistan Demographic and Health Survey 2006-07.

BMC Public Health, 2014- Pp.1471-2458, Vol.14, Iss.663.

Yasir Bin Nisar and Michael J Dibley (2014) in their study that globally 7.6 million children died in 2010 before reaching their fifth birthday and 40% of these deaths occur in the neonatal period. Pakistan has the third highest rate of neonatal mortality globally. To implement evidence-based interventions for the reduction of neonatal mortality, it is important to investigate factors associated with neonatal mortality. The aim of the current study was to identify determinants of neonatal mortality in Pakistan. Data was derived from the Pakistan Demographic and Health Survey 2006–07. All singleton live births between 2002 and 2006 were selected for the current analyses. Data was analysed by using STATA 13 and adjusted for the cluster sampling design. Multivariate Cox proportional hazard models were performed using step-wise backward elimination procedures to identify the determinants of neonatal mortality. A total of 5,702 singleton live births in the last five years preceding the survey were selected. Multivariate analyses showed that living in Punjab province (Adj HR = 2.10, p = 0.015), belonging to the poorest household wealth index quintile (Adj HR = 1.95, p = 0.035), male infants (Adj HR = 1.57, p = 0.014), first rank baby (Adj HR = 1.59,p = 0.049), smaller than average birth size (Adj HR =1.61, p = 0.023) and mothers with delivery complications (Adj HR = 1.93, p = 0.001) had significantly higher hazards of neonatal death in Pakistan. To reduce neonatal mortality, there is

a need to implement interventions focusing on antenatal care, effective referral system and retraining of healthcare providers to manage delivery complications and smaller than average birth size babies in resource poor communities of Pakistan.

2.10 Global, regional, and national levels of neonatal, infant, andunder-5 mortality during 1990–2013: a systematic analysis forthe Global Burden of Disease Study 2013.

Europe PMC Funders Group 2014-Vol.384, Iss.9947, Pp.957–979.

Wang et al. (2014) in their study that remarkable financial and political efforts have been focused on the reduction of child mortality during the past few decades. Timely measurements of levels and trends in under-5 mortality are important to assess progress towards the Millennium Development Goal 4 (MDG 4) target of reduction of child mortality by two thirds from 1990 to 2015, and to identify models of success. They generated updated estimates of child mortality in early neonatal (age 0–6 days), late neonatal (7–28 days), postneonatal (29–364 days), childhood (1–4 years), and under-5 (0–4 years) age groups for 188 countries from 1970 to 2013, with more than 29 000 survey, census, vital registration, and sample registration datapoints. We used Gaussian process regression with adjustments for bias and non-sampling error to synthesise the data for under-5 mortality for each country, and a separate model to estimate mortality for more detailed age groups. They used explanatory mixed effects regression models to assess the association between under-5 mortality and income per person, maternal education, HIV child death rates, secular shifts, and other factors. To quantify the contribution of these different factors and birth numbers to the change in numbers of deaths in under-5 age groups from 1990 to 2013, they used Shapley decomposition. They used estimated rates of change between 2000 and 2013 to construct under-5 mortality rate scenarios out to 2030.

2.11 Impact of Newborn Skin-Cleansing With Chlorhexidine onNeonatal Mortality in Southern Nepal: A Community-Based,Cluster-Randomized Trial.

NIH Public Access, 2007 –Vol.119, Iss.2, e330–e340.

James M. Tielsch et al.(2007) in their study that hospital-based data from Africa suggest that newborn skin-cleansing with chlorhexidine may reduce neonatal mortality. Evaluation of this intervention in the communities where most births occur in the home has not been done. Our objective was to assess the efficacy of a 1-time skin-cleansing of newborn infants with 0.25% chlorhexidine on neonatal mortality. The design was a community-based, placebo-controlled, cluster-randomized trial in Sarlahi District in southern Nepal. Newborn infants were cleansed with infant wipes that contained 0.25% chlorhexidine or placebo solution as soon as possible after delivery in the home (median: 5.8 hours). The primary outcome was all-cause mortality by 28 days. After the completion of the randomized phase, all newborns in study clusters were converted to chlorhexidine treatment for the subsequent 9 months. A total of 17 530 live births occurred in the enrolled sectors, 8650 and 8880 in the chlorhexidine and placebo groups, respectively. Baseline characteristics were similar in the treatment groups. Intention-to-treat analysis among all live births showed no impact of the intervention on neonatal mortality. Among live-born infants who actually received their assigned treatment (98.7%), there was a nonsignificant 11% lower neonatal mortality rate among those who were treated with chlorhexidine compared with placebo. Low birth weight infants had a statistically significant 28% reduction in neonatal mortality; there was no significant difference among infants who were born weighing ≥2500 g. After conversion to active treatment in the placebo clusters, there was a 37% reduction in mortality among low birth weight infants in the placebo clusters versus no change in the chlorhexidine clusters. Newborn skin-wiping with chlorhexidine solution once, soon after birth, reduced neonatal mortality only among low birth weight infants. Evidence from additional trials is needed to determine whether this inexpensive and simple intervention could improve survival significantly among low birth weight infants in settings where home delivery is common and hygiene practices are poor.

2.12 Infant and Child Mortality in India in the Last Two Decades: A Geospatial Analysis.

PLoS ONE, 2011-Vol.6,Iss.11,e26856.

Abhishek Singh et al. (2011) in their Studies examining the intricate interplay between poverty, female literacy, child malnutrition, and child mortality are rare in demographic literature. Given

the recent focus on Millennium Development Goals 4 (child survival) and 5 (maternal health),they explored whether the geographic regions that were underprivileged in terms of wealth, female literacy, child nutrition, or safe delivery were also grappling with the elevated risk of child mortality; whether there were any spatial outliers; whether these relationships have undergone any significant change over historical time periods. The present paper attempted to investigate these critical questions using data from household surveys like NFHS 1992–1993, NFHS 1998–1999 and DLHS 2002–2004. For the first time, they employed geo-spatial techniques like Moran's-I, univariate LISA, bivariate LISA, spatial error regression, and spatiotemporal regression to address the research problem. For carrying out the geospatial analysis, they classified India into 76 natural regions based on the agro-climatic scheme proposed by Bhat and Zavier (1999) following the Census of India Study and all estimates were generated for each of the geographic regions. This study brings out the stark intra-state and inter-regional disparities in infant and under-five mortality in India over the past two decades. It further reveals, for the first time, that geographic regions that were underprivileged in child nutrition or wealth or female literacy were also likely to be disadvantaged in terms of infant and child survival irrespective of the state to which they belong. While the role of economic status in explaining child malnutrition and child survival has weakened, the effect of mother's education has actually become stronger over time.

2.13 Infant and under-five mortality in Afghanistan: currentestimates and limitations.

Bull World Health Organ,2010-Vol.88, Pp.576–583

Kavitha Viswanathan et al.(2010) in their study thatexamine historical estimates of infant and under-five mortality in Afghanistan, provide estimates for rural areas from current population-based data, and discuss the methodological challenges that undermine data quality and hinder retrospective estimations of mortality. Indirect methods of estimation were used to calculate infant and under-five mortality from a household survey conducted in 2006. Sex-specific differences in underreporting of births and deaths were examined and sensitivity analyses were conducted to assess the effect of underreporting on infant and under-five mortality. Findings For 2004, rural unadjusted infant and under-five mortality rates were estimated to be

129 and 191 deaths per 1000 live births, respectively, with some evidence indicating underreporting of female deaths. If adjustment for underreporting is made (i.e. by assuming 50% of the unreported girls are dead), mortality estimates go up to 140 and 209, respectively. Commonly used estimates of infant and under-five mortality in Afghanistan are outdated; they do not reflect changes that have occurred in the past 15 years or recent intensive investments in health services development, such as the implementation of the Basic Package of Health Services. The sociocultural aspects of mortality and their effect on the reporting of births and deaths in Afghanistan need to be investigated further.

2.14 Infant mortality in South Africa - distribution, associations and policy implications, 2007: an ecological spatial analysis.

International Journal of Health Geographics, 2011- Vol.10, Iss.1, Pp.6

Benn KD Sartorius et al. (2011) in their study that many sub-Saharan countries are confronted with persistently high levels of infant mortality because of the impact of a range of biological and social determinants. In particular, infant mortality has increased in subSaharan Africa in recent decades due to the HIV/AIDS epidemic. The geographic distribution of health problems and their relationship to potential risk factors can be invaluable for cost effective intervention planning. The objective of this paper is to determine and map the spatial nature of infant mortality in South Africa at a sub district level in order to inform policy intervention. In particular, the paper identifies and maps high risk clusters of infant mortality, as well as examines the impact of a range of determinants on infant mortality. A Bayesian approach is used to quantify the spatial risk of infant mortality, as well as significant associations (given spatial correlation between neighbouring areas) between infant mortality and a range of determinants. The most attributable determinants in each sub-district are calculated based on a combination of prevalence and model risk factor coefficient estimates. This integrated small area approach can be adapted and applied in other high burden settings to assist intervention planning and targeting. Infant mortality remains high in South Africa with seemingly little reduction since previous estimates in the early 2000's. Results showed marked geographical differences in infant mortality risk between provinces as well as within provinces as well as significantly higher risk in specific sub-districts and provinces. A number of determinants were found to have a

significant adverse influence on infant mortality at the sub-district level. Following multivariable adjustment increasing maternal mortality, antenatal HIV prevalence, previous sibling mortality and male infant gender remained significantly associated with increased infant mortality risk. Of these antenatal HIV sero-prevalence, previous sibling mortality and maternal mortality were found to be the most attributable respectively. This study demonstrates the usefulness of advanced spatial analysis to both quantify excess infant mortality risk at the lowest administrative unit, as well as the use of Bayesian modelling to quantify determinant significance given spatial correlation. The "novel" integration of determinant prevalence at the sub-district and coefficient estimates to estimate attributable fractions further elucidates the "high impact" factors in particular areas and has considerable potential to be applied in other locations. The usefulness of the paper, therefore, not only suggests where to intervene geographically, but also what specific interventions policy makers should prioritize in order to reduce the infant mortality burden in specific administration areas.

2.15Neonatal mortality in Ethiopia:trendsand determinants

BMC Public Health,2013-Pp1471-2458,Vol.13, e.483.

Mekonnen et al. (2013) in their study that Ethiopian neonatal mortality rate constitutes 42% of under-5 deaths. They aimed to examine the trends and determinants of Ethiopian neonatal mortality. They analyzed the birth history information of live births from the 2000, 2005 and 2011 Ethiopia Demographic and Health Surveys (DHS). They used simple linear regression analyses to examine trends in neonatal mortality rates and a multivariate Cox proportional hazards regression model using a hierarchical approach to examine the associated factors. The neonatal mortality rate declined by 1.9% per annum from 1995 to 2010, logarithmically. The early neonatal mortality rate declined by 0.9% per annum and was where 74% of the neonatal deaths occurred. Using multivariate analyses, increased neonatal mortality risk was associated with male sex (hazard ratio (HR) = 1.38; 95% confidence interval (CI), 1.23 − 1.55); neonates born to mothers aged < 18 years (HR = 1.41; 95% CI, 1.15 − 1.72); and those born within 2 years of the preceding birth (HR = 2.19; 95% CI, 1.89 − 2.51). Winter birth increased the risk of dying compared with spring births (HR = 1.28; 95% CI, 1.08 − 1.51). Giving two Tetanus Toxoid Injections (TTI) to the mothers before childbirth decreased neonatal mortality risk (HR = 0.44; 95% CI, 0.36 − 0.54). Neonates born to women with secondary or higher schooling vs. no

education had a lower risk of dying (HR = 0.68; 95% CI, 0.49 − 0.95). Compared with neonates in Addis Ababa, neonates in Amhara (HR: 1.88; 95% CI: 1.26 − 2.83), BenishangulGumuz (HR: 1.75; 95% CI: 1.15 − 2.67) and Tigray (HR: 1.54; 95% CI: 1.01 − 2.34) regions carried a significantly higher risk of death. Neonatal mortality must decline more rapidly to achieve the Millennium Development Goal (MDG) 4 target for under-5 mortality in Ethiopia. Strategies to address neonatal survival require a multifaceted approach that encompasses health-related and other measures. Addressing short birth interval and preventing early pregnancy must be considered as interventions. Programs must improve the coverage of TTI and prevention of hypothermia for winter births should be given greater emphasis. Strategies to improve neonatal survival must address inequalities in neonatal mortality by women's education and region.

2.16 Neonatal Mortality Levels for 193 Countries in 2009 with Trends since 1990: A Systematic Analysis of Progress,Projections, and Priorities.

PLoS Med,2011-Vol, 8 Iss.8, e1001080.

Mikkel Zahle Oestergaardet al. (2011) in their study that historically, the main focus of studies of childhood mortality has been the infant and under-five mortality rates. Neonatal mortality (deaths,28 days of age) has received limited attention, although such deaths account for about 41% of all child deaths. To better assess progress, we developed annual estimates for neonatal mortality rates (NMRs) and neonatal deaths for 193 countries for the period 1990–2009 with forecasts into the future. They compiled a database of mortality in neonates and children (,5 years) comprising 3,551 countryyears of information. Reliable civil registration data from 1990 to 2009 were available for 38 countries. A statistical model was developed to estimate NMRs for the remaining 155 countries, 17 of which had no national data. Country consultation was undertaken to identify data inputs and review estimates. In 2009, an estimated 3.3 million babies died in the first month of life—compared with 4.6 million neonatal deaths in 1990—and more than half of all neonatal deaths occurred in five countries of the world (44% of global livebirths): India 27.8% (19.6% of global livebirths), Nigeria 7.2% (4.5%), Pakistan 6.9% (4.0%), China 6.4% (13.4%), and Democratic Republic of the Congo 4.6% (2.1%). Between 1990 and 2009, the global neonate mortality rate(NMR) declined by 28% from 33.2 deaths per 1,000 livebirths to 23.9. The proportion of child deaths that are in the neonatal period increased in all regions of the

world, and globally is now 41%. While neonate mortality rates(NMRs) were halved in some regions of the world, Africa's NMR only dropped 17.6% (43.6 to 35.9). Neonatal mortality has declined in all world regions. Progress has been slowest in the regions with high neonate mortality rates(NMRs). Global health programs need to address neonatal deaths more effectively if Millennium Development Goal 4 (two-thirds reduction in child mortality) is to be achieved.

2.17 Risk factors for early infant mortality in Sarlahi district, Nepal

Bulletin of the World Health Organization 2003-Vol.81, Iss.10,PP.717-725

Joanne Katz et al. (2003) in their study that early infant mortality has not declined as rapidly as child mortality in many countries. Identification of risk factors for early infant mortality may help inform the design of intervention strategies. Over the period 1994–97, 15 469 live-born, singleton infants in rural Nepal were followed to 24 weeks of age to identify risk factors for mortality within 0–7 days, 8–28 days, and 4–24 weeks after the birth.In multivariate models, maternal and paternal education reduced mortality between 4 and 24 weeks only: odds ratios (OR) 0.28 (95% confidence interval (CI) = 0.12–0.66) and 0.63 (95% CI = 0.44–0.88), respectively. Miscarriage in the previous pregnancy predicted mortality in the first week of life (OR =1.98, 95% CI = 1.37–2.87), whereas prior child deaths increased the risk of post-neonatal death (OR =1.85, 95% CI 1.24–2.75). A larger maternal mid–upper arm circumference reduced the risk of infant death during the first week of life (OR = 0.88, 95% CI = 0.81–0.95). Infants of women who did not receive any tetanus vaccinations during pregnancy or who had severe illness during the third trimester were more likely to die in the neonatal period. Maternal mortality was strongly associated with infant mortality (OR = 6.43, 95% CI = 2.35–17.56 at 0–7 days; OR =11.73, 95% CI = 3.82–36.00 at 8–28 days; and OR = 51.68, 95% CI = 20.26–131.80 at 4–24 weeks). Risk factors for early infant mortality varied with the age of the infant. Factors amenable to intervention included efforts aimed at maternal morbidity and mortality and increased arm circumference during pregnancy.

2.18 Spatial patterns of fetal loss and infant death in an arsenic-affected area in Bangladesh.

International Journal of Health Geographics ,2010-Vol.9, Iss.1, Pp.35.

Sohel et al. (2010) in their study that arsenic exposure in pregnancy is associated with adverse pregnancy outcome and infant mortality. Knowledge of the spatial characteristics of the outcomes and their possible link to arsenic exposure are important for planning effective mitigation activities. The aim of this study was to identify spatial and spatiotemporal clustering of fetal loss and infant death, and spatial relationships between high and low clusters of fetal loss and infant death rates and high and low clusters of arsenic concentrations in tube-well water used for drinking. Pregnant women from Matlab, Bangladesh, who used tube-well water for drinking while pregnant between 1991 and 2000, were included in this study. In total 29,134 pregnancies were identified. A spatial scan test was used to identify unique non-random spatial and spatiotemporal clusters of fetal loss and infant death using a retrospective spatial and spatiotemporal permutation and Poisson probability models: Two significant clusters of fetal loss and infant death were identified and these clusters remained stable after adjustment for covariates. One cluster of higher rates of fetal loss and infant death was in the vicinity of the Meghna River, and the other cluster of lower rates was in the center of Matlab. The average concentration of arsenic in the water differed between these clusters (319 μg/L for the high cluster and 174 μg/L for the low cluster). The spatial patterns of arsenic concentrations in tube-well water were found to be linked with the adverse pregnancy outcome clusters. In the spatiotemporal analysis, only one high fetal loss and infant death cluster was identified in the same high cluster area obtained from purely spatial analysis. However, the cluster was no longer significant after adjustment for the covariates. The finding of this study suggests that given the geographical variation in tube-well water contamination, higher fetal loss and infant deaths were observed in the areas of higher arsenic concentrations in groundwater. This illustrates a possible link between arsenic contamination in tube-well water and adverse pregnancy outcome. Thus, these areas should be considered a priority in arsenic mitigation programs.

2.19 Under-Five Mortality in High Focus States in India: A District Level Geospatial Analysis.

PLoS ONE,2012 Vol.7, Iss.5, e37515.

Chandan Kumar et al. (2012) in their study this paper examines if, when controlling for biophysical and geographical variables (including rainfall, productivity of agricultural lands,

topography/temperature, and market access through road networks), socioeconomic and health care indicators help to explain variations in the under-five mortality rate across districts from nine high focus states in India. The literature on this subject is inconclusive because the survey data, upon which most studies of child mortality rely, rarely include variables that measure these factors. This paper introduces these variables into an analysis of 284 districts from nine high focus states in India. Information on the mortality indicator was accessed from the recently conducted Annual Health Survey of 2011 and other socioeconomic and geographic variables from Census 2011, District Level Household and Facility Survey (2007–08), Department of Economics and Statistics Divisions of the concerned states. Displaying high spatial dependence (spatial autocorrelation) in the mortality indicator (outcome variable) and its possible predictors used in the analysis, the paper uses the Spatial-Error Model in an effort to negate or reduce the spatial dependence in model parameters. The results evince that the coverage gap index (a mixed indicator of district wise coverage of reproductive and child health services), female literacy, urbanization, economic status, the number of newborn care provided in Primary Health Centers in the district transpired as significant correlates of under-five mortality in the nine high focus states in India. The study identifies three clusters with high under-five mortality rate including 30 districts, and advocates urgent attention. Even after controlling the possible biophysical and geographical variables, the study reveals that the health program initiatives have a major role to play in reducing under-five mortality rate in the high focus states in India.

2.20 A population-based study of effect of multiple birth on infantmortality in Nigeria.

BMC Pregnancy and Childbirth 2008-ISSN.1471-2393, Vol.8, Pp.41.

Olalekan A Uthman et al. (2008) in their study that multi-foetal pregnancies and multiple births including twins and higher order multiples births such as triplets and quadruplets are high-risk pregnancy and birth. These high-risk groups contribute to the higher rate of childhood mortality especially during early period of life.They examined the relationship between multiple births and infant mortality using univariable and multivariable survival regression procedure with Weibull hazard function, controlling for child's sex, birth order, prenatal care, delivery assistance; mother's age at child birth, nutritional status, education level; household living conditions and

several other risk factors. Children born multiple births were more than twice as likely to die during infancy as infants born singleton (hazard ratio = 2.19; 95% confidence interval: 1.50, 3.19) holding other factors constant. Maternal education and household asset index were associated with lower risk of infant mortality. Multiple births are strongly negatively associated with infant survival in Nigeria independent of other risk factors. Mother's education played a protective role against infant death.This evidence suggests that improving maternal education may be key to improving child survivalin Nigeria.

CHAPTER # 3

METHODOLOGY

3.Methodology

3.1 Research Design

The study was a review study.The paper was based on the information collected from various journal.

3.2Study Size

Sample size was 20 journal.

3.3 Study Period

Study period was 1 year (June, 2015-June 2016)

3.4 Inclusion Criteria

- Subject only with infant mortality rate (IMR),neonate mortality rate (NMR)& under five years mortality rate (U5MR)was taken for these research.
- Age from 0-<5 years was included in this study.
- Both girl and boy child was included in this study.

3.5 Data Analysis

The data were put on a tabular form and it was analyzed statistically like frequency counts and simple percentages by using Microsoft Excel.

3.6 Data Identification and Inclusion

Data on neonatal mortality come from a variety of sources, including civil registration systems and household surveys such as Demographic and Health Surveys (DHS). All these different data sources are included those meeting myinclusion criteria, that is, reporting population-based data with neonatal deaths and under-five deaths with a denominator of live births. Although under-reporting of neonatal deaths is a concern even in middle- and high-income settings. To ensure consistency witunder five years mortality rateh estimates produced for the UN by IGME(Inter-

agency Group for Child Mortality Estimation) and to account for variation in survey-to survey measurement, rescaled under five years mortality rate and neonate mortality rate data points for all years to match the latest time series estimates ofunder five years mortality rateproduced by IGME (Inter-agency Group for Child Mortality Estimation)

3.7 OutcomeVariables

To measure three main outcome variables, infant mortality rate (IMR),neonate mortality rate (NMR) and under-five mortality rate (U5MR) are important indicators of average population health and are widely used to document the progress in the achievement of the fourth Millennium Development Goal (MDG-4) a commitment to reduce under-five mortality by two-thirds, between (1990 to 2015). Infant mortality rate measures the probability of death before the child's first birthday.On the other hand, the under five years mortality rate is a measure of the probability of death among children before their fifth birthday and the neonate mortality rate is a measure of the probability of death among children before their (0-28days) birthday. Estimated infant mortality rate, neonate mortality rate and under five years mortality rate using information on the births and deaths in last (1970 to 2015) years internet survey rounds.

3.8 Exposure Variables

This study utilizes five main exposure variables that is- low income, underweight children, female literacy, percent urban and proportion of safe delivery. Measurement of poverty is a complex and debatable issue, particularly due to the unavailability of direct and reliable information on household income or expenditure in sample surveys like DLHS (Demographic and Health Surveys.) In the absence of such relevant information, studies have successfully used the information on household assets, consumer durables, quality of housing and access to utilities and infrastructure as proxies to measure the wealth status of the households.

3.9 Study variables

The primary outcome was neonatal death, which was the death of a live born infant in the first month of life. In the descriptive analysis, infant mortality rate (IMR), neonatal mortality rate (NMR) and under-five mortality rate (U5MR), defined as the number of neonatal, infant & under-five deaths per 1000 live births, was used. In these analysis, the outcome was neonatal,

infant & under-five deaths recoded. The explanatory variables included community level contextual variables, socioeconomic and proximate determinants, covering maternal, neonatal, pre-natal, delivery and post-natal factors.

CHAPTER # 4

RESULTS

4.Results

TABLE.1 Socioecnomic and DeomographicCharacteristic of Infant & Neonate Mortality.

Source	**Income**
Amir Mohammad Sayem et al. (2011)	
Amal K. Halder et al. (2009)	
P. Kim Streatfield et al. (2014)	
Wang et al.(2014)	
James M.Tielsch et al.(2007)	
Abhishek Singh et al. (2011)	
Kavitha Viswanathan20-34et al.(2010)	**50%**
Mekonnen et al. (2013)	
Mikkel Zahle Oestergaard et al. (2011)	
Sohel et al. (2010)	
Source	**Maternal Age(Mother)**
BerheWeldearegawi et al. (2015)	
Christiana R Titaley et al. (2008)	
Ezeh et al.(2008)	
Yasir Bin Nisar and Michael J Dibley (2014)	
Wang et al.(2014)	

James M.Tielsch et al.(2007)	**75%**
Abhishek Singh et al. (2011)	
Kavitha Viswanathan20-34et al.(2010)	
Benn KD Sartorius et al. (2011)	
Mekonnen et al(2013)	
Mikkel Zahle Oestergaard et al. (2011)	
Joanne Katz et al.(2003)	
Chandan Kumar et al. (2012)	
Olalekan A Uthman et al. (2008)	
Source	**Educational Status(parent)**
BerheWeldearegawi et al. (2015)	**20%**
AbdurRazzaque et al. (2007)	
Christine Stabell Benn et al. (2008)	
Kavitha Viswanathan20-34et al.(2010)	
Source	**Birth Place of child(home)**
BerheWeldearegawi et al. (2015)	**60%**
Amir Mohammad Sayem et al. (2011)	
P. Kim Streatfield et al. (2014)	
AbdurRazzaque et al. (2007)	
Ezeh et al.(2008)	
James M.Tielsch et al.(2007)	
Wang et al.(2014)	
Abhishek Singh et al. (2011)	
Kavitha Viswanathan et al.(2010)	
Joanne Katz et al.(2003)	
Sohel et al. (2010)	
Olalekan A Uthman et al. (2008)	

TABLE 2. Risk Factors of Infant & Neonate Mortality

Source	**Acute Respiratory Infection**
Amir Mohammad Sayem et al. (2011)	**10%**
Amal K. Halder et al. (2009)	
Source	**Diarrhea**
BerheWeldearegawi et al. (2015)	**25%**
Amir Mohammad Sayem et al. (2011)	
Amal K. Halder et al. (2009)	
P. Kim Streatfield et al. (2014)	
Ezeh et al.(2008)	
Source	**Sepsis**
BerheWeldearegawi et al. (2015)	**15%**
Amal K. Halder et al. (2009)	
Mekonnen et al(2013)	
Source	**Asphyxia**
BerheWeldearegawi et al. (2015)	**25%**
Amir Mohammad Sayem et al. (2011)	
P. Kim Streatfield et al. (2014)	
Mekonnen et al(2013)	
Mikkel Zahle Oestergaard et al. (2011)	
Source	**Low Birth Weight**
BerheWeldearegawi et al. (2015)	**55%**
Amir Mohammad Sayem et al. (2011)	
P. Kim Streatfield et al. (2014)	
Mekonnen et al(2013)	
Mikkel Zahle Oestergaard et al. (2011)	
Joanne Katz et al. (2003)	
Sohel et al. (2010)	
Yasir Bin Nisar and Michael J Dibley (2014)	

Wang et al.(2014)	
James M. Tielsch et al.(2007)	
Abhishek Singh et al. (2011)	
Source	**Pneumonia**
BerheWeldearegawi et al. (2015)	
P. Kim Streatfield et al. (2014)	
Mekonnen et al(2013)	**15%**
Mikkel Zahle Oestergaard et al. (2011)	

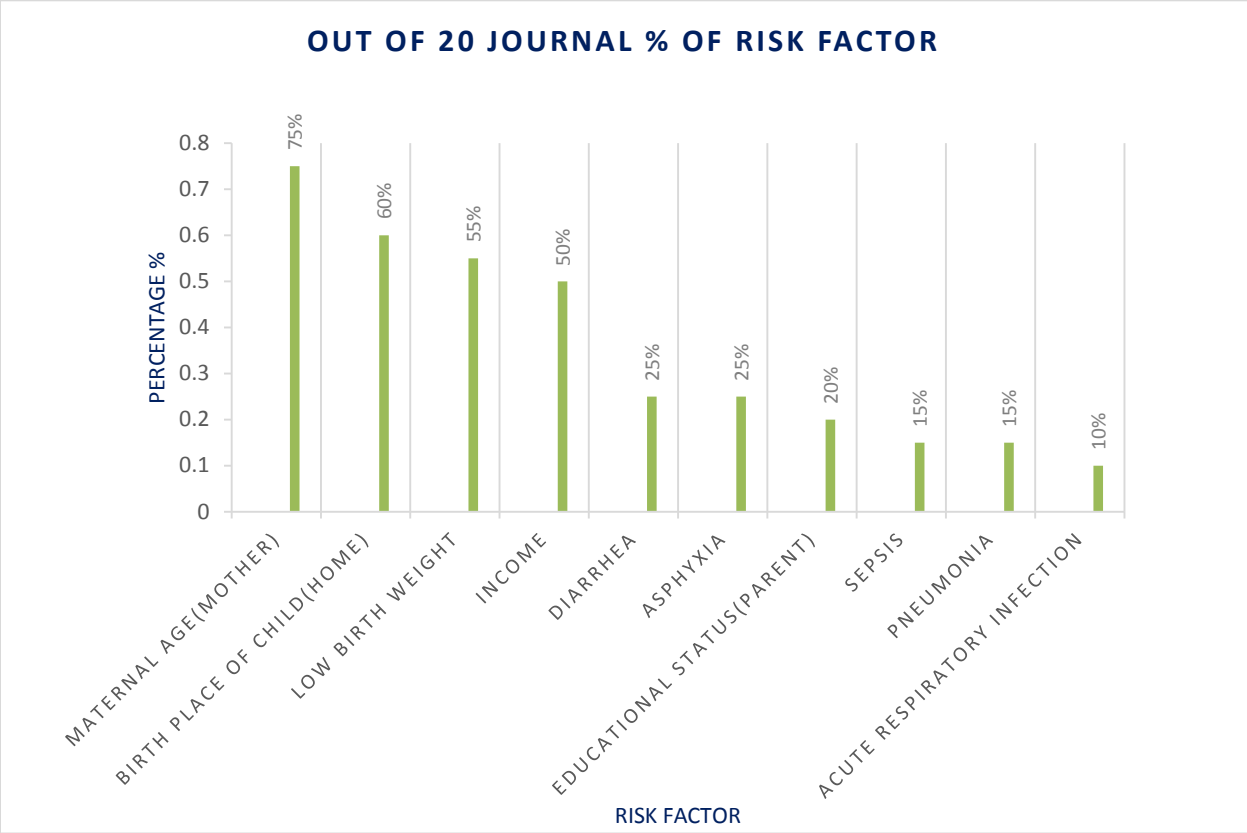

Fig-4: Percentage of risk factor in infant & neonate mortality rate. (out of 20 journal)

CHAPTER # 5

DISCUSSION

5. Discussion

The overall aim of this study was to identify the infant mortality rate (IMR), neonate mortality rate(NMR)& under- five mortality rate (U5MR) using a nationally representative sample. This study showed several factors that were significantly associated with neonate mortality rate, infant mortality rate&under- five mortality rate after adjusting for contributing factors, and each of these factors are discussed. Additionally, a cross-sectional study performed in Bangladesh in 2009 reported a lower relative risk for female neonates compared with male neonates(Mondal,etal.2009).

Globally, it is estimated that approximately 23% of newborn deaths are attributed to respiratory problems.In this study, mothers who perceived the size of their newborns to be small or very small had a 2.26 times greater risk of dying in the first month of life than those mothers who perceived their neonates to be of average or larger size. Similarly, findings from a cross-sectional study conducted in five Asian countries (India, Indonesia, Nepal, Bangladesh, and the Philippines) in 2008 also showed that smaller than average neonates had an increased risk of neonatal deaths than average or larger sized neonates in four of the five countries with data on perceived newborn size (Fort,et al.2008)

The current study observed that neonates born to mothers aged younger than 20 years had a significantly higher risk of mortality than those born to mothers aged20–29 years, 30–39 years, and 40–49 years. This finding is similar to that reported in previous studies (Mostafa Kamal, 2007 & Conde-Agudelo, et al.2005)

The current study showed that neonates born to mothers residing in rural areas had a higher risk of neonatal mortality compared with those living in urban areas. This finding is consistent with previous studies, which attributed this finding to limited access to health facilities and maternal healthcare services, such as delivery assisted by a healthcare professional, and prenatal and postnatal care(Oti&Odimegwu ,2011&Golding,et al.1994).

Infant of teenage mothers (15-19 years old) were 2.68 times at higher risk of death than those whose mothers were 25-29 years old. Infantshad 56% lower risk of death if they were born to

mothers who attained secondary school and avobe. The infant mortality rate in the present study, during the period of 2009 & ,was lower than the national & regional estimates.(Weldearegawi,et al.2015).

Globally,80% of total neonatal deaths are attributed to prematurity and complications at birth, low birth weight ahd asphyxia. Nervertheless, the present study has limitation.Up-to-date data on important variables such as maternal nutritional status, breastfeeding, and hygiene and sanitation were not available;and therefore, not included in the analysis. Leading causes of Infant & Neonate Mortality under-five death in this community included respiratory disease, Diarrhea, Asphyxia, Low Birth Weight,Pnemonia and sepsis.Over the last several years mortality from diarrhea has declined but ARI has remained steady in Bangladesh 1and in other settings. Reducing mortality from respiratory illness and neonatal mortality will be important to achieve the millennium development goal for child survival. However, this study population represents a large socio-economically &geographicdiverse population and suggests that access to appropriate clinical care may contribute to improved child survival (Halder,et al.2009).

Although these data suggest that under-five child survival is better in this study community in bangladesh and some countries. However the mortality is still high. Improving child survival in Bangladesh will require reducing serious child respiratory disease, reducing neonatal deaths, and extending effective health services to both rural and urban areas (Halder,et al.2009).

CHAPTER # 6

CONCLUSION

6.Conclusions

This paper reviewed the present status of infant and neonatal mortality a reviewrevealed that living in rural and urban areas, child bearing at a younger age, birth order and birth interval, sex of the newborn, caesarean delivery, Maternal Occupation,Educational Status,Birth Place and mothers who perceive their newborns as smaller than average at birth significantly increased the risk of neonatal death. Overall, this study found that achievement in child mortality in Bangladesh is optimistic, especially in infant and under-five mortality but immunization is yet to achieve universal coverage as it is needed to achieve MDG 4(Millennium Development Goal 4). To improve the health of children further, some issues, such as lower use of maternal healthcare services, hazardous environmental effects on childhood illness, high malnutrition among children, shorter duration of exclusive breastfeeding practices, various child injuries leading to death and low healthcare-use for children, and strategies lacking area-wise focus on child mortality need to be considered. Neonates should be given the highest priority so that neonatal deaths contribute more to the reduction of under-five mortality in this country. Area-specific focus should be given on an emergency basis in achieving the MDG (Millennium Development Goal)relating to under-five mortally on time. Management of financial support from inside and outside the country should also be ensured so that services provided to the most needy population, especially the rural poor, become smooth. Without proper consideration of these issues, the achievement of MDG(Millennium Development Goal) relating to child mortality may not be possible within 2015.

CHAPTER # 7

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7. Refference

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