FACTORS INFLUENCING NEONATAL MORTALITY: EVIDENCE FROM THE 2007 ZAMBIA DEMOGRAPHIC HEALTH SURVEY

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DECLARATION

This dissertation is the original work of **ETAMBUYU LUKONGA.**

It has been produced in accordance with the guidelines for MSc. Epidemiology dissertation for the University of Zambia. It has not been submitted elsewhere for a degree at this or another University.

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CERTIFICATE OF COMPLETION OF DISSERTATION

I…….

Hereby state that this dissertation is entirely the result of my own personal effort. The various sources to which I am indebted have been clearly indicated in the references and acknowledgements.

I further attest that this dissertation herein presented for the Degree of Master of Science in Epidemiology has not been previously submitted either wholly or in part for any other Degree at this or any other University nor is it being currently submitted for any other Degree

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Having supervised and read this dissertation is satisfied that this is the original work of the author under whose name it is being presented.

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CERTIFICATE OF APPROVAL

The University of Zambia approves this dissertation of Etambuyu Lukonga in partial fulfilment of the requirements for the award of the degree in Master of Science in Epidemiology.

Examiner's Signature **Date**

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3. **……..** **……**

DEDICATION

I dedicate my dissertation work to my late husband Anang'anga Imwiko, a very special man in my life, who gave me support and encouraged me to undertake my studies from the word go, whose words of encouragement and push for tenacity still ring in my ears. I also dedicate this work and give special thanks to my sisters and brothers who have never left my side. I also dedicate this dissertation to my many friends and church choir family who have supported me throughout the process. I will always appreciate all they have done. You have all been my best cheerleaders.

ABSTRACT

Background

Of the estimated 130 million infants born each year worldwide, 4 million die in the first 28 days of life illustrating how neonatal mortality accounts for almost 40 percent of under-five child mortality, globally. The continued loss of infants within the first month of life results from a complex chain of socio-economic, biological and healthcare-related factors. We examined factors that may be associated with neonatal mortality in Zambia.

Materials and Methods

Using a cross-sectional design, data were extracted from the 2007 ZDHS Women's Questionnaire for respondents aged 15-49 years in the selected households. Women who reported having given birth to live infants within the five years preceding the survey were included as the study population but only those infants who could have lived through the first month (28 days) were assessed.

Results

A total number of 6 435 live-born infants within the five years preceding the survey were extracted as the study population. Of these births, 219 (3.4%) neonatal deaths were recorded. Low birth weight and overweight were reported as the prominent factors .The odds of dying were significantly higher for infants with low birth weight compared to infants born with normal weight, (aOR=2.58, 95% CI 1.02-6.49). The pattern was the same in both rural though insignificant. Over weight born babies were also associated with increased odds of dying (aOR 3.21, CI 1.36-7.59) compared to normal sized born babies. Compared to infants born from Mothers with no education, infants born from mothers with at least secondary school and higher were associated with increased odds of dying (aOR 3.55, CI 95%, 1.26-9.94). Mother's age at birth also showed some relationship with neonatal mortality. Babies born to Mothers in the age group 18-24 years had reduced odds of dying than babies born to those in the age group 12- 17 years.

Conclusion

There were marked differentials by residence in the way factors affected neonatal survival both at national and rural and urban level. The results clearly indicate that factors such as birth weight, level of education were had more significant influence in rural than urban areas.

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ACRONYMS AND ABBREVIATIONS

AIDS	-	Acquired Immuno Deficiency Syndrome
ANC	-	Antenatal Care
C-SECTION	-	Caesarean Section
CDC	-	Centre for Disease Control and Prevention
CRC	-	Convention on the Rights of the Child
CSO	-	Central Statistical Office
HIV	-	Human Immuno Deficiency Virus
MDG	-	Millennium Development Goals
OR	-	Odds ratio
UNFPA	-	United Nations Population Fund
UNICEF	-	United Nations Children's Fund
WHO	-	World Health Organisation
ZDHS	-	Zambia Demographic Health Survey

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Chapter One: INTRODUCTION

1.1 Overview of Neonatal Mortality

The first four weeks of life, which is the neonatal period, is the most vulnerable time for a child. The stress of delivery, as well as the first adaptations from being in the relative safety of its mother's womb to an existence far less protected is a time of great risk. "Of the estimated 130 million infants born each year worldwide, 4 million die in the first 28 days of life (World Health Organization, 2005). "Despite accounting for almost 40 per cent of all under-five child deaths and more than half of infant deaths, neonatal mortality is not a target of the Millennium Development Goals". (United Nations Report: 2001). Three-quarters of neonatal deaths occur in the first week, and more than one-quarter occur in the first 24 hours" (World Health Report 2005). "Neonatal death is defined as death of a live-born infant who dies within 28 days after birth" (World Health Report 2005). The fourth Millennium Development Goal (MDG) entails the reduction of child mortality by two-thirds by the year 2015, from the base year of 1990. However if the MDG target of a two-thirds reduction in child mortality by 2015 is to be achieved, then neonatal mortality must be addressed. To address this issue of neonatal mortality, the major risk factors should be identified.

Studies have indicated that Neonatal deaths stem from poor maternal health, inadequate care during pregnancy, inappropriate management of complications during pregnancy and delivery, poor hygiene during delivery and the first critical hours after birth, and lack of new born care. Several factors such as women's status in society, their nutritional status at the time of conception, early childbearing, too many closely spaced pregnancies. "Causes of neonatal death are often difficult to ascertain, because most of the births occur at home unattended by medical personnel, or because the neonates present with non-specific diagnostic signs" (Barbara Stoll, 1999).

In the last 30 years, the reduction in neonatal mortality rates has been slower, compared to both under-five and child mortality rates after the first month of life (Moss W, et al 2002). "According to the Convention on the Rights of the Child, new-borns have a basic right to enjoy the highest attainable standard of health" (UN General Assembly 1989). Recent

reviews of child mortality reveal that the proportion of under-five child deaths occurring in the first month of life has been increasing (Black RE et al., 2003).

Previous studies on the causes of neonatal deaths have shown that up to 70 per cent of neonatal mortality could be prevented using evidence-based interventions (Darmstadt GL et al., 2005; Yinger NV, Ransom EI, 2003). To adopt a focused, evidence-based approach to reduce neonatal mortality, a clear understanding of the associated risk factors is necessary.

An understanding of the risk factors related to neonatal mortality is important to guide the development of focused and evidence-based health interventions to prevent neonatal deaths.

Figure 1.1 illustrates the global distribution of neonatal mortality. On average, neonatal mortality rates (NMR) are highest in sub-Saharan Africa, where 41 out of every 1000 babies born alive die within the first month of life (UNICEF 2009:10).

Figure 1.1: Global Distribution of Neonatal Mortality (Lawn et al. 2005:894)

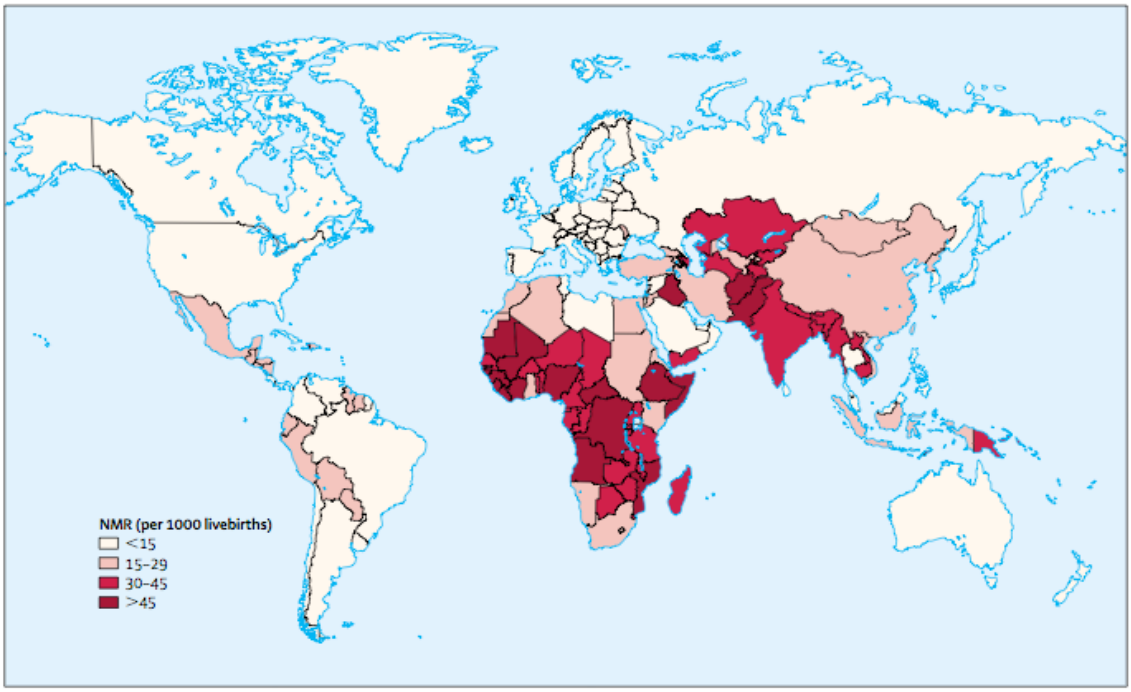


Figure 2: Variation between countries in NMRs[1]

The health of mothers and that of their young children are closely related, especially during gestation and in the neonatal period (Mubarak, 1989; Tinker & Koblinsky: 1993). According

to World Health Organization (WHO) “Maternal health refers to the health of women during pregnancy, childbirth and the postpartum period while motherhood is often a positive and fulfilling experience, for too many women it is associated with suffering, ill-health and even death” (WHO, 2005). Utilization of maternal health services is associated with improved maternal and neonatal health outcomes. Understanding the factors affecting maternal health use is crucial (Stella Babalola1 et al, 2009). High quality maternal health care is an important tool to reduce maternal and neonatal mortality (Graner et al, BMC Public Health 2010). Lack of antenatal care is also a major cause of neonatal mortality (Miller et al., 1996; Clarke & Coward, 1991; Bhatia & Cleland, 1995; Foege, 1983).

“Neonatal mortality is the number of deaths during the first 28 completed days of life per 1,000 live births in a given year or period” (WHO, 2005). Neonatal deaths may be subdivided into early neonatal deaths, occurring during the first seven days of life, and late neonatal deaths, occurring after the seventh day but before the 28 completed days of life (WHO, 2005). “Although being new born is not a disease, large numbers of children die soon after birth: many of them in the first four weeks of life (neonatal deaths), and most of those during the first week known as early neonatal deaths (WHO, 2006). Literature shows that 99 per cent of neonatal deaths occur in developing countries (Lawn JE et al, 2005).

“Neonatal mortality is one of the most important determinants of children health status” (Chaman R. et al., 2009). “Neonatal death has a complex causal framework and improvement of this health indicator is quite gradual" (Chaman R. et al., 2009). Studies also show that causes of death in the neonatal period in the developing world are poorly measured (Lawn JE, 2005). Decrease in Perinatal and neonatal mortality often lag behind reduction in infant mortality in general. In many countries the new-born remains neglected by the health care system and interventions to reduce neonatal deaths are of low priority (WHO report, 1996).

1.2 Neonatal Mortality in the Zambian Context

Zambia as a developing country, located in the sub-Saharan region, has an infant mortality rate of 70 deaths per 1000 live births and a neonatal mortality of 34 deaths per 1,000 births (ZDHS, 2007).

Neonatal mortality is still a problem in Zambia. Currently, data from the 2007 Zambia Demographic and Health Survey (ZDHS) report shows that neonatal mortality rate has remained unchanged in the last 7-10 years. The report shows that there has been reduction in both child mortality and under-five mortality from 81 and 168 deaths per 1,000 births in 2001-2002 to 52 and 119 deaths per 1,000 births in 2007, respectively. The results indicate that neonatal mortality only registered a 0.3 percentage point reduction between 2001-2002 and 2007. The percentage of hospital deliveries in Zambia is 47 per cent.

Figure 1.2: Save the Children

Source: *Save the Children*

1.3 Background to identifying Factors that influence Neonatal Mortality

Neonatal health is critically related to maternal health, with many early neonatal deaths related to care during delivery (UNFPA, 2006). High neonatal mortality in developing countries is a major obstacle in achieving the MDG 4 by two-thirds by 2015. High neonatal mortality indicates the existence of poor maternal health. Neonatal deaths account for the loss

of thousands of potential citizens, apart from parental grief which cannot be measured. Babies are born every day but the outcome in terms of child survival still leaves much to be desired. The question that arises is why neonatal mortality has not shown any significant reduction compared to child and under five mortality. In order to reduce neonatal mortality rate, it is very important to fully understand the risk factors and causes associated with neonatal mortality and try to solve the problem from the grass root.

A study on neonatal risk factors conducted in Iran showed that prematurity, low birth weight, Ceasarian-section (C-Section), birth spacing less than 24 months and birth rank more than 3 were important risk factors for neonatal mortality (Chaman1 R, 2008). A study conducted in Zambia showed that of 32 neonatal deaths that were in the study 84 per cent occurred within the first week of life, primarily because of infections and prematurity (Eleanor Turnbull, 2011).

According to a study done in Eastern Sudan, it was found that illiteracy and ethnicity were significantly associated with neonatal deaths (Abdel Aziem A. Ali 2010). A prospective study conducted in rural India on pregnant women showed poor utilization of primary health services and very poor maternal care receptivity especially in terms of antenatal care. A very high neonatal mortality rate of 63.7/1000 live births was observed in the present study. Of the 204 live births, 72.1 percent of newborn developed complications within 6 weeks of the delivery. Most of the complications were of a minor nature and could be attributed to poor environmental conditions, lack of personal hygiene and ignorance.

“An institution-based surveillance and nested case-control study was conducted in Natal, North-eastern Brazil to estimate the level and determinants of early neonatal mortality. The early neonatal mortality rate was 25.5 per 1000 live births, 75 per cent of early neonatal deaths were premature low birth weight infants, and the mortality rates were 591 and 31 per 1000 live births respectively, for preterm small for gestational age (PT-SGA) and preterm appropriate for gestational age (PT-AGA) infants. Mortality was 50 per 1000 for term low birth weight, and 8.6 for term normal birth weight AGA infants.

In order to reduce neonatal mortality, it is essential to come up with interventions. Findings from the BMJ team from the Boston University Center for Global Health and Development show that training and equipping Zambian traditional birth attendants to perform a neonatal

resuscitation intervention led to a net reduction of about 18 deaths per 1,000 live births in the first 28 days of life, a significant reduction in the overall neonatal mortality rate in Zambia, of about 34 deaths per 1,000 live births (Science Daily February, 2011). Appropriate antenatal care can play a role by educating women and their families to recognize delivery complications that require referral to health care services to achieve a better health outcome for both mothers and infants. (Mercer A, Haseen, 2006). The Lancet neonatal series, published in 2005, highlighted the need to improve delivery and postnatal care. In an effort to address this need, 16 interventions with proven efficacy or effectiveness were identified and packaged into three service delivery modes: Family and Community, Outreach, and Facility-based care. Facility-based interventions were identified as being the most cost-effective, achieving estimated reductions in neonatal mortality by 23 to 50 per cent. Family and Community-based interventions were similarly estimated to correspond to reductions in neonatal mortality ranging from 15 to 32 percent (Projahnmo, 2007). A study done by World Health Organisation came up with interventions to reduce neonatal mortality. This is during the neonatal period could include one or more of the following, "the promotion of optimal neonatal care practices, such as exclusive breastfeeding, keeping the baby warm and clean umbilical cord care, caregiver education to improve caregiver recognition of life-threatening neonatal problems and appropriate health care seeking behaviour; the identification of signs of severe neonatal illness and referral to a health facility; or home-based management of neonatal conditions. Interventions during pregnancy could comprise one or more of the following: promotion of antenatal care; health education and/or counselling of the mother regarding desirable practices during pregnancy; promotion of delivery in a hospital or at home by a skilled birth attendant; and education about safe and/or clean delivery practices Interventions during delivery could include the implementation by community health workers of safe delivery practices at home and proper care of the neonate immediately after birth, such as keeping the baby warm, providing neonatal resuscitation (if required) and initiating breastfeeding early"(Siddhartha Gogia et al, 2010).

The fact that neonatal mortality rate is not reducing entails that MDG 4 will not be achieved as Zambia will continue losing new born babies. Perhaps it is important to ask why neonatal mortality is not given as much attention as infant and under-five mortality. To save new-born babies in Zambia, there is need to change the focus to the time when most infants die, the neonatal period. The only way this problem could be resolved and have neonatal mortality reduced is to come up with good interventions mentioned above that have proved significant.

The only way good interventions can be implemented is only after risk factors and causes have been identified.

1.4 Statement of the Problem

Neonatal health is critically related to maternal health, with many early neonatal deaths related to care during delivery (UNFPA, 2006). Currently, data from the 2007 ZDHS report shows that neonatal mortality rate in Zambia is at 34 deaths per 1,000 births. Neonatal mortality continues to be a major challenge in Zambia. Due to complex causal framework of neonatal mortality, improvement of this health indicator is quite gradual and its decreasing trend is not as great as other health indicators such as infant and under 5 mortality rates. In order to reduce neonatal mortality rate in Zambia and given the trauma of losing a child, it is very important to fully understand the causes and risk factors associated with neonatal mortality.

1.5 Rationale

Neonatal deaths account for a large proportion of child deaths. Mortality during neonatal period is considered a good indicator of both maternal and new born health and care. Neonatal mortality has not been given enough emphasis it deserves. There has been very limited research investigating the factors that influence neonatal mortality in Zambia. An understanding of the factors related to neonatal mortality is important to guide the development of focused and evidence-based health interventions to prevent deaths. Neonatal mortality constitutes a significant burden in Zambia, and it is an important national challenge to reduce this burden. “The estimates of neonatal mortality rate must be known precisely in order to monitor progress in safe motherhood and health of new borns” (Stephen P Munjanja, 2007). To achieve the MDG for child health, it will be necessary to reduce new born deaths substantially. “The quality of information needed for such assessments of programmes cannot come from statistical modelling, sisterhood methods or censuses as they are currently conducted” (Stephen P Munjanja, 2007). The need to know the risk factors that are associated to neonatal mortality is further justification for doing the study. Understanding factors associated with Neonatal mortality and why it is not significantly reducing will help in:

- Guiding the development of focused and evidence-based health interventions to prevent neonatal deaths.
- Designing preventive and corrective strategies at both community and facility level.
- Adjusting and refining existing child health policies focussing on neonatal life.
- Reduce the burden of disease and conversely improve child survival.
- Help Policy makers and implementers to use the data in planning for preventive measures to reducing neonatal mortality.

Chapter Two: AIMS AND OBJECTIVES

2.1 Research Questions

Given that neonatal mortality is not reducing significantly, there is need to adopt a focused, evidence-based approach to reduce neonatal mortality in Zambia and a clear understanding of the associated factors is necessary: The key question is:

- What are the factors influencing neonatal mortality at population level? (Primary Question).

2.2 General Objectives

To analyse the risk factors associated with neonatal mortality at population level.

2.3 Specific Objectives

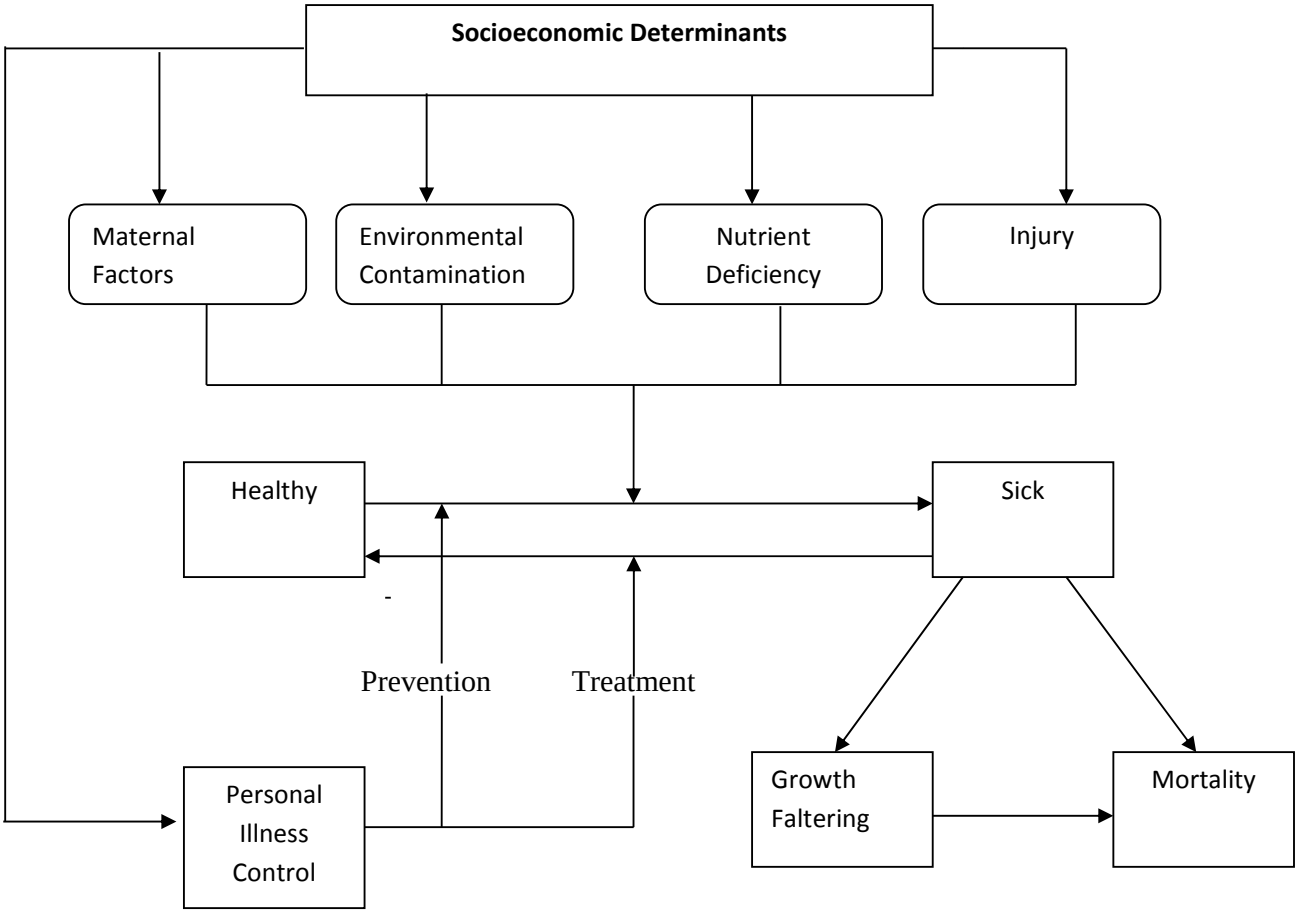
- To assess the association between age of mother at birth and neonatal mortality.
- To assess the association between the birth order and neonatal mortality.
- To assess the association between the quality of antenatal care received during pregnancy and neonatal mortality.
- To assess the association between place of delivery and neonatal mortality.
- To assess the association between assistance during delivery and neonatal mortality.
- To assess the association between birth weight and neonatal mortality.

In order to achieve these objectives, the conceptual framework by Mosley and Chen has been used.

2.4 Conceptual Framework

The Mosley and Chen conceptual framework **(figure 2.1)** for the study of child survival in developing countries was adapted based on the available information in the 2007 datasets. The analysis and interpretation of this data is based on proximate determinants **(figure 2.2)** influencing the survival of children in developing countries developed by Mosley and Chen's model of five groups of health determinants. They sought to merge the traditional approaches of social scientists with those of medical researchers. The proximate determinants are grouped into five categories: maternal factors; environmental contamination; nutrient deficiency; injuries; and personal illness control (prevention, treatment). The cardinal aspects of this model are "to clarify our understanding of the many factors involved in the family's production of healthy children in order to provide a foundation for formulating health policies and structures". The underlying variables in this study are age of mother at birth, birth order, quality antenatal care, place of delivery, low birth weight and assistance during delivery. This conceptual framework is very important in that it is based “on the premise that all social and economic determinants of child mortality necessarily operate through a common set of biological mechanisms or proximate determinants to exert an impact on mortality. The framework is intended to advance research on social policy and medical interventions to improve child survival” (Mosley and Chen, 1984). The conceptual framework helps to understand the causal pathways from socioeconomic determinants to child mortality. Surveys on child mortality should follow this framework because proximate determinants that directly influence child mortality are identified and this framework can help formulate policies that will curb the problem at that level hence reducing child mortality.

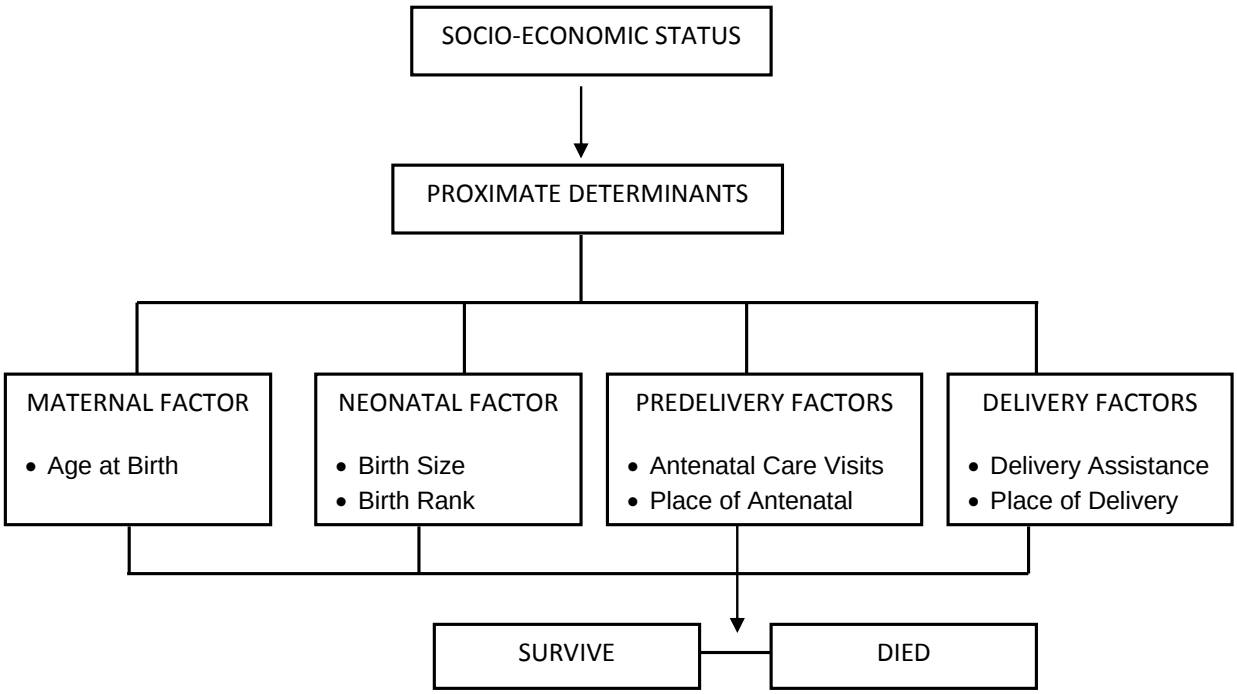
Figure 2.1: Mosley and Chen Conceptual Framework



Source: WH Mosley & LC Chen. An analytical framework for the study of child survival in developing countries. *Population and Development Review 1984*; 10 (Suppl): 25-45. Reprinted in *Bull WHO* 2003; 81(2): 140-148.

Figure 2.2: Proximate Determinants by Mosley and Chen's Model of Five groups of Health Determinants

Based on the above, below is the framework of the study



Source: WH Mosley & LC Chen. An analytical framework for the study of child survival in developing countries. *Population and Development Review 1984*; 10 (Suppl): 25-45. Reprinted in Bull WHO 2003; 81(2): 140-148.

Figure 2.2 shows an assessment or examination of the factors influencing neonatal mortality in particular maternal, neonatal and delivery factors were done. The analysis also took into consideration other proximate determinants that influence child mortality such as personal illness control where health individuals take preventive measures to avoid disease. In this study, such practices were seen as pre-delivery factors i.e. quality of antenatal care during pregnancy and also care given during child birth. Mosley and Chen have clearly indicated that the novel aspect of this model is its definition or a specific disease state in an individual as an indicator of the operation of the proximate determinants rather than as a cause of death.

Chapter 3: METHODOLOGY

3.1 Study Setting

Zambia is a landlocked sub Saharan country located in Southern Africa with a total land area of 752,612 sq.km .According to the 2010 Census of Population and Housing Report, Zambia has a population of 13,092,666 million people with an annual growth rate of 2.8. The country is administratively divided into 10 provinces, of which 60.5 percent were in rural areas and 39.5 percent live in urban areas (Population Analytical Report: 2010).

3.2 Study Population

All Women aged 15-49 years who reported having had given birth to live infants within the five years preceding the survey were included as the study population but only those infants who could have lived through the first month (28-30 days) have been included in the analysis.

3.3 Study Design and Sampling Procedures

This study is a cross sectional study based on data from the 2007 ZDHS. The variables that have been used in the study are from the woman's questionnaire and include questions on mother's age at birth, birth order of the child, quality of antenatal care, place of delivery, who assisted during delivery and the weight of a baby at birth. A proxy for quality of antenatal care is place of delivery which could possibly have had an impact on neonatal mortality.

3.3.1 Data Source: Zambia Demographic Health Survey (ZDHS)

The data examined was the ZDHS 2007.This was a nationally representative survey of 7,146 women age 15-49 years and 6,500 men age 15-59 years. The ZDHS used standardized methods that achieved high individual and household response rate. This was the fourth comprehensive survey conducted in Zambia as part of the Demographic and Health Surveys (DHS) programme. A representative sample of 8,000 households was drawn for the 2007 ZDHS survey. The sample for ZDHS 2007 was a stratified sample selected in two stages from the Census of Population and Housing 2000 frame. In the first stage, 320 SEAs were

selected with probability proportional to the SEA size. The household listing operation was conducted in all selected SEAs, with the resulting lists of households serving as the sampling frame for the selection of households in the second stage. Selected SEAs with more than 300 households were segmented, with only one segment selected for the survey with probability proportional to the segment size. Household listing was conducted only in the selected segment. Therefore, a ZDHS 2007 cluster is either an SEA or a segment of an SEA. In the second stage selection, an average number of 25 households were selected in every cluster, by equal probability systematic sampling.

The 2007 Zambia Demographic and Health Survey was designed to provide up-to-date information on background characteristics of the respondents, fertility levels, nuptiality, sexual activity, fertility preferences, awareness and use of family planning methods; breastfeeding practices; nutritional status of mothers and young children; early childhood mortality and maternal mortality; maternal and child health; and awareness, behaviour, and prevalence regarding HIV/AIDS and other sexually transmitted infections. The target groups were men age 15-59 and women age 15-49 years in randomly selected households across Zambia. Information about children age 0-5 was also collected, including weight and height.

3.3.2 Neonatal Mortality Survey

3.3.2.1 Data Extraction

Data was extracted from the 2007 ZDHS Women's Questionnaire for women aged 15-49 years. The information recorded on the Women's Questionnaire included the women's demographic characteristics, their full birth history, history of antenatal care for the most recent birth within a five-year period preceding the survey, delivery and postnatal care for all births, as well as the survival of their live-born infants. Data was obtained from the full birth histories collected from eligible women aged 15 to 49 years in sampled households. For each live birth, the month and year of the birth were reported. If the child had died, the mother was asked for the age of the child at death: in days, months and years. It is the deaths reported in days that we extracted deaths that took place in the first 28 days of life (neonatal deaths).

Proximate determinants at the individual level were identified through which socioeconomic variables could possibly have had an impact on neonatal mortality. These variables were

maternal age at child birth to represent, maternal factors; maternal subjective assessment of the infant's size, infant's birth rank which represented the neonatal factors; delivery assistance and place of delivery for delivery factors; and antenatal care visits and place of delivery to represent predelivery factors.

3.3.2.2 Data Analysis

The analysis was purely based on respondents who reported having had given birth to a live child but died within the first month of life (neonatal mortality). Basically the characteristics of this study population which were socio-demographic variables have been analysed using descriptive tables. Analysis was done using STATA version 12 Special Edition.

The factors associated with neonatal mortality were assessed using univariate and multivariate logistic regression model. All the variables included in both the univariate and multiple regression model were outlined based on the literature review and also following the conceptual framework based on Mosley and Chen. A univariate analysis was done and all independent variables whether significantly associated with neonatal mortality at 5 percent level of significance or not were included in the multivariate logistic regression. The Multivariate model also controlled for confounder age of mother at birth and/or birth order and 95 percent confidence interval was determined.

Multiple regression models for savings in terms of the explanatory /independent variables as expressed as:

$$\ln\left(\frac{\hat{p}}{(1-\hat{p})}\right) = b_0 + b_1X_1 + b_2X_2 + \ldots + b_pX_p$$

Where $\hat{p}$ is the expected probability that the outcome is present; X_1 through X_p are distinct independent variables; and b_0 through b_p are the regression coefficients. This model (e.g., b_1) indicates the change in the expected log odds relative to a one unit change in X_1, holding all other predictors constant.

3.4 Ethical Considerations

The ZDHS survey obtained ethical approval from the Tropical Disease and Research Centre (TDRC) in Ndola, Zambia and the US Centre for Disease Control and Prevention (CDC) Atlanta research ethics review board. Participation in the survey was based on informed and voluntary consent. Participants were informed about this in accordance with ethical requirements. Our re-analysis of the data did not infringe on participant's privacy since this data was already anonymised, approved and made available for public use and can be used for academic purposes as long as authority is given by the Central Statistical Office. In addition, to the above, a waiver was also sought from the Biomedical Research Ethics Committee. A waiver of ethics review for protocol was granted to conduct the study on factors influencing Neonatal Mortality based on the 2007 ZDHS.

3.5 Dependent Variable and Explanatory Variables

The primary outcome is neonatal mortality and the explanatory variables are Socio-economic variables / proximate determinants. Table 3.1 shows the operational variable framework.

i. Primary Outcome

Neonatal status at day 28 which is neonatal mortality is the number of deaths during the first 28 completed days of life per 1,000 live births in a given year or period.

ii. Explanatory Variables

Socio-demographic factors: These are characteristics of a population expressed statistically, such as age, sex, education level, income level, marital status, occupation, religion, birth rate, death rate, average size of a family, average age at marriage. In this study, the explanatory variables included are age of mother at birth, birth order, quality of antenatal care, place of delivery, assisted during delivery and a proxy for quality antenatal care being place of antenatal care.

a. **Age of Mother at birth:** To measure age of mother, respondents were asked questions on when they were born and when their first born child was born. These

two questions are linked to create a variable age at first birth. Age of mother at birth seeks to collect information on how old the respondent was when she gave birth to the neonate that died. However, there was no question asking particularly on the age of the mother at birth for the neonate that died. For this reason, age at first birth was used as a proxy to obtain mean age of the mother at birth.

b. **Birth Order:** This variable was measured by asking the respondents to list the names of all the births they have had whether still alive or not starting with the first born and continuing until the last born following the order they were born.

c. **Quality of Antenatal Care:** To measure quality of antenatal care, the respondents were asked how many times they received antenatal care during the pregnancy of the last born. The major objective of antenatal care is to achieve the optimal health outcome for the mother and the baby. The newest WHO approach to promoting safe pregnancies recommends that a woman without complications have at least four antenatal care visits. The assumption is that more visits result in better care for the pregnant woman.

d. **Place of Antenatal Care:** This is a proxy for quality of antenatal care. The respondents were asked where they received antenatal care for pregnancy of the last birth whether it was home, government health facility or private/mission hospital

e. **Place of Delivery:** The variable was measured by asking respondents where they gave birth to that particular child. The purpose of this question is to identify births delivered in a health facility. Increasing the number of births delivered in health facilities is an important factor in reducing deaths arising from the complications of pregnancy. The expectation is that if a complication arises during delivery, a skilled health worker can manage the complication and/or refer the mother to the next level

f. **Assisted during Delivery:** To measure this variable, respondents were asked who assisted with the delivery of that particular pregnancy. Assistance during childbirth is an important variable that influences the birth outcome and the health of the mother and infant.

g. Low Birth Weight: To measure this variable, respondents were asked how much the child weighed at birth. Overall, 4 percent of births with a reported birth weight in Zambia are less than the normal weight of 2.5 kg. "Birth weight of less than 2,500 kg is recognized as the most influential factor in determining neonatal morbidity-mortality. Low birth weight stems from prematurity and/or delayed intrauterine growth and is associated with around four million neonatal deaths around the world every year, mostly in developing countries" (Lawn, 2005).

Table 3.1: Operational Variable Framework

Variable	Scale of measurement (if any)
Primary Outcome	
Neonatal Mortality	All live born infants within the 5 years preceding the study but only those infants who could have lived through the first month
Explanatory Variable	
Socio-demographic Determinants	
Maternal age at first birth	Age at first birth (Less than 15, 15- 24, 25 and above)
Maternal age at child birth	Age at child birth (Less than 20, 20-34, 35 and above)
Birth Order	First birth, 2nd or 3rd birth rank
Low Birth weight	Less than 2.5 kg, 2.5 kg or more
Health Seeking Behavior	
Mother attended antenatal	Yes/No, How many times and when was the first visit
Place of Antenatal care	
Delivery assistance	Birth attendance during delivery (health professional, traditional birth attendant/other)
Place of Delivery	Home, Public health facility, Private health facilities

Chapter 4: RESULTS

4.1 General Characteristics of Study Population

The distribution of the study population used in the analysis is shown in table 4.1 below. To identify the associated factors for neonatal mortality, 6435 live-born infants within the five years preceding the survey were included as the study population. Of these births, 219 (34 per 1000 live births) neonatal deaths were recorded. Below is the percentage distribution of neonatal mortality by background characteristics.

Table 4.1: Percentage Distribution of Neonatal Mortality by Background Characteristics in Zambia

Predictor Variable	Total Number of Births	Neonatal Death	
Age of Mother		**Number**	**Percent**
12 - 17	2649	101	46.1
18-24	3520	103	47.2
25-29	233	14	6.4
30-34	30	0	0
35-49	3	1	0.3
Birth Order			
1-3rd Birth order	3502	116	53.0
4-6th birth order	1998	76	35.0
7th + birth order	935	27	12.0
Place of Delivery			
Home	3325	98	45.0
Government Healthy Facility	2745	103	46.9
Private Healthy Facility	324	13	5.9
Other places	23	0	0
Unspecified	18	4	2.2
Assisted to Deliver			
Skilled doc/midwife	2969	111	52.5
Traditional birth attendant	1441	42	20.1
Relative	1672	52	24.6
No one	303	5	2.8
Birth Weight (kg)			
1000-2499	**285**	**17**	22.0
2500-3999	**2384**	**50**	61.0
4000+	**407**	**14**	17.0
ANC Visits			
1 antenatal Care visit	95	4	4.8
2 Antenatal care Visits	336	12	12.7
3 Antenatal Care Visit	1068	21	21.6
4+ ANC Visits	2494	61	60.8
Proximate Determinants			
Place of Antenatal Care			
Home	22	1	0.8
Government Facility	3729	92	91.5
Private/Mission	268	7	7.7

Predictor Variable	Total Number of Births	Neonatal Death	
Age of Mother		**Number**	**Percent**
Other	20	0	0
Highest Level of Education			
No Education	4089	147	76.7
Primary Education	1320	34	18.2
Higher Education	156	9	5.1
Total	**6435**	**219**	**3.4**

4.2 Factors influencing Neonatal Mortality

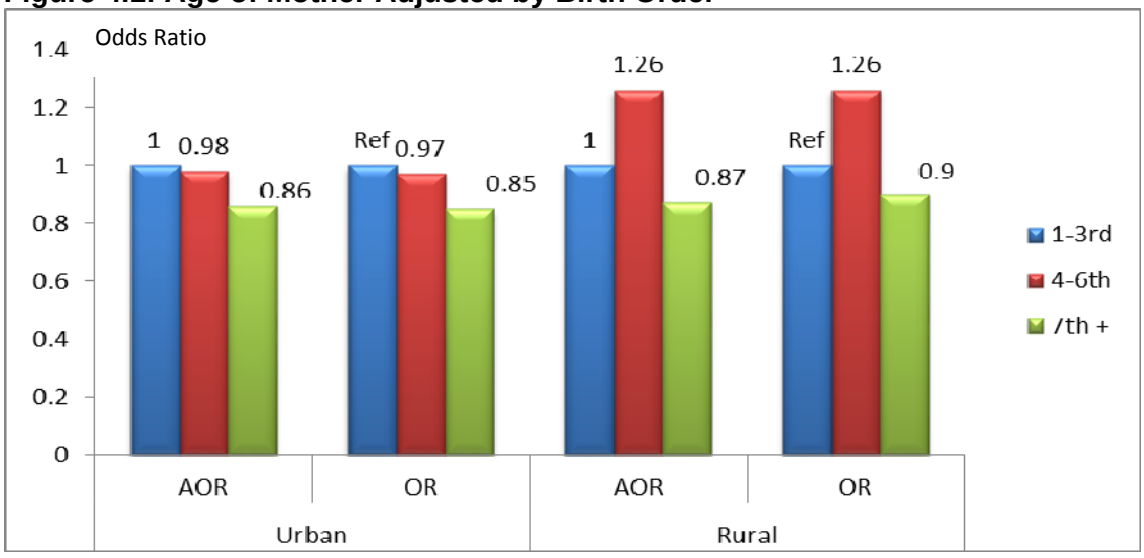
The results from the univariate and multivariate logistic regression indicate that age of mother was not associated to neonatal mortality (Table 4.2). The age group 18-24 years tended to be associated with reduced odds of neonatal mortality but was not statistically significant (OR 0.76 95% CI 0.53 – 1.09). Further, the age group 25-29 years had increased odds of neonatal mortality but was not statistically significant (OR 1.60, 95% CI 0.76 - 3.38). The age group 30-34 years showed no difference with the age group 12- 17 years old as there were no deaths recorded (OR 1). The age group 35-39 years showed increased odds of infants dying (OR 10.4 95 % CI 0.87-123.8) though insignificant.

Assessing the age of mother after controlling for birth weight showed that age group 18-24 had weakened reduced odds, i.e. 0.49 times lower odds of dying than babies born from mothers in the age group 12-17 years and was statistically significant with a p value of 0.007. Babies born from mothers in the age group 25-29 years had 1.36 times higher odds of dying than babies born from those aged 12-17 years. The pattern for the age group 30-34 remained unchanged. Adjusting for birth weight by residence showed that in urban areas, the age group 18-24 years was associated with reduced odds of neonatal deaths but insignificant while in rural areas, reduced odds of neonatal deaths were also noted and were significant (OR 0.71, CI 0.45-1.10, p 0.007).The age group 25-29 years also showed increased odds of neonatal deaths in urban areas though insignificant while in rural areas, it was associated with reduced odds of neonatal deaths.

The table also shows data on univariate and multivariate analysis of birth order and neonatal mortality. Birth order 1-3 was more likely to be associated with reduced odds of neonatal mortality. On the other hand, birth orders 4-6th birth orders was associated with increased

odds of neonatal mortality (OR 1.15 95% CI 0.81 – 1.63). Birth order 7th and above was associated with reduced odds of neonatal mortality compared to 1-3rd birth order (OR 0.86 95% CI 0.53 – 1.37) though this was not statistically significant. Adjusting for age of mother did not affect the unprotective effect of 4th -6th birth order on neonatal mortality. The birth orders 7th and above showed weakened reduced odds of neonatal mortality though not significant. After adjusting for age of mother in both urban and rural areas, the association in urban areas showed that 4-6th births was associated with reduced odds of neonatal deaths (OR 0.98, CI 0.44-2.15) and no evidence of statistical significance was noted. In urban areas, 7th birth order and above showed reduced odds though not significant. In contrast, 4-6th birth order in rural areas was associated with increased odds of neonatal deaths while 7th birth order and above was associated with reduced odds of neonatal deaths.

Figure 4.1: Age of Mother Adjusted by Birth Order

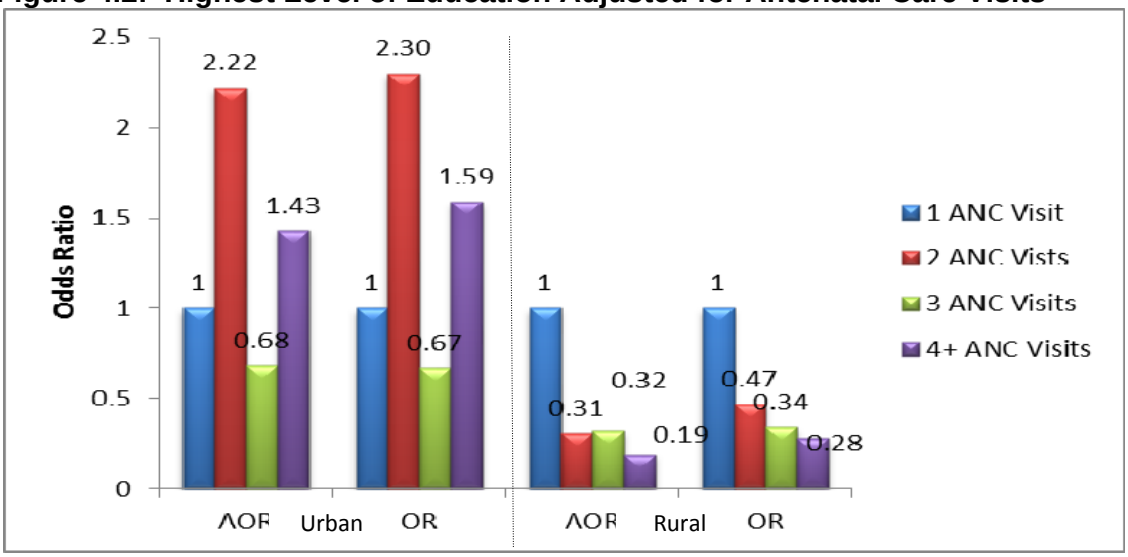


The table further presents data on univariate and multivariate analysis of quality of antenatal care and neonatal mortality assessed by the number of ANC visits. The results show that two ANC visits was associated with reduced odds of neonatal deaths (OR 0.73 95% CI 0.23-2.27) though not significant. Three (3) antenatal care visits was associated with reduced odds i.e. 38 times lower odds of neonatal deaths than 1 (one) antenatal care visit. Attending antenatal care 4 times and above showed reduced odds of neonatal mortality (OR 0.47, 95% CI 0.17-1.22) though no evidence of statistical significance was observed. Adjusting for highest level of education showed weakened reduced odds for 2 (two) ANC visits (OR 0.57 95% CI 0.17-1.86). The pattern was the same for three ANC visits (OR 0.36 95% CI 0.12-1.04). Having

attended ANC 4 times and above showed weakened reduced odds (OR 0.36 95% CI 0.13-0.95, p=0.04) and this was significant.

Analysis by residence after adjusting for highest level of education in urban areas showed that visiting antenatal care 4 times and above tended to be associated with increased odds of neonatal deaths though insignificant. In rural areas, attending antenatal care 4 times and above was associated with reduced odds of neonatal deaths and was significant (OR 0.19, CI 0.06-0.61,p= 0.005).

Figure 4.2: Highest Level of Education Adjusted for Antenatal Care Visits



As a proxy for quality care, place of antenatal care was assessed and ANC done at home was our reference point. Having had antenatal care at a Government health facility was associated with reduced odds of neonatal mortality (0.68, 95% CI 0.09 – 4.99) i.e. Antenatal care at a Government facility was a protective measure for neonatal mortality. The pattern was the same for Private /Mission hospital/Clinic with reduced odds of neonates dying (OR 0.79, 95% CI 0.92 – 6.91) compared to Home. No statistically significant association was observed. Adjusting for age of mother weakened the protective effect of antenatal care at a government on neonatal mortality. The protective effect of Private/Mission hospital on neonatal mortality also showed weakened reduced odds after controlling for age of mother though not statistically significant. Antenatal care at Government and private hospitals had almost equivalent survival prospects for infants. In both urban and rural areas, the association remained insignificant.

Furthermore the table shows data on univariate and multivariate analysis of place of delivery and neonatal mortality. Place of delivery at home was our reference point. Delivering at a Government Health facility tended to be associated with increased odds of neonatal mortality (OR 1.27, 95% CI 0.91-1.77) though no evidence of statistical significance was observed. Having a private health facility as a place of delivery also increased the odds of neonatal mortality (OR 1.37, 95% CI 0.68-2.76) equally not statistically significant. This means that infants delivered in public and private hospitals tended to have higher odds of dying than those delivered from home. The results also show that women who did not specify where they delivered from were associated with higher odds of neonatal mortality (OR 11.4 95% CI 2.91-44.6, p=0.001). Adjusting for highest level of education increased the odds neonatal deaths for infants born at both Government and Private health facility. As for place of deliveries unspecified, the odds of neonatal deaths increased further and was significant.

Adjusting for highest level of education in urban areas showed reduced odds of neonatal deaths in Government Health facilities (OR 0.66, CI 0.30-1.39). In private health facilities, increased odds of neonatal deaths were noted (OR 1.06, CI 0.25-4.47) but no statistical significance was observed. Place of delivery unspecified did not show any difference with the deliveries done at home. In contrast for rural areas, adjusting for highest level of education showed increased odds of neonatal deaths (OR 1.72, CI 1.06-2.78, p= 0.027). Private health facility also tended to have increased odds of neonatal deaths (OR 1.34, CI 0.57-3.16) but was insignificant. Unspecified deliveries showed increased odds of neonatal mortality in rural areas.

The table shows data on univariate analysis of assistance during delivery and neonatal mortality. Having been assisted by skilled doctor/nurse/midwife/health professional was our reference point for neonatal mortality. Assistance by a Traditional birth attendant was associated with reduced odds of neonatal mortality (OR 0.78, 95% CI 0.53-1.14) though not statistically significant than being assisted by skilled doctor/nurse/midwife/health professional. Assisted by a relative/friend during delivery had equally a protective effect against neonatal mortality (OR 0.82, 95% CI 0.55-1.14). The data also indicates that with no one assisted during child birth tends to reduce the odds of neonatal mortality (OR 0.51 95% CI 0.18-1.42). These results were quite puzzling and when fit into the multiple regression analysis, it did not change the association between being assisted by skilled doctor/nurse/midwife/health professional and neonatal mortality. The protective effect of

assistance at delivery by a traditional birth attendant on neonatal mortality remained the same but the effect remained statistically insignificant. Assistance by relative/friend during delivery did not change. Having no one assisting at birth showed a weakened protective effect.

Adjusting for age of mother in urban areas showed that Traditional birth attendant had increased odds of neonatal mortality (OR 1.04, CI 0.28-3.73). Being assisted by a relative/friend also had increased odds of neonatal deaths in urban areas (OR 2.44, CI 1.13-5.22, p=0.022) and was significant. Having no one assisted during delivery was associated with reduced odds but insignificant. In rural areas, adjusting for age of mother showed that traditional birth attendant was associated with reduced odds of neonatal deaths. (OR 0.68, CI 0.43-1.07), with no evidence of statistical significance. Being assisted by a relative/friend had a protective effect of neonatal deaths (OR 0.60, CI 0.36-0.99, p=0.048). With no one to assist during delivery showed reduced odds of neonatal deaths but insignificant.

The results in table reveal data on univariate analysis of birth weight and neonatal mortality. The data shows that there was an association between low birth weight and neonatal mortality. Giving birth to an underweight child weighing (1000-2499 grams) was associated with increased odds of neonatal mortality (OR 3.10 95% CI 1.66-5.79, P<0.000) compared to infants born with normal weight (2500-3999 grams). There was evidence of statistical significance. While the odds ratio is statistically significant, the confidence interval suggests that the magnitude of the effect could be anywhere from a 1.66 fold increase to a 5.79 fold increase. Large born infants weighing (4000^{+}kgs) had increased odds of neonatal deaths (OR 1.68 95% CI 0.86-3.28) compared to normal weight infants. Adjusting for age of mother did not affect the protective effect of normal birth weight (2500-3999 g) but rather showed increased odds of neonatal deaths with reduced strength (OR 3.08, 95% CI 1.62 -5.82), p=0.001) The association between large babies (4000^{+} grams) and neonatal was still a risk. Birth weight was again adjusted for place of antenatal care. Underweight born babies were still associated with increased odds of neonatal mortality (OR 2.48 95% CI 1.06-5.82, p=0.036. Large born babies also tended to have 25 times higher odds of neonatal deaths than normal weight with a p-value of 0.024 which is significant. Another variable was added to the model adjusting for place of delivery. Both underweight and large born babies had higher odds of neonatal deaths with underweight showing high levels of significance (OR.3.10 95% CI 1.66-5.78, P<0.000).

After adjusting for age of mother, low birth weight still showed reduced odds of neonatal deaths in urban areas but was significant (OR 3.53, CI 1.50-8.24, p=0.004. Large weight babies also had increased odds of neonatal deaths though insignificant. (OR 1.66, CI 0.50-5.41). In rural areas, low birth weight showed weakened increased odds of neonatal deaths (OR 2.58, CI 0.97- 6.87, p=0.057). On the other hand, large weight babies still had increased odds of neonatal deaths. Adjusting for place of antenatal care showed that low birth weight was associated with increased odds of neonatal deaths though insignificant. The pattern was the same for large birth weight. In rural areas low birth weight was associated with increased odds of neonatal deaths though insignificant while large weight babies showed increased odds of neonatal deaths (OR 3.04, CI 1.02-9.06,p=0.046).

The relationship between level of Education and neonatal mortality was also assessed. The results showed that mothers with primary education were associated with reduced odds of neonatal mortality (OR 0.72 95% CI 0.45-1.14) compared to mothers with no education. On the other hand, mothers with secondary education tended to have increased odds of neonatal deaths (OR 1.78 95% CI 0.82-3.84, p=0.140) than those with no education. This did not show any evidence of statistical significance. In both urban and rural areas, Primary education was associated with reduced odds of neonatal deaths while higher education tended to be associated with increased odds of neonatal deaths. This was insignificant.

Table 4.2: Factors associated with Neonatal Mortality by Age of Mother, Birth Order, ANC Visits, Place of ANC, Place of Delivery, Assistance during Delivery and Birth Weight

	Total						Urban						Rural					
Variables	**Univarite Unadjusted**			**Multivariate Adjusted by Birth weight**			**Univariate Unadjusted**			**Multivariate Adjusted by Birth weight**			**Univariate Unadjusted**			**Multivariate Adjusted by Birth weight**		
	Odds Ratio	**95%**	**P**	**Odds Ratio**	**95%**	**P**	**Odds Ratio**	**95% CI**	**P**	**Odds Ratio**	**95% CI**	**P**	**Odds Ratio**	**95% CI**	**P**	**Odds Ratio**	**95% CI**	**P**
Age of Mother																		
12- 17	1	Ref		1	Ref		1	Ref		1	Ref		1	Ref		1	Ref	
18-24	0.76	0.53-1.09	0.139	0.49	0.30-0.82	0.007	0.87	0.47-1.61	0.667	0.63	0.31-1.28	0.205	0.71	0.45-1.10	0.126	0.38	0.19-0.77	0.007
25-29	1.60	0.76-3.38	0.21	1.36	0.51-3.62	0.533	1.49	0.48-4.56	0.483	1.86	0.59-5.52	0.283	1.69	0.61-4.59	0.304	0.37	0.05-2.63	0.322
30-34	1			1			1			1			1			1		
35-39	10.4	0.87-123.8	0.06										10.6	0.87-127.6	0.06			
Birth order	**Univariate**			**Multivariate (Adjusted by Age of Mother)**			**Univariate (OR)**			**Multivariate (AOR)**			**Univariate (OR)**			**Multivariate (AOR)**		
1-3rd birth	1	Ref		1	Ref		1	Ref		1	Ref		1	Ref		1	Ref	
4-6th birth	1.15	0.81-1.63	0.432	1.15	0.80-1.64	0.427	0.97	0.47-1.98	0.936	0.98	0.44-2.15	0.960	1.26	0.83-1.90	0.263	1.26	0.83-1.89	0.264
7th +births	0.86	0.53-1.37	0.523	0.84	0.52-1.35	0.480	0.85	0.24-2.98	0.799	0.86	0.24-3.01	0.814	0.90	0.54-1.49	0.692	0.87	0.52-1.44	0.597
Variables	**Univariate**			**Multivariate**			**Univariate**			**Multivariate**			**Univariate**			**Multivariate**		
	Odds Ratio	**95%**	**P**	**Odds Ratio**	**95%**	**P**	**OR**	**95% CI**	**P**	**OR**	**95% CI**	**P**	**OR**	**95% CI**	**P**	**OR**	**95% CI**	**P**
Antenatal Care Visits	**Adjusted for Highest education**																	
1 antenatal Care visit	1	Ref		1	Ref		1	Ref		1	Ref		1	Ref		1	Ref	
2 Antenatal care Visits	0.73	0.23-2.27	0.591	0.57	0.17-1.86	0.356	2.30	0.24-21.7	0.463	2.22	0.22-21.5	0.466	0.47	0.12-1.83	0.278	0.31	0.07-1.39	0.128
3 Antenatal Care Visit	0.38	0.13-1.09	0.07	0.36	0.12-1.04	0.061	0.67	0.07-6.21	0.726	0.68	0.74-6.33	0.739	0.34	0.10-1.11	0.075	0.32	0.09-1.05	0.060
4+ ANC Visits	0.47	0.17-1.22	0.121	0.36	0.13-0.95	0.040	1.59	0.20-12.4	0.655	1.43	0.18-11.0	0.726	0.28	0.09-0.84	0.025	0.19	0.06-0.61	0.005
Place of Antenatal care	**Unadjusted**	**AOR**					**Univariate**			**Multivariate (AOR) Age of Mother**			**Univariate**			**Multivariate (AOR) Age of Mother**		
Home	1	Ref		1	Ref		1	Ref		1	Ref		1	Ref		1	Ref	
Government Health Facility	0.68	0.09-4.99	0.705	0.64	0.08-4.74	0.667	0.39	0.12-1.27	1.118	0.38	0.12-1.20	0.100	0.59	0.07-4.40	0.608	0.56	0.07-4.12	0.566
Private/Mission Hospital	0.79	0.92-6.91	0.839	0.72	0.08-6.22	0.768	1			1			0.33	0.03-3.42	0.356	0.29	0.02-3.05	0.304
Other	1	empty		1	empty		1			1			1			1		

Place of Delivery	Univariate			Multivariate (AOR) Highest Level Education			Univariate			Multivariate (AOR) Highest Level Education			Univariate			Multivariate (AOR) Highest Level Education		
Home	1	Ref		1	Ref		1	Ref		1	Ref		1	Ref		1	Ref	
Government Health Facility	1.27	0.91-1.77	0.146	1.36	0.92-2.02	0.121	0.56	0.31-1.01	0.058	0.66	0.30-1.39	0.272	1.62	1.04-2.52	0.030	1.72	1.06-2.78	0.027
Private Health Facility	1.37	0.68-2.76	0.369	1.47	0.71-3.05	0.295	1.07	0.27-4.24	0.916	1.06	0.25-4.47	0.932	1.22	0.55-2.72	0.616	1.34	0.57-3.16	0.491
Unspecified	11.4	2.91-44.6	0.001	12.4	2.71-56.3	0.001	1			1			23.2	5.71-94.3	0.000	30.3	5.22-175.7	0.000
Assisted During Delivery	**Univariate**			**Multivariate (AOR) Age of Mother**			**Univariate**			**Multivariate (AOR) Age of Mother**			**Univariate**			**Multivariate (AOR) Age of Mother**		
Skilled doctor/nurse/midwife/ health professional	**1**	**Ref**		**1**	**Ref**		**1**	**Ref**		**1**	**Ref**		**1**	**Ref**		**1**	**Ref**	
Traditional Birth Attendant	0.78	0.53-1.14	0.204	0.78	0.53-1.14	0.212	1.03	0.28-3.73	0.965	1.04	0.28-3.73	0.954	0.69	0.43-1.07	0.100	0.68	0.43-1.07	0.096
Relative/Friend	0.83	0.55-1.22	0.345	0.82	0.55-1.22	0.342	2.34	1.13-4.81	0.021	2.44	1.13-5.22	0.022	0.61	0.37-1.01	0.057	0.60	0.36-0.99	0.048
No one	0.51	0.18-1.42	0.197	0.48	0.88-1.26	0.140	0.53	0.07-4.00	0.539	0.58	0.07-4.40	0.599	0.46	0.14-1.45	0.184	0.40	0.14-1.25	0.120
Birth Weight	**Univariate**			**Multivariate (AOR) Age of Mother**			**Univariate**			**Multivariate (AOR) Age of Mother**			**Univariate**			**Multivariate (AOR) Age of Mother**		
Normal Weight	1	Ref		1	Ref		1	Ref		1	Ref		1	Ref		1	Ref	
Low birth weight	3.10	1.66-5.79	0.000	3.08	1.62-5.82	0.001	3.49	1.52-8.00	0.003	3.53	1.50-8.24	0.004	2.69	1.02-7.08	0.045	2.58	0.97-6.87	0.057
Large Weight	1.68	0.86-3.28	0.126	1.67	0.85-3.28	0.131	1.65	0.51-5.29	0.397	1.66	0.50-5.41	0.397	1.78	0.76-4.16	0.182	1.69	0.72-3.98	0.225
				Multivariate (AOR) Place of ANC						**Multivariate (AOR) Place of ANC**						**Multivariate (AOR) Place of ANC**		
Normal Weight				1	Ref					1	Ref					1	Ref	
Low birth weight				2.48	1.06-5.82	0.036				2.31	0.77-6.90	0.130				2.82	0.71-11.0	0.137
Large Weight				2.50	1.13-1.56	0.024				2.39	0.75-7.63	0.138				3.04	1.02-9.06	0.046
Highest level of Education	**Univariate**						**Univariate**						**Univariate**					
No Education	1	Ref					1	Ref					1	Ref				
Primary Education	0.72	0.45-1.14	0.171				0.70	0.35-1.37	0.297				0.71	0.33-1.50	0.367			
Higher Education	1.78	0.82-3.84	0.140				1.68	0.69-4.04	0.243				1.61	0.18-14.0	0.662			

Note:

Odds Ratio (OR): An odds ratio is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure compared to the odds of the outcome occurring in the absence of that exposure.

Adjusted Odds ratio (aOR): Adjusted odds ratio are the odds of a dichotomous event being true adjusted for or controlling for other possible contributions from other variables in the model.

Chapter 5: DISCUSSION

5.1 Study Discussion

Our analysis of the 2007 ZDHS has revealed that low birth weight, large weight and unspecified place of delivery were associated with increased odds of neonatal deaths while age group 18-24 years and 4 and above antenatal care visits were associated with reduced odds of neonatal

The results have shown that quality antenatal care which in this case was analysed by the number of antenatal care visits showed an association between the number antenatal care visits and neonatal mortality. Those who attended ANC two times were less likely to experience neonatal deaths. This means that attending antenatal care 2 times was a protective effect for neonatal death than attending ANC once. Attending ANC 3 times also showed reduced odds of neonatal mortality in comparison to attending ANC once. Antenatal care visits made 4 times and above improved the protective effect of neonatal death. This was even more significant after adjusting for highest level of education. This means that antenatal care visits 4 and above was associated with reduced odds of neonatal mortality. Antenatal care is an important determinant of high maternal mortality rate and one of the basic components of maternal care on which the life of mothers and babies depend [30]. Analysis by residence after adjusting for highest level of education showed that 2 antenatal care visits in urban areas was associated with increased odds of neonatal deaths while in rural areas, it was associated with reduced odds of neonatal deaths. In both rural and urban areas were insignificant. For 3 antenatal care visits, reduced odds of neonatal deaths were noted in both rural and urban areas. The 4^{th} birth order and above tended to associated with increased odds of neonatal deaths in urban areas though insignificant while the picture was different for rural areas as reduced odds of neonatal deaths was observed and was significant.

As a proxy for quality care, another important determinant for neonatal mortality was place of antenatal care. Compared to mothers who had their antenatal care at a government health facility and a private/mission hospital, the odds of neonatal mortality was significantly higher for infants whose mothers had antenatal care at home. This shows that having antenatal care at home was a risk factor for neonatal mortality than having antenatal care from a

government health facility and private/mission health facility. Government health facility in both urban and rural areas was associated with reduced odds of neonatal deaths but remained insignificant. Private/mission hospital in rural areas was associated with reduced odds of neonatal deaths.

Analysis by Place of delivery revealed that delivering from a government health facility and/or a private health facility tended to have increased odds of neonatal deaths than delivering at home. However it is important to note that this result is quite puzzling because we expect to have reduced odds of neonatal deaths in health facilities than at home. The results are insignificant and could be by chance. However, this result is contrary to the existing literature where findings from studies lend credence to the vital role that the place of delivery plays in neonatal survival. In this study, however, delivery outside a health facility is a risk factor of neonatal mortality. This finding concurs with the 2005 World Health Report which states that, giving birth in a health facility (not necessarily a hospital) with professional staff is safer by far compared to doing so at home [23]. A study conducted in Tanzania shows that delivery outside a health facility remained a significant risk factor for neonatal mortality [12].

Place of delivery unspecified showed increased odds of neonatal mortality than at home and this was significant even after adjusting for highest level of education giving a p-value of 0.001. In urban areas, delivering from a government health facility was associated with reduced odds of neonatal deaths while for rural areas, delivering at a government health facility was associated with increased odds of neonatal deaths and this was significant. This suggests that delivering a baby at a government health facility in rural areas is a risk factor compared to urban areas. In both urban and rural areas, delivering at a private health facility was associated with increased odds of neonatal deaths. This shows that the place of birth other than home or health facility was a risk factor.

Analysis by assistance during delivery showed that being assisted by a traditional birth attendant, a relative/friend and no one was associated with reduced odds of neonatal death than being assisted by a doctor/midwife/nurse. This is another astonishing result and could be alluded to the fact that there is reporting bias from the mothers. This could be that under reporting is very high and it is very difficult to estimate the degree of under reporting. On the other hand, mothers do not want to discuss children that died early in infancy. A study done in

Mumbai, India shows that there is high misclassification of data such as neonatal deaths being misclassified as stillbirths because of cultural beliefs and practices [21]. Neonatal deaths are less probable to be recorded if a baby dies in the first hours or days after birth or is very small [21]. Nevertheless, the presence of skilled birth attendants either doctor/nurse/midwife is important to ensure appropriate management of the delivery process and prevent fatal events attributed to delivery- related complications [23]. The results show a different picture and this does not necessarily mean that being assisted by skilled health personnel is associated with increased odds of neonatal death. It could be by chance and these results are insignificant. The other issue could be that the assistance by a nurse, doctor/midwife could have been a consequence of referral system due to complications during delivery. A complicated delivery will most likely end up in a hospital or clinic and will more likely end up with adverse outcome. The deaths could have been led by other proximate factors not captured in the study but part of the theory by Mosley and Chen. However, analysis by residence showed that assistance by a relative/friend in urban areas was associated with increased odds of neonatal deaths and this was significant while in rural areas, it was associated with reduced odds of neonatal deaths and this was significant. It is plausible that being assisted by a friend/relative was a risk factor for neonatal death.

It is well known that the mother's age at birth and birth order are related to children's mortality [11]. The study also analysed the age of mother to assess its association with neonatal mortality. The age group 25-29 years showed increased odds of dying. The increased odds ratios and the broad confidence intervals could be as a consequence of the small number of women who gave birth to children who later died in that age group compared to the former age groups. Adjusting for birth weight still showed the same picture but with weakened reduced odds for the age group 18-24 years. The results clearly shows that neonatal mortality was associated with the youngest age group, then reduces in the age group 18-24 years and shows an increase in the latter part of the reproductive span because of the meagre numbers of births reported and hence giving few or zero fatality cases. In this case, we can conclude that there is no association between maternal age and neonatal mortality.

The study also shows that birth order/rank 4^{th} – 6^{th} was associated with increased odds of neonatal deaths. This means that 1^{st} -3^{rd} born infants had lower odds of dying than the latter ranks. The results also show that the 8^{th} birth order and above had reduced odds of neonatal mortality than the 1^{st}-3^{rd} rank. The results are related to studies conducted where strong

associations have been reported between birth rank more than 3 and neonatal death [5]. This is where higher birth order had increased odds of dying than lower orders. Birth rank more than 3 was found as a potential risk factor for neonatal mortality. The data shows that the 4-6th birth rank both adjusted and unadjusted had 115 times higher odds of neonatal deaths than 1st - 3rd birth. We conclude that 3 or less births were associated with reduced odds of neonatal death while 4 and more birth orders were associated with increased odds of neonatal death. After adjusting for age of mother in urban areas, 4-6th birth order was associated with reduced odds of neonatal deaths while in rural areas. It was associated with increased odds of neonatal deaths. For 7th birth order and above, reduced odds of neonatal deaths were noted in both rural and urban areas.

In this study, it is worth noting that low birth weight came out prominently as the strongest determinant or factor associated with neonatal mortality. The findings from the 2007 ZDHS have clearly revealed that weight of infant was associated with neonatal mortality. This finding is supported by other Literature that has shown that low birth weight as being a strong determinant of neonatal mortality (8, 13). A study in Bangladesh reported that approximately 75 percent of neonatal deaths associated with low birth weight were attributed to preterm birth rather than small for gestational age infants [28]. However, due to the nature of this study, we were not able to differentiate between preterm and small for gestational age infants but conclude that low birth weight was high even after adjusting for age of mother, place of antenatal care and place of delivery. The results were statistically significant. Large weight also tended to be associated with increased odds of neonatal mortality and even showed statistical evidence after controlling for place of antenatal care. Our findings of low birth weight being a determinant of neonatal mortality is supported by this statement that infant weight between 2000-2499 grams at birth is 4 times more likely to die during first 28 days of life than infants whose weight lie between 3000-34999 grams (26). In urban areas adjusting for age of mother, low birth weight was associated with increased odds of neonatal deaths and was significant. This was the picture in rural areas where low birth weight was associated with increased odds of neonatal deaths and was significant. Large birth weight was associated with increased odds of neonatal mortality in both urban and rural areas though insignificant. Adjusted by place of antenatal care showed that low birth weight was associated with increased odds of neonatal deaths in both urban and rural though insignificant. Large birth weight was also associated with increased odds of neonatal deaths in both urban and rural areas and was significant in rural areas.

Highest level of education showed that primary education as the highest level of education was associated with reduced odds of neonatal deaths while higher education was associated with increased odds of neonatal deaths compared to no education. The pattern was the same in both urban and rural areas with primary education being associated with reduced odds of neonatal deaths while higher education being associated with increased odds of neonatal deaths.

5.2 Strengths and Limitations

This study had both strengths and weaknesses. The strengths of the ZDHS are that firstly; it is a nationally representative population based survey. The ZDHS uses standardized methods that have proved to achieve high individual and household response rates. The response rate for the 2007 ZDHS household questionnaire was 97.8% for both rural and urban areas and for eligible women response rate was 96.5 percent. Our study assesses the factors influencing neonatal mortality based on the aforementioned study, of which neonatal survival data was collected from a five year period preceding the survey. The reference period under review tends to reduce more especially the recall error of the births and deaths that occurred within this period.

The study equally had a number of limitations that should be taken into consideration when interpreting these results that were observed after the analysis. The ZDHS woman's questionnaire is only asked to eligible women aged 15-49 years who were usual household members and available during the survey. This means that only alive women were captured and this could have led to an underestimation of neonatal mortality considering that there is evidence based data that shows the correlation between maternal deaths and neonatal death. Due to the small number of neonatal deaths, this tended to affect the odds ratio as well as having wide Confidence intervals.

One other notable limitation was that of some proximate factors which were not available in the ZDHS that influence infant mortality according to Mosley and Chen (maternal factors; environmental contamination; nutrient deficiency; injuries; and personal illness control (prevention, treatment)) such as environmental contamination and nutrient deficiency. In this case we could have missed out factors that are associated with neonatal mortality. The other limitation was on questions asked on number of antenatal care visits, place of antenatal care

and assistance during delivery. These questions are only asked for the last birth. This means that if a woman had more than one birth within the reference period, the other births where not asked these questions and this could have led to not having sufficient evidence of these factors being associated to neonatal mortality.

Chapter 6: CONCLUSION & RECOMMENDATION

6.1 Conclusion

The 2007 ZDHS data assessed in our analysis shows that at national level, low birth weight; large birth weight and unspecified place of delivery were significantly determinants of neonatal mortality.

Results showed that government health facility as a place of delivery in rural areas was associated with increased neonatal deaths. Assistance during delivery by a relative/friend was equally associated with increased odds of neonatal deaths in both urban and rural areas.

Low birth weight is seen to be a risk factor for neonatal death whose prevention is quite complex and that it is related to the improvement of the quality of life of the population. A neonate's chance of survival begins well before birth where good care should be given including regular and quality antenatal care as well as good nutrition.

Analysis by residence shows that unspecified places of delivery also come out so prominently as a determinant of neonatal mortality. These may be associated with neonatal mortality because they could be births that happen in any other place other than health facilities and homes Delivering at a government health facility in rural areas was associated with increased odds of neonatal deaths than in urban areas. Assistance during delivery by a relative /friend was associated with increased odds of neonatal deaths in urban areas and associated with reduced odds in rural areas.

In conclusion, we have reported alarmingly high observed burden of neonatal mortality and associated determinants in this population. Although these findings could potentially be prone to measurement and information biases, the burden reported remain an under-estimate. The presence of this burden may thus not just indicate presence of the problem, rather it may be a pointer to either failures in past child survival strategies or limitations in existing system responses. The child survival strategies in Zambia are driven by global agenda and are not only complex but they also used multiple approaches that may not be driven by local contexts such as this population based data to inform the interventions. We hypothesise that using clinic based child survival data may have limited responses in the past and lacked more

informed parallel survival strategies grounded in a combination of system, individual and community or population based data. The burden observed among predominantly rural suggest a need to refocus and re-package strategies to target selected populations. Unless this is done existing child survival strategies, though given, might remain "irrelevant and inoperable" to these groups whose poor economic and social conditions create an environment that might exacerbate their states. Poverty reduction programmes, including strategies to increase maternal educational attainment, are therefore to be seen as necessary components of effective child survival strategies. Furthermore, These findings point to a need for a comprehensive surveillance system to continually capture patterns and trends of these and other potential determinants of child survival.

6.2 Recommendation

Low birth weight has significantly come out as a factor influencing neonatal mortality, hence the need to create preventive and corrective strategies that help pregnant women reduce on the burden of disease, good nutrition and other factors that will conversely improve child survival. Findings in the survey highlight the importance of providing and improving health facilities in rural areas. However, the study highlights the importance of providing and improving health care and this should be a broad strategy complimented with other programmes that will ensure that child survival is improved.

It is thus very important to adopt good policies that will ensure that pregnant women have quality antenatal care that will help them take all the necessary precautions to keep them health and give birth to health babies. Development of focused and evidence-based health interventions to prevent neonatal deaths should trickle down to the communities from facility level.

Lastly but not the least, these findings point to a need for a comprehensive surveillance.

Further research is needed to examine the exact mode of operation through which the stated factors exert their influence on neonatal deaths. Notably, the observed burden was less in urban areas suggesting that that prevention works, and it should continue to be given "highest priority" among all other strategies. However, what works and in what contexts must be known especially through local and indigenous knowledge so as to sustain setting driven programming.

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