THE UNIVERSITY OF ZIMBABWE

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DEPARTMENT OF ECONOMICS

REGIONAL VARIATIONS IN CHILDHOOD MORTALITY IN ZAMBIA

BY

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A dissertation submitted to the University of Zimbabwe in partial fulfilment of the requirements of the Master of Science Degree in Economics (MSc Econ).

ABSTRACT

Although Zambia has experienced reductions in childhood mortality over the years, wide gaps in childhood mortality rates still exist across the provinces within the country, warranting for a call for an equity focused approach to reducing child mortality. Motivated by this discrepancy, and guided by the Mosley and Chen (1984) conceptual framework, this dissertation aimed at establishing the socioeconomic, demographic and cultural factors that influence childhood mortality in Zambia, as well as the extent to which these factors possibly explain the observed regional variations in childhood mortality across the country.

The study established that a number of factors significantly influence childhood mortality rates in the country. The chances of a child dying increased for a child born from: a non-Christian mother, a mother in the age category "45-49", a mother who was not attended to by a midwife during delivery, and for the child whose mothers used "Pit latrines" or "bush" as their toilet facility. However, the chances of dying reduced for a child born in the rural area, or one in which the spacing between them and the previous sibling was 24 months or longer.

In analyzing factors influencing childhood mortality rates in individual provinces, the study revealed that factors associated with child deaths were not homogenous, but differed from province to province.

Finally, the study established that factors that have higher magnitudes in terms of their effects on child mortality in Zambia were significant and predominant in high mortality regions. Particularly, these included Religion, Attendence by midwife, Birth Interval, Literacy and Type of residence. And these were more influential in Eastern, Luapula, Northern, Muchinga, Lusaka and Western Provinces. The study therefore concluded that these socio economic, demographic and cultural factors are important in explaining the variations in childhood mortality observed among the different provinces of the country.

The implication of these findings demonstrated the fact that ultimately, addressing the problem of childhood mortality effectively in Zambia calls for disaggregated analysis of individual regional problems.

DECLARATION

I, **Tobias Michelo**, declare that this dissertation:

a) Represents my own work and not previously been submitted for a degree at this or any other University; and

b) Does not incorporate published work or material from another dissertation.

Signed……………………………………………………………………………………………

Date………………………………………………………………………………………………

ACKNOWLEDGEMENTS

First and foremost, my gratitude goes to the Almighty God. The Alpha and Omega, my pillar and strength in all the successes and failures, challenges and trials. You have never failed me in all your promises and I shall forever lean on them Lord. Jeremiah 29:11.

The writing of this dissertation was made possible by my financiers, The African Economic Research Consortium (AERC), who fully funded my coursework at the University of Zimbabwe, and through to the Joint Facility Electives (JFE) that were done in Arusha Tanzania, and finally the putting up of this whole document done at the University of Zimbabwe.

The formulation and development of this paper would not have been, without the inspirational guidance of my supervisor, Dr Clever Mumbengegwi. Always guided me on “what” needed to be done, but left me to figure out on “how’ to do it. I shall forever remain indebted and grateful to his intelligent and critical supervision.

My gratitude to Mr. Pindiriri, my econometric lecturer for the continuous guidance in all the metrics involved in this paper.

Dr. Makandwe Nyirenda, Medical Research Council, South Africa and Dr. Mapoma from the University of Zambia, Demography Department for the inspirational insights into survival analysis.

My Course mates Tapiwa Mutambirwa, Leonard Usai, Mulenga Kabaso, Trust Gangaidzo, Precious Mukaira, Tavonga Mhari, Nyasha Munditi and Bongai Munguni. You were a true family away from home.

Finally, my CMAP course mates from across the African Continent, family and friends back home too numerous to mention who kept giving me and my family encouragement to soldier on.

DEDICATION

For the two most important girls in my life. **Hazel M. Michelo (My wife),** and **Michelle Wangu Michelo (My Daughter).** Your sacrifice in the process of achieving this was simply profound and beyond measure. You are my world.

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LIST OF ACCRONYMS

AAP	Annual Action Plans
ACCA	Association of Chattered Certified Accountants
BHCP	Basic Health Care Package
CBoH	Central Board of Health
CR	Children Records
CSO	Central Statistics Office
HIV	Human Immuno Virus
HR	Hazard Ratio
IGME	Interagency Group for Child Mortality Estimation
LCMS	Living Conditions Monitoring Survey
LDHMT	Lusaka District Health Management Team
MDG	Millennium Development Goals
MoH	Ministry of Health
MTEF	Mid-Term Expenditure Framework
NGO	Non-Governmental Organisations
NHP&S	National Health Policies and Strategies
NHSP	National Health Strategic Plans
TARSC	Training and Research Support Centre, Zim
TDRC	Tropical Disease Research Centre
UN	United Nations

UNESCO	United Nations Education, Social and Cultural Organization
UNFPA	United Nations Population Fund
UNICEF	United Nations International Children Fund
UNZA	University of Zambia
UTH	University Teaching Hospital
WHO	World Health Organization
ZDHS	Zambia Demographic Health Survey

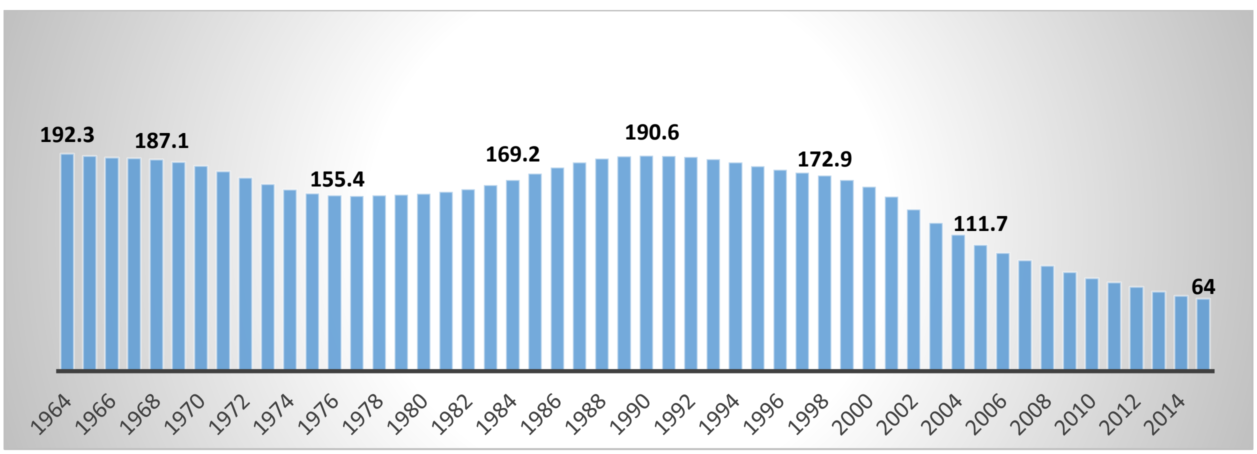
CHAPTER ONE

INTRODUCTION AND BACKGROUND OF THE STUDY

1.0. Introduction

The problem of childhood mortality has been prominent in Zambia from as early as 1964 when the country gained independence. However, with the advent of Millennium Development Goals in 1990 that were meant to address World poverty in general, and to specifically reduce childhood mortality as goal number 4 (United Nations, 2000), the country has recorded tremendous reduction in incidences of child mortality rates. From a figure as high as 191 deaths per 1000 live births in 1990, the rates reduced to 64 per 1000 live births by the year 2015 (World Bank Indicators, 2015). Childhood mortality, is defined as the probability of dying between birth and exactly five years of age, and is expressed per 1,000 live births (UNICEF, 2000). It is an important indicator of a country's socioeconomic development, quality of life, health status and a key measure of a country's stock of health (ZDHS, 2013/14).

Fig 1.0 Zambia's Child Mortality Rates 1964-2014



Source: author's constructions from the 2015 World Bank Economic Indicators

Despite this national progress however, the observed reduction in the incidences of childhood mortality have been uneven across the various provincial regions of the country. Typical examples of these variations are observed with Eastern Province that stood at 115 deaths, against Copperbelt

Province with 63 deaths per every 1000 live births by the end of year 2014. (ZDHS, 2013/14). These variations have been in existence over time as observed from the Zambia Demographic Health Surveys carried out in the country since 1992. See Fig 1.1. Several studies on this subject in Zambia acknowledge the existence of these regional variations in childhood mortality across the country. (Chabila, 2004; Mcwang'i and Phiri, 2008; Colson et al., 2015; ZDHS, 2013/14). Mcwang'i and Phiri, (2008).

Average childhood mortality rates at national level conceal these regional variations, and this is often misleading for policy making because if the reduction is not evenly distributed across all sub groups and regions of the country, policy interventions based on national average indicators might prove to be grossly inadequate. Understanding and taking into account differentials in childhood mortality rates according to socioeconomic and demographic characteristics would therefore help to identify and target high-risk population groups for more effective policy intervention programmes (Zambia Demographic Health Survey, 2014).

It is the contention of this study therefore that health policy makers and other stakeholders in the health sector consider regionally disaggregated child mortality indicators when evaluating health sector performance, and formulating policy, to counter these differences in regional characteristics. This, in turn, would more realistically determine the level of national development progress.

Thus the study intended to identify and analyze the socio economic, demographic, and cultural factors affecting under-five mortality rates in the country at large, and in each of the provinces specifically. By doing so, the study hoped to establish if these factors explain the observed differentials in childhood mortality among provinces in the country, thereby making an important contribution to the body of knowledge.

1.1. Background of the study

In a bid to fight poverty in all its dimensions, World leaders gathered at the beginning of the new Millennium with a view to shape a broader vision aimed at finding a lasting solution to the world poverty problem. That vision, translated into the Millennium Declaration (United Nations, September 2000), signed by 189 countries in September 2000. Relevant targets and indicators in human and economic development to be attained between the periods 1990 and 2015 were agreed upon, and one of these goals was the Millennium Development Goal 4 (MDG4), which stated, "To reduce the under-five mortality rates by two thirds between 1990 and 2015." (United Nations, 2000). Zambia was one of the countries that signed this agreement.

1.1.1. Demographic and Socioeconomic Characteristics of Zambia and its Provinces

Situated in Southern Africa, Zambia is a lower middle income country with an estimated population of 15, 519, 000, and an average annual economic growth of 7.8%. (World Bank, 2014). Life expectancy is estimated at 58 years (World Bank, 2013), while Maternal and child mortality is estimated at 224 deaths per 100000 mothers and 64 child deaths per 1000 live births respectively. (World Bank, 2015). Close to 67% of the population live below the datum line. (CSO, 2013).

Administratively, Zambia is divided into 10 provinces and 74 districts. Two of the provinces, namely Lusaka and Copperbelt are predominantly urban, while the rest of the remaining Provinces are largely rural. Approximately, 60% of Zambia's population live in rural areas. (CSO, 2011).

Statistics on the socio-economic, demographic and cultural factors in Zambia reveal that they are far reaching inequalities and differences among the different groups of people in the country e.g., the urban-rural socio economic differences, literacy, poverty, education levels, etc. (CSO, 2011; ZDHS, 2013/14 ; Seshamani, 2010).

a) Maternal Education

The Government of the Republic of Zambia recognizes education as a powerful tool for economic development of an individual and nation. The Sixth National Development Plan, 2013-2016 identifies education, training, science and technology as prime movers of Zambia's development. (CSO, 2013). However, the country has recorded very low literacy levels over time. By 1990, the proportion of women who were literate, was only 57.36% compared to 73.04% of male. By 2010 this figure for females had come down to 51.8%, with rural literacy levels much lower than those of urban areas. However, the most recent statistics from the Demographic Health Survey indicate that literacy in Zambia is still very low especially among the female with Eastern, Northern and Luapula Provinces being the most affected, recording as low as 42.2% 45.75% and 47.72% literacy rates respectively. Lusaka, Copperbelt and Southern Provinces have the highest literacy levels among females with 70.85%, 69.81% and 67.54% respectively. (ZDHS, 2013/14).

b) Wealth/Poverty

The Zambian economy is primarily driven by mining, followed by Agriculture, Construction, Transport and then Communication. As such the economy is vulnerable to the economic shocks affected by both internal and external factors. The country has particularly failed to achieve the Millennium Development Goal number one of halving extreme poverty by 2015. (ACCA, 2011). The majority of Zambians have continued to live in poverty. Poverty is more of rural areas than urban phenomenon with the level of poverty in rural areas being three times that in urban areas. In 2010, rural poverty was estimated at 79.9% compared to the urban one at 27.5%. (CSO, 2013). Among the provinces considered the poorest are Western Province and Luapula Provinces (CSO, 2011). The 2013/14 ZDHS confirms these statistics with wealth index indicating that 63.72% of women in Western Province fall in the poor category, followed by Northern Province and Luapula Provinces with 62.96% and 62.22% respectively. Lusaka, Copperbelt and Southern Province have only 9.3%, 22.84% and 36.8% falling in the poor category respectively. (ZDHS, 2013/14). Income inequity is still high between and among population groups. Poverty levels are still high, (67% in 2006) while access to safe water and sanitation is erratic. (2011-2015 NHSP, 2010).Only 33.9% of people in the rural area have improved sanitation facilities compared to 56.4% in urban. Equally, only 49.2% rural dwellers have access to clean water compared to 84.8% in urban. (2015 World

Fact Book, CIA). In comparison with urban areas, rural areas are also poorly served as regards access to healthcare. The location of health facilities is heavily skewed towards more urban areas so that 99% of the population in urban areas live within 5km of a health facility compared with 46% in rural areas. (Zambia Central Statistics Office, 2011). If these discrepancies are not addressed, then it has the potential to undermine the even distribution of health care facilities to the whole Zambian population.

c) Ethnicity/Culture

Zambia is a multi-cultural Society with 72 different tribes and ethnic groups. The major tribes with significant influence in the Zambian society and whose languages and culture are taught as part of education curriculum include: Tongas from the Southern Province, Bembas from Northern and Luapula Provinces, Lubales and Kaonde from the North Western Provinces, Nyanjas from Eastern Provinces, Lozis from Western Provinces. Lusaka, Copperbelt and Central Provinces are largely cosmopolitan habited by a combination of various tribes that share different cultures. There are a number of ingrained cultural and religious practices traditionally undertaken by Zambian groups and tribes that have an adverse impact on health, including the early marriages of the females, polygamy, genital mutilation, and sexual cleansing of widows, (where widow has sexual intercourse with one of the relatives of the deceased).((ACCA) April, 2013.) These myths and beliefs are largely responsible for the different community and individual behaviors seen among Zambians in general.

Community members with similar tribes share cultural values and have common perceptions of what constitutes sexual orientation, disability, sources of ill health and health care seeking behavior, conception, pregnancy, labor, birth and the postpartum periods. This perception is mostly influenced by the lack of knowledge for physiology of the birth processes and compounded by myths and superstition. (EQUINET, March 2013).

In terms of religion, Zambia is officially a Christian nation according to the 1996 constitution (CSO, 2013). The largest Christian group is the Protestants constituting 75.3%, followed by the Roman Catholic with 20.2%, others 2.7 %(Includes Muslims, Buddist, Hindu and Bahai) and Non-Christian are a paltry 1.8%. (2015 World Fact Book, CIA). Religious affiliation in the country is often associated with certain provincial regions depending on the missionaries that influenced the particular grouping at the time the country was colonized. E.g. the two largest tribes of the country namely Bembas (in the Northern Province) and Tongas (in the Southern part of the country) are greatly dominated by the Roman Catholic and Seventh Day Adventist respectively.

d) **Sex**

Beginning in the 1990s, sex ratios between male and female in Zambia has been almost proportionally equal, with the female population having a slight higher percentage compared to the males in the country. In the 1990 Census, the male to female ratio was 49% to 51 %,(CSO, 1990) while in 2010 the ratio was 49.5% to 50.5% (CSO, 2013) respectively. From the 2010 Census, the sex proportions at birth indicated that the males were more than women with a ratio of 103 male births per 100 female birth. However, important to note also is the fact that in 2011, total infant mortality for the year 2011 indicates that the rates are much higher among the male than the female children with 81.3% and 75.7% respectively (CSO, 2013). This could account for the number of males being less than that of females ultimately.

e) **Safe Motherhood**

Inappropriate health infrastructure in the health sector, short supply of drugs, obsolete equipment, high turnover of qualified staff as well as lack of proper policy to guide the operations of the health sector have been major factors contributing to poor quality of safe mother hood in the country. Other contributing factors to poor quality safe motherhood include a high number women having babies at tender age, poor family methods, lack of knowledge of the risk factors, health behaviors, poor economic status, and harmful traditional practices during labor and delivery. (Reproductive Health Policy, 2000). According to the ZDHS (1996), about 50% of women gave birth at home and were attended to either by friends or relatives with no midwifery training. It is however important to note that the Reproductive Health Policy (2000) observed that the provision of safe motherhood services (i.e. ensuring affordable quality care for the mother and the new born baby) in the past has not made a significant difference on the health indicators for either the mothers or their new born baby.

A critical analysis of the latest Demographic health survey indicate poor safe mother hood method is rife among individual Zambian women with 14.6% having as much children as seven or more. This problem is rifer in Central, Northern and Muchinga Provinces with 19.9%, 19.24% and 16.4% of women respectively having seven or more children. Further, 12.3% of mothers countrywide space their children with less interval of less than 24 months. This is more pronounced in Northern, Central and Luapula Province while in Lusaka, Eastern and Western Province the problem seem to be more controlled. (ZDHS, 2013/14).

The above demographic trends give rise to different expectations in terms of the peculiarity of the problems that are likely to be experienced in these provinces. For example, from the background information, Northern, Eastern, Luapula and Muchinga seem to be more vulnerable provinces, while Lusaka, Copperbelt, North Western and Southern Province are more advantaged. Other provinces are on averaged balanced in their socio economic and demographic factors. This is may be explained by the fact Lusaka and Copperbelt are predominantly urban areas where most of the country's production activities are centered. Southern Province is the food basket of the country and engages in agricultural activities, while North Western is economically viable because of bulky mining activities taking in the province. Northern, Eastern, Luapula and Muchinga are predominantly rural areas with not much economic activities going on in these provinces.

1.1.2. Childhood Mortality Rates in Zambia

In 1990, childhood mortality rates in Zambia stood at 191 deaths per 1000 live births, way above the average mortality rates in the whole Sub-Saharan Region and the world at large of 180 and 91 deaths per 1000 live births respectively. (World Bank Indicators, 2015). With the set target of reducing the rates by two thirds, Zambia's target was therefore to reduce its rate to 63 deaths per 1000 live births by the year 2015. (NHSP, 2010).

By the year 2014, when the last Demographic Health Survey was carried out in Zambia, the child mortality rates had reduced to 75 deaths per 1000 live births. Further, by September 2015, statistics from the World Bank indicated that nationally, the rates were at 64 deaths per 1000 live births. This represents a tremendous progress of 66.5% reduction compared to the 53.9% and 52.7%

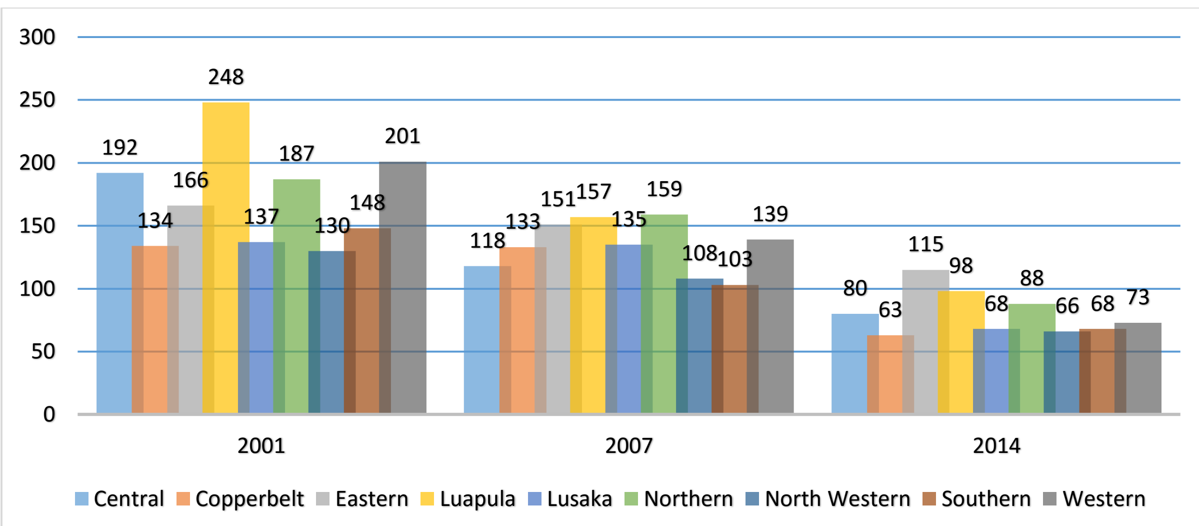
reduction for the Sub-Saharan Region and the global reductions respectively (World Bank Indicators, 2015).

Besides the policy measures put in place by the Government to mitigate the mortality rates in the country, a myriad of factors could be responsible for the dynamics of child mortality changes in the country, and the socio economic, and demographic factors are the main focus of this study.

1.1.3. Analysis of Mortality Rates across Provinces

Ever since the 2013/14 ZDH survey, there hasn't been latest figures for trends in the various Zambian regions/Provinces. However, from the latest demographic Health Survey conducted in 2013/2014, almost all the provinces in Zambia had equally made some progress towards reduction in the rates of childhood mortality, with most of them recording above 50% reduction, except for Eastern and Southern provinces.

Fig 1.1: Provincial Mortality Rates 2001, 2007 & 2014



Source: 2001, 2007 & 2013/14 Zambia Demographic Health Surveys

However, even amidst this provincial progress, huge gaps still existed between and among certain regions of the country, some of which share similar characteristics in terms of their place of residence i.e. rural or urban. For example, North Western and Eastern Province are both rural areas but with huge differences in the mortality rates with the two provinces recording **66** and **115** deaths per **1000** live births respectively.

Further, a look at North Western and Eastern Provinces indicate that in 1992, the two provinces had almost equal rates of childhood mortality, yet by 2013/14, the discrepancy between the two provinces was one of the highest among all the other provinces. These variations are also observed in the rates for the years 2001 and 2007. See Fig 1.1 above.

In terms of overall decline in mortality rates among all the provinces, Eastern and Southern Province have the lowest rates of decline with **42.5%** and **49.3%** respectively while North Western and Western Provinces have the highest rates of decline with **68.6%** and **65.3%** respectively.

Health Policies, particularly those targeted at tackling childhood mortality, should therefore be formulated using provincial lens in order to address the peculiar challenges observed in the different provinces.

1.1.4. Health Policy Reforms

Since 1992, Zambia has been implementing a number of significant health sector reforms through the Ministry of Health with the purpose of strengthening health services, and improve the health status of Zambians in general, but specifically, to achieve the goal of equity of access to assured quality, cost effective and affordable health care that is as close to the family as possible. (MOH, 2005:1). These reforms are based on policies and strategies established in 1992 (NHP&S-92) and implemented through such plans as Annual Action Plans (AAPs), a five year National Health Strategic Plans (NHSPs), and a three year medium-term expenditure frameworks (MTEF). (2011-2015 NHPS, 2010).

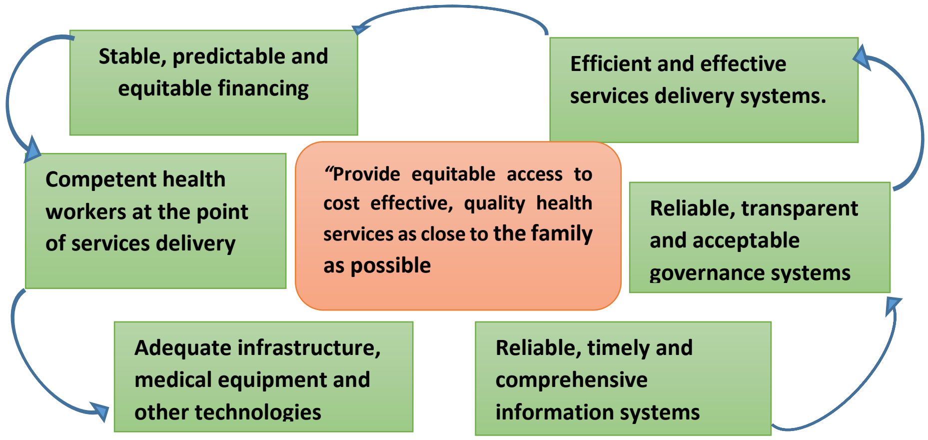
Apart from the NHP&S-1992, a number of other policies and strategies have been established over the years. These include, but not limited to:

- The Decentralization Policy-2003, aimed at devolving specified functions and authority with matching resources, to local authorities at District levels and ultimately strengthen community participation, distribution of power, and thus ensure that health benefits were distributed across all the provinces of the country.

- Child Health Policy, Reproductive Health Policy and the Basic Health Care Package (BHCP) developed in 1995. (2011-2015 NHPS, 2010). The BHCP is an important component of health reform that involves a restructured primary health care program aimed at bringing efficient and cost effective quality basic health care services for common illnesses as close to the families as possible. (MOH, 1992). Through this BHCP, priority areas are identified among which are: nutrition, environmental health, prevention, school health and oral health, control and management of communicable diseases. (ZDHS, 2013/14). Most importantly, BHCP was intended to address inequality in access to quality health services.

- Another very cardinal health policy reform was the 2011-2015 National Health Strategic Plan which was a departure from the past strategic plans in that it emphasized on addressing human resource crisis; state of health care infrastructure; promoting health education, as well as provide more access and availability of such elementary environmental health facilities as sufficient electricity, clean water and improved sanitation. The major objectives of this policy document, among others, was to reduce under five mortality; increase the proportion of residents living within 5km of a health facility from 54% to 70% by 2015, reduce the population/doctor ratio from 17,589 to 10,000; and reduce the population/nurse ratio from 1,864 to 700 by 2015. (ZHDS, 2013/14). The policy adopted the World Health Organization's (WHO) six building blocks for health systems for analyzing the Health Sector. (2011-2016 Draft NHSP, 2010).

Fig 1.2: The "WHO" Six Building Blocks for Health System.



Source: 2011-2016 National Health Strategic Plan, 2010

The above outlines health reforms were all directly, or indirectly meant to ultimately improve, among other health issues, the childhood mortality rates in the country. It is also apparent that to achieve these goals, equity of access was one of the major intermediate goals of the health reforms. Policy makers need on hoe these policies have been effective in addressing all the issues stated in the "WHO" Six Building Blocks for Health Systems. *See fig 1.2 above.*

1.1.5. Challenges in the Health Sector

With the implementation of these various policies, substantial improvements were made in relation to health service delivery and support systems, ultimately leading to improvement in most of the key performance indicators of health. (NHSP, 2010). However, while the country achieved an increase in access to the health facilities, quality of services and equity in the distribution of these health services to various different groups separated by geographical, biological or socio economic status was compromised. Phiri& Ataguba (2013) argue that the many interventions have not translated into corresponding reductions in inequalities/inequities. Other studies have revealed distributions in general health care that favored mostly the rich. (Zyambo, C; Siziya, S and Fylkesnes K, 2012).

Among the reasons leading to these inequalities were the limited capacity which resulted in health programmes not always being implemented as designed. Further, District Health Services in Zambia still face problems with low geographical coverage of health services especially in remote areas and a less than optimal referral system. (2011-2015 Draft NHSP, 2010). Other challenges generally facing the health sector in Zambia and associated with failure in achieving the health related MDGs and National Health Priorities include: the high disease burden worsened by the high incidence of HIV infections, critical shortages of health personnel; deteriorating health infrastructure; on-going restructuring of the health sector; high levels of poverty and poor macroeconomic conditions; and inadequate funding to the health sector (NHSP 2006-2011, 2005).

With the challenges of child mortality differentials still existing even amidst all these policies meant to address inequalities in the health sector, it is prudent for policy makers to also look into the environmental factors, even as they continue implementing their various policies meant to reduce childhood mortality rates to very minimal levels. Environmental factors will determine the health status of a population, that includes the under five children. These factors include socioeconomic standing of the society, demographic status and trends, education and literacy levels of the society, unemployment levels and working conditions of service, as well as gender issues. (2011-2015 NHSP, 2010).

1.2. Statement of the problem

While it is clear that Zambia has certainly come closer to achieving the Millennium Development Goal number four of reducing childhood mortality rates nationally by two thirds between the years 1990 and 2015, it is also apparent that this progress has been uneven across regions, as incidence of mortality rates are still much higher in certain regions and less in others. Typical examples of these variations exist between Copperbelt and North Western with low rates on one hand, and, Luapula and Eastern with extreme high mortality rates (ZDHS, 2013/14).

The high mortality rates recorded in some provinces are therefore being overshadowed because the country is sorely focused on the positive outcomes observed nationally. This has serious policy implications for Zambia's health sector, as policy makers are bound to undertake policy formulation, implementation and interventions based on national average indicators that might on their own be inadequate at addressing the overall problem of childhood mortality across all the sectors of the country.

Currently, it is not known what is causing these childhood mortality differentials among the different regions in the country. This is because there is insufficient evidence in the existing empirical literature that outlines factors that are specifically influence mortality rates among the different provinces in the country, and to what extent these factors are responsible for the mortality differentials observed among the regions.

As a result, policy makers in Zambia currently are formulating and implementing general health policies to tackle child mortality problems across the country at a high cost when in actual fact, more efficient and cost effective ways can be adopted. This scenario is likely to create huge Government costs, while at the same time leaving significant inequality gaps as millions of people may be left behind on account of their sex, socio economic status, ethnicity or geographical location.

In establishing factors that influence childhood mortality rates, **Mosley and Chen (1984)** developed a theoretical framework in which they postulated that even though ultimately death is caused by biological factors such as infectious diseases, these biological factors may in turn be determined by a chain of socio-economic, demographic, environmental and cultural factors. The theory detailed a set of 14 proximate determinants that directly influence the risk of morbidity and mortality in individuals, and all the socio economic, demographic, environmental and cultural factors must operate through these proximate determinants in affecting child mortality. These factors include maternal age, maternal education, income parity, birth interval, air, food, water, finger, antenatal care, etc. This theory was also supported by other scholars who divided these factors into biological, individual lifestyle, social and community networks as well as the living conditions (Dahlgren and Whitehead, 1991; Lalou, 1997).

Using this theory, and the country characteristics outlined in the background, this study hopes to establish the demographic, socioeconomic, environmental and cultural determinants of child mortality in the country, and the extent to which these determinants can be used to explain the mortality differentials observed among the provinces. By so doing, the study hopes to help cover this existing knowledge gap in the country.

1.3. Objectives

General Objectives

- To establish factors that influence childhood mortality rate in Zambia, and how these factors help explain the observed differentials across the various provincial regions of Zambia

Specific Objectives

- To identify demographic, socio economic and environmental factors that influence childhood mortality in Zambia as a country.
- To identify factors that are associated with childhood mortality for each of the individual provinces of the country.
- To demonstrate the extent to which these factors are responsible for the observed differences in childhood mortality among the various provinces in the country

Research Questions

- What are the determinants of childhood mortality rates in Zambia?
- Which of the factors influence childhood mortality in individual provinces?
- To what extent does the influence of these factors explain the childhood mortality differences observed among the individual provinces in the country?

Hypotheses

- Being exposed to poor socio-economic conditions such as residing in the rural area, belonging to the "poor" people in society, having no access to electricity, and using a pit latrine and the bush as toilet facility increases the chances of the child dying.
- Attaining higher levels of education, ability to read, having a child at an older age, delivering a child at a health facility, being attended to by a midwife or a health personnel, belonging to a Christian religion, and a longer interval between one child and the preceding sibling reduces the chances of a child dying.

- Differences in the socio-economic status, demographic location, biological and cultural factors among the different regions accounts for the variations in childhood mortality rates among different regions in the country.

1.4. **Rationale of the Study**

The efficient and equitable provision of health care has been at the center of public debate in recent years, and many countries in the developing world have adopted health sector reforms and implemented new health policies and programs. (William, 1999). Thus issues of equity and inequality are of concern in Africa in General, and Zambia in particular, as a measure of people's welfare.

Inequities in health arise because of the conditions surrounding the people. These include where they are brought up, where they live, work, grow old and the systems available to attend to them when they are sick. These listed factors are in turn shaped by the social, economic, cultural and political forces in the country. The nature of economic and social policies therefore determine whether a child can grow and develop to its full potential and live a flourishing life, or whether its life will be blighted. (WHO, 2008).

Understanding the problem of child mortality rates in the country, and how they vary among different country regions, through analysis of demographic, socio economic and cultural differences helps in formulating and implementing appropriate policies specifically aimed at achieving health equity in the country. If disparities in health indicators are not identified and timely attended to, the country risks widening the inequality gaps, leaving behind many citizens and denying them the benefits accrued by the nation as a whole.

Finally, while there are various literature on this particular subject, in Zambia, most of it has been descriptive in nature and lacks the predictive power to associate the causal-effect relationships in these variations. This paper hopes to contribute to the existing literature by applying econometrics to this subject.

1.5. Methodology adopted

The study employed a cross sectional analysis with the use of the 2013/14 Zambia Demographic Health Survey. The ZDHS dataset is accessible on the World Health Organisation Website as well as the Central Statistics of Zambia, (CSO).The ZDHS contains bio-demographic and health data for a representative sample of women and their children across the whole country. These are selected in conformity with the sample areas used in the national census. In analysing the data, a multivariate logistic regression model was fit in Stata Version 12.

1.6. Outline of the study

The outline of this study was as follows: Chapter one presents the introduction, background, the research problems, objectives, and hypotheses as well as the justification of the study. Chapter two explores the theoretical and empirical literature on the factors that determine childhood mortality differentials across different geographical regions. Chapter three presents the methodology used to analyse the data while chapter four presents estimations and discussion of the empirical findings. Chapter five concludes by making recommendations, policy implications and provides suggestions for further studies.

CHAPTER TWO

LITERATURE REVIEW

2.0. Introduction

This chapter reviews theoretical and empirical literature on the factors that determine health outcomes at the global level, within the Zambian context and in particular on childhood mortality rates as a health outcome. The central focus of this review is to analyze the observed the different socio economic backgrounds, and stablish how these social differences within societies are a possible catalyst for child mortality differentials.

2.1. Theoretical and Empirical Literature

The problem of child mortality in Zambia has been one of the major concerns for the country, and as such, it was given prominence, among other health problems listed on the eight Millennium Development Goal targeted for achievement by the year 2015. This vice however, is not peculiar to Zambia alone. The UN Interagency Group for Child Mortality Estimation (IGME, 2011) report observed that 16000 children die every day across the world, with Sub Saharan Africa having the highest rates of one death for every 12 children, followed by South Asia that experiencing one death for every 19 children. Further, that within Sub Saharan Africa these rates vary across various countries.

Given the above facts therefore, understanding the general causes of child deaths at global level, and at micro-geographical level helps to focus policy interventions on specific identified problems, and in specific areas.

2.2. Causes of Child Mortality

The UN Interagency Group for Child Mortality Estimation (IGME, 2011) report identified 8 categories of causes of child deaths. These included pneumonia, diarrhea, malaria, injury, meningitis, congenital abnormalities, causes arising during perinatal period and other causes. (IGME, 2011).

Theory of health outcome cannot however be limited to sicknesses or absence of it only, but rather, to a combination of a lot of other concepts such as the quality, costs of acquiring, distribution of this health within the society etc., which ultimately should improve the overall quality of people's health lives. Thus, while it is important for us to take note of these diseases listed in the UN report, society cannot ignore the socio economic environment surrounding the affected individual, if the health challenges are to be tackled in totality.

In developing countries, Public Health Policy is being reshaped in order to improve population health and to elucidate the problem of inequalities in the distribution of health (Graham, 2002). This theory of social determinants of health came into being in the early 1970 aimed at countering public health processes that narrowly focused on diseases and health care processes. Ever since then, tackling the social influences on health is seen as a way to remove health inequalities.

Because of this growing interest in the subject of child mortality, various models have been developed to explain the concept of social determinants of health and the inequalities in provision of health. Some of the widely known models that explain this phenomenon, but not limited to, are: the Mosley and Chen, 1984, which identifies a number of proximate variables, through which socio economic factors affect child mortality; the Dahlgren and Whitehead's (1991) model, which represents the main determinants of health as a set of concentric arcs around the individual, and the Lalou (1997) model that postulated that causes may roughly be divided between endogenous and exogenous.

Although these models provide health determinants explanations using different styles and complexities, all of them present health as the outcome of a web of social influences, and the common factor among them is the general socioeconomic, cultural and environmental conditions attributed to health outcomes.

2.3. Models of Health

2.3.1. The Mosley and Chen Model (1984)

One of the earliest, and widely known health model of child survival. Mosley and Chen (1984) argued that research efforts to identify the most cost effective use of resources is being hindered by lack of clear conceptual models specifically for child health. They noted that the disparity between social science and medical research, which both focus on one aspect while ignoring the other.

Fig 2.0: The Mosley and Chen (1984)

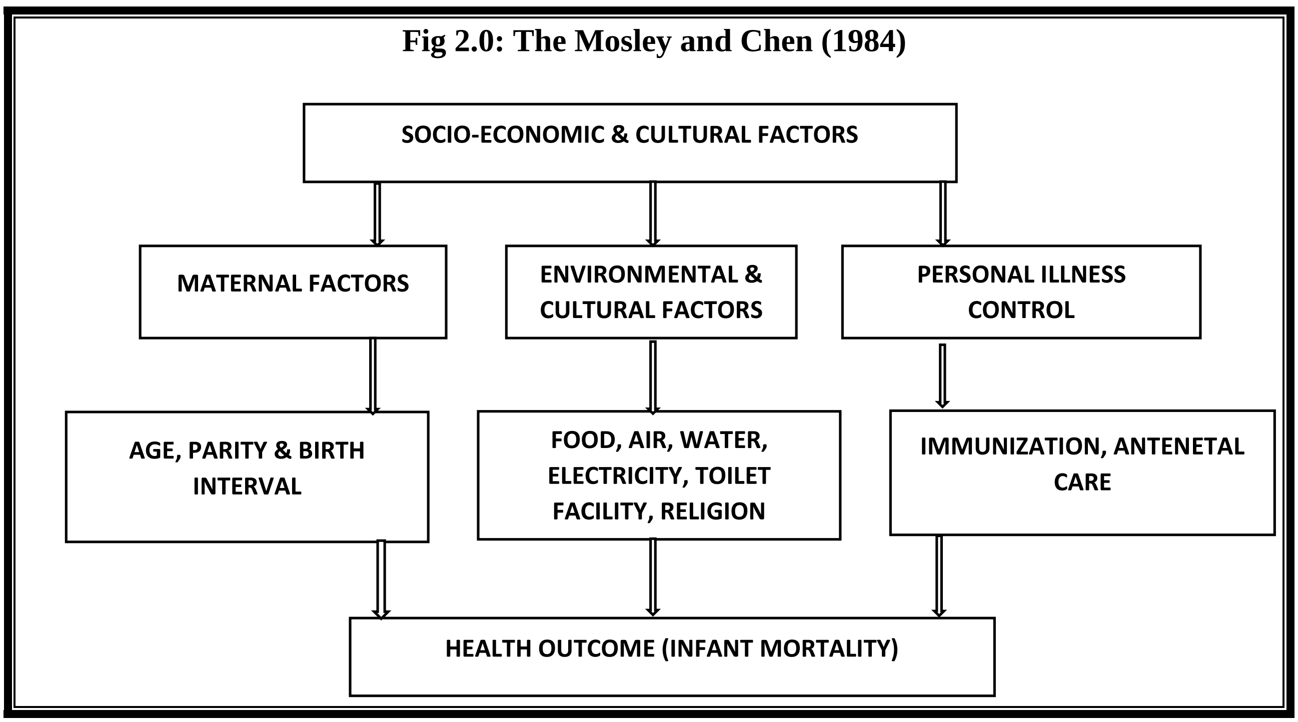


Fig 2.0: The Mosley and Chen (1984)

Adopted from the Mosley and Chen (1984) model of child survival: Slightly modified to conform to this particular study

Thus their model is based on the premise that even though ultimately death is caused by biological factors such as infectious diseases, these biological factors are in turn determined by a chain of socio-economic, demographic, environmental and cultural factors.

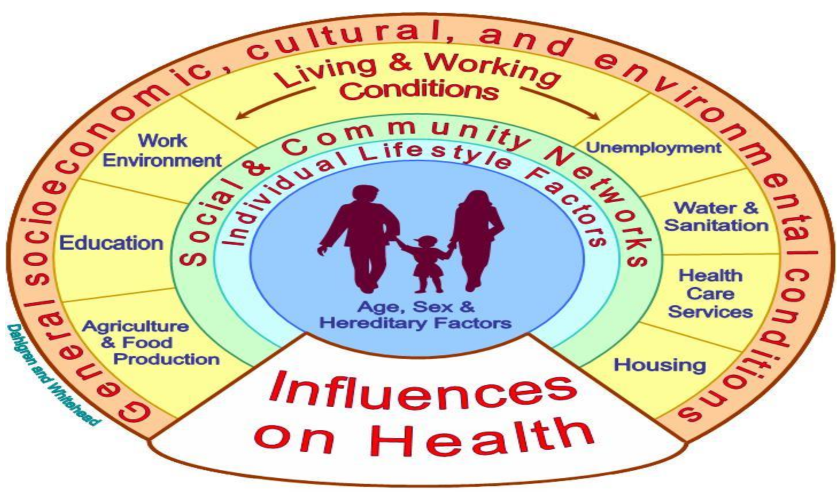
The model details how five broad socio-economic, demographic, environmental and cultural factors combine to influence the health outcomes. The model further identifies 14 proximate determinants through which these five broad factors operate to influence the risk of morbidity and child mortality. These factors include:

i. Maternal factors: Broken down into: Age, Parity and Birth Interval.
ii. Environmental and cultural factors: Broken into air, food, water, fingers, skin, inanimate objects, and insect vendors.
iii. Nutrient deficiency: Broken into calories, proteins and micronutrients.
iv. Injury, which can either be intention and unintentional accidents.
v. Personal illness control broken into Immunizations, malaria, or antenatal care.

2.3.2. Dahlgren & Whitehead (1991) Model

In explaining the theory of health outcome determinants, Dahlgren and Whitehead (1991) came up with a model that arranges these determinants of health into circular layers. These layers bring out the interaction between individuals and their environment, and eventually how they cause diseases.

Figure 2.1: Dahlgren & Whitehead Model of Influences on Heath



Sources: Dahlgren and Whitehead (1991).

In the first layer, the authors recognized individuals with their fixed characteristics like age, sex and hereditary factors, etc. Surrounding these fixed factors are other factors that influence their health. The next layer consists of individual behavior and their individual life style e.g. smoking, sexual behavior. This layer is followed by another one that consists of community characteristics which influence individual behavior in these communities. The final layer consists of structural factors such as housing, working conditions, access to services and provision of essential facilities.

Like many other models of health determinants, the Dahlgren and Whitehead model is a typical representation of a health consumer in Zambia, whose lifestyle is influenced by the environment they grow up in, their individual behavior and the community they network with every day. However, unlike the Mosley and Chen that focuses on health outcome on children or other models that are concerned with specific age group category of the people, or specific health problem, the Dahlgren and Whitehead addresses the determinants of health in general and broad terms.

Lalou (1997) developed a model, with a similar view with that of Dahlgren and Whitehead (1991), but presented differently. Commenting on the causes of death in the early years of life, the Lalou (1997) model postulated that causes may roughly be divided between endogenous and exogenous. He classified endogenous variables as those factors that are independent of socio economic and cultural conditions into which a child is born. These are biological and genetic factors that influence survival chances of the child after being born such as sex, survival status of other siblings, etc. However, just like in Dahlgren and Whitehead, these factors are strongly influenced by the surrounding environment in which the child grows in. Exogenous factors in this case would then be those factors determined by cultural and environmental factors and are not affected by any biological mechanisms. These include ethnicity of the mother, geographical location, etc.

Conceptually, the model is exactly similar to the Dahlgren and Whitehead model. The difference is motivated more by the convenience in presentation and analysis of the model rather than providing the technical explanation on influence of the different socioeconomic factors on health outcomes. While the Dahlgren and Whitehead model analyses the factors influencing health outcomes by breaking them into so many layers, Lalou 1997 groups the factors into two categories, namely: Endogenous and exogenous. Further, the above reviewed models lack detail to explain how processes in these layers are interlinked to finally end up with a particular health outcome.

The Dahlgren and Whitehead and Lalou models were developed much later than the Mosley and Chen. However, because of their shortcomings already alluded to above, they have failed to surpass that of the Mosley and Chen model, and thus the later has remained the most preferred model in child survival.

On the other hand, Mosley and Chen's analysis cannot be applied to all economies in its totality. For example the health system variable in the model talks about institutionalized actions where Government makes it a law for everyone to receive health services, failure to which one is prosecuted. This system requires that the health system is heavily subsidized. As such, this aspect of the model poses a challenge in developing countries like Zambian setting where health resources are scarce even to implement the law against those who might not comply with the requirements. Another shortcoming in the model is that, inspite of the importance of "Sex" as a social determinant that affects the health outcome, the variable is silent in the model.

2.4. Socio Economic Determinants of Child Mortality in Zambia

In the ongoing debate between the role of social and economic transformations on one hand, and specific health interventions, on the other, the Mosley and Chen model remains the most ideal model in analyzing the determinants of child mortality rates in Zambia because of its robustness and detail in breaking down the broader socio economic and health systems into detailed specific factors, that ultimately result into the final health outcome.

Mosley and Chen (1984), noted that socioeconomic factors shape and modify the economic choices and health related practices of individuals according to the cultural traditions and norms of society. They divided these factors into three broad categories namely individual, household, and community level factors. By and large, this aspect of the Mosley-Chen theory resonates with the country characteristics for Zambia.

Though Zambia is a unitary state, governed as a single power in which the central government is ultimately supreme power, the country's population is divided on so many fronts in terms of languages spoken, religion, cultural beliefs, education levels and even poverty levels. These differences exist both at individual and community level and are often reflected on the economic choices and healthy behavior of the different groups of people in the Zambian society, which ultimately determine the morbidity and mortality levels in different provinces.

2.4.1. Individual Level Factors

The Mosley-Chen framework proposed that if the interest is specifically for the survival or health outcome of a child, then the child bearing adult should be analyzed separately from other adults. Commenting on the male parent, they noted that the father's socio economic status is likely to influence the child only through education and income effect especially where the father is the income earner in a home, and may have little direct impact on the child. However, the model singled out the mother's characteristics and behavior in detail to have far reaching effects on the child. Because of their biological and physical connection with the child during and after pregnancy, their personal nutrition status, reproductive patterns, and personal skills in health care practices have direct influence on the proximate determinants.

a) **Age, Parity and Birth Interval**

The Mosley and Chen (1984) proposed that maternal factors such as age, parity, birth interval etc., have shown to exert an independent influence on child mortality rates. This is because the quality of health of any child is dependent on the amount of care they get from their mother, and this in turn is dependent on the number of children the particular mother has to care for at the same time, and at what frequency these children are born.

Approximately 40% of women in Zambia have their first pregnancy before the age of 17. (ZDHS, 2013/14). Fertility displays the same pattern as nutrition, with lowest economic quintile of women giving birth to more than twice the children than women in the highest quintile and rural women experiencing notably more births than urban women (National Health Policy, 2010).

The 2013-14 ZDHS report further noted that on average, women in Zambia space their children in intervals of 25months. Further that comparatively, the spacing is much longer in urban (at 40 months) compared to the rural (with 32 months). Regionally, Copperbelt has the longest birth interval on average, with 40 months, while Luapula, North Western and Northern have the short birth interval all with 32months. Similarly, child spacing proportionally increased with wealth of an individual. For women in the first and second quantile, the average birth interval 33 months while those in the highest wealth quantile had an average birth interval of 44 months.

This pattern exposes most of the women in Zambia to health risks, and in the process exposing the health of the unborn child. The risk is worse in the rural areas, among the poor and those based in Luapula, Northern and North Western provinces.

The above statistics goes to show the variations in the social behavior among people of different age groups, provinces, educational level, etc. that has potential to expose children in Zambia with different levels of risk and potential health problems.

In a study of child survival in Zambia, Nsemukila (1996) established a strong association with mortality by the length of the preceding birth interval. Mortality was found to be lowest among births with birth intervals of at least 36 months. Births with less than 24 months intervals were more than twice at risk of dying compared to births with intervals of between 24-35 months. He also found a stronger relationship between the age of a mother at birth and the neonate's risk of dying. With younger mothers being at higher risk of dying than those from older mothers. Further, birth order was strongly linked with the risk of dying, with the first birth order having a higher risk of dying than those in higher orders.

Supporting this view, the International Conference for Population and Development Programme of Action, (2014) which noted that child survival is closely linked to reproductive patterns such as when the child is born, interval between two siblings, number of children born from the same mother, and the reproductive health of the individual mother. Other studies across Africa have looked at the impact of socio economic and environmental variables on infant and child mortality in different environmental settings, using censuses and Demographic Health Surveys data. Their findings have revealed that mortality was lower among the second and third born order, birth interval between two siblings of more than two years, and those with access to clean water. (Muntago; Lukama 2015 and Sahu et al., 2014).

However, using the Kenya Demographic Health Survey to analyze these factors, Mustafa and Odimegwu (2008) argued that factors that determine deaths of infants were not absolute, but rather vary as the children grow. In the first month, the most important determinant of infant mortality is breast feeding status, followed by ethnicity, then fertility factors, (birth order and intervals), and the least of the factors is gender. Nevertheless, once the child survives the first month of being born, ethnicity becomes the most important determinant in both rural and urban, followed by breastfeeding status, gender of the child, fertility factors, and the least significant are mother's occupation and education level.

With Zambia's population growth projected to grow almost twice as much between 2011 and 2035, (CSO, 2011), there seem to be a correlation between the population growth in the country and the poor family methods being practiced with most mothers. Child spacing remains the most health threatening aspect in the country especially among the rural mothers whose family planning practices are less guided by the conscious of economic ability.

b) **Education**

Dahlgren and Whitehead (1991) model classified education as a structural factor that influences an individual's living and working conditions, while Mosley and Chen (1984) postulated that education level influences a mother's choices and increases her skills in health care practices related to contraception, nutrition, hygiene, preventive care, and disease treatment. (Mosley, 1983).

Caldwell (1979) first suggested that Education in general, and female education in particular exert a great influence in children's health and survival with regard to pregnancy, childbirth, immunization and management of child disease. Caldwell and other scholars independently proposed that level of education attained by the mother is negatively related to infant mortality rates (Caldwell, 1979; Anker and Knowles, 1977; and Mott, 1982).

Caldwell (1979) put up a theory that this inverse relationship is attributed to various positive practices that come with increased knowledge from the acquired education. These include better child care, breakdown of primitive traditional child rearing practices, improved nutrition and increased income.

Lack of education is substantially high in Zambia, particularly among females. The Human Development Report (2013), reports that 44.2% of males at least attained Secondary education compared to only 25.7% of females. Adult literacy, defined by UNESCO as the percentage of people aged 15 and above who can both read and write with understanding about their everyday life, is estimated at 64% of women and 82% of men, with urban areas having higher literacy levels than rural areas (2011-2015 NHSP, 2010). Eastern and Northern Provinces have the highest illiteracy levels among the mothers with 57.7% and 54.2% respectively. While Lusaka and Copperbelt have the lowest illiteracy levels of 29.2% and 29.8% respectively. (ZDHS Data, 2013/14). If the above statistics are anything to go by, the scenario has the potential to affect safe motherhood, and contribute to the experienced deaths in the country. This is because of the far reaching effects of illiteracy such as pregnancy among very young mothers, lack of family planning, lack of knowledge of the risk factors, health behaviors, poor economic status, and harmful traditional practices during labor and delivery (Zambia Reproductive Health Policy, 2000). And if illiteracy levels are a proximate determinant of child deaths as predicted by literature, then it must follow that the differences in literacy levels, among different groups of people will result in different mortality rates among these different groups of people. Coincidentally provincial regions mentioned above, that have high levels of illiteracy levels among the females are adversely affected with high childhood mortality rates.

To this effect, the 2001 Zambia Demographic Health Survey revealed that birth interval is positively related with education attainment. Women without education averaged 34 months while with those with secondary education had an average birth interval of 42 months.

However, a number of studies on this subject have agreed with Caldwell's theory postulating a negative relationship between education and child mortality (Akum, 2013; Adedini, 2014; Singh, et al., 2011 and Kraf et al., 2013), a few other studies carried on this subject have not been able to establish this relationship between child mortality and maternal education. Further, others have completely rejected the theory hypothesized by Caldwell and others (Muntago, 2004; and Rubalcava and Tervel, 2004). In a study determining the impact of socioeconomic and environmental variables on infant and child mortality in Kenya, Muntago, (2004) established no association whatsoever between mortality rates and maternal education. Rubalcava and Tervel (2004) disputed Caldwell's position in relation to health knowledge. Using data from Mexican family survey, they established that maternal cognitive ability is rather an important factor in improving child health, unlike formal schooling, and that the impact of this cognitive behavior is independent of childhood background. The implication of this finding was that maternal ability is more instinctive in nature and does not require one to acquire education.

In Zambia, the Reproductive Health Policy, 2000 argued that although safe motherhood services in Zambia (i.e. ensuring affordable quality care for the mother and the new born baby), have been provided in the past, it has not had any noticeable impact on either the health of the mother or the baby.

Intuitively, the arguments advanced by Rubalcava and Tervel (2004) make a lot of logical sense in an environment such as Zambia where, by nature, as girls grow in a Zambian society, they are oriented and made to believe that it's the duty of mothers to take care of the babies. Thus when they grow up, regardless of their education level, they take care of their babies with every little thing they have. This is because firstly it's inculcated in them by society, and secondly it's instinctively part of a woman's nature to be caring to her child. Following this line of thought therefore, the argument by of mothers' care being more instinctive by nature, rather than through being dependent on education, becomes more persuasive to follow than the one advanced by Caldwell.

Further, in putting up the theory on the association of maternal education and child mortality, these scholars did not take into account the fact that in a modern world, specifically in a setting like Zambia, where majority of women are migrating to the city immediately they acquire education. Once in the cities, educated mothers are now engaging in employment which keep them away from their children for many hours on end, leaving their babies in the care of house maids. This effectively means the care for their children is transferred to some other individuals rather than the biological mothers of these children. This argument on maternal education further renders Mosley and Chen's philosophy of isolating a single adult in analyzing child survival as, invalid.

Sex of the baby

Though Mosley and Chen model is silent on the variable sex of a child as a factor that potentially affects infant mortality, lots of literature has recognized the importance of sex in determining child deaths. Dahlgren and Whitehead's (1991) model place this variable in the first layer where they recognized that individuals' fixed characteristics like age, sex and hereditary factors, etc. have influence on their health, while Lou (1997) classified it as an endogenous variable that affects child survival, and is independent of any socio economic or cultural and environmental factors.

The estimated male female ratio in Zambia according to the 2010 National Census 49.5% to 50.5% (CSO, 2013). However, the sex proportions in Zambia indicate that at the time of birth, the males were more than women with a ratio of 103 male births per 100 female birth. Thus even though the national average indicate that women ratio is more than that of women, the proportion of male is more at the birth compared to female. This gives reason to suspect male children could be experiencing more deaths.

This suspicion is given more strength with the National Health Policy (2011) recognizing that malnutrition is consistently highier among boys than among girls, and also higher in rural than in urban areas. Further, the 2013/14 Zambia Demographic Health Survey revealed that child mortality rates between male and female were 5.9% and 5.1% respectively. From the above, male children in Zambia are more vulnerable to diseases and therefore record higher death rates compared to female babies. These sex proportions show similar trends between rural and urban areas and also among all the eight provinces except in Central Province and North Western Provinces where the ratios of female deaths are higher than that of male of deaths.

In a study looking at Child survival in Zambia, Nsemukila (1996), concluded that male births were more likely to die than female births in the first few weeks after birth. Studies done on the similar subject in other countries support this view (Carla, 2003; Mustafa and Odimegwu, 2008).

Social Studies literature on the possible reasons behind the variations in mortality rates among children of different sexes particularly in Zambia is silent. This is largely because this is more of a scientific phenomenon. However, in an article Genes, Behavior, and Social environment, Krieger (2003) states that genetic and physiological make up, in addition to an individual's personal experiences and interactions with the environment, can play a large part in observed characteristic differences such as varying incidence and severity of diseases. Further that males have higher rates of illness and deaths than female because of genetic, hormonal, atomic, or other inherent differences between the sexes. These affect their susceptibility or physiological responses.

The demographic set up in Zambia is such that different tribal groupings are concentrated in various specific provinces. This often results in some of the major cultural factors impeding the communication and interaction of people, and thus restricts marrying within the same groups, thereby producing certain specific genetic differences, and ultimately likely to produce differences in certain disease-related alleles.

2.4.2. Household Level Variables

a) Wealth/Poverty

May et al., (1998) defines poverty as the inability to command sufficient resources to satisfy a socially acceptable minimum standard of living. Mosley and Chen classified Wealth/Poverty under "Household" variable because this is not only determined by the mother of the baby, but by the overall socioeconomic status of the family that the child is born into.

In the Zambian context, poverty is defined as having no access to income, having no access to employment opportunities, and the inability to freely determine one's own consumption levels of goods and services. (CSO, 2011). The country consists of a rural agriculture sector and a modern urban sector. The proportion of the population living in urban areas is about 40%, and varies by province, from only 13% in Eastern and Western Province to 85% in Lusaka. (CSO, 2012). Rural poverty stands at 78% while urban stands at 28%, while 67.5% of the population country live.

Thus the poverty statistics on Zambia outlined above, are a reflection of the socioeconomic status of individual households in the country. Wealth or disposable resources available to an individual household are an important variable in determining infant mortality rates as well as differentials between population groups. This is because there is a vicious cycle exists between health status of the nation and the poverty level. Areas with high levels of poverty are often associated with poor nutrition, overcrowding, lack of clean water, poor education, stress and the harsh realities of life capable of continuously putting the poor's health at risk. On the other hand, poor health hinders on the productive capacity of individuals.

Mosley and Chen (1984) suggested that a variety of goods and services, and assets at the household level operate on children's health and mortality through proximate determinants. These are food, water, clothing, housing, preventive care, information, etc. This is because people have different opportunities and access to societal resources, and so therefore, their social standing in society cannot be equal. Consequently, those with more access to these resources are less prone to various diseases, regardless of the severity of the disease compared to the have nots. (Linkard and Phelan 1995, 87).

Studies in Zambia reveal that many women in the country have limited access to skilled professionals for maternal and child health care. For example, the 2001/2002 ZDHS shows that only 43 percent of mothers delivered with the assistance of skilled professionals, compared with 48 percent in 1996. The figure however, increased substantially to 69% in 2014. Their limitation to a larger extent was as a result of their poor economic status.

In a report on research priorities and recommendations for action for 1999-2001, the Central Board of Health of Zambia (CBoH) noted that there was a tendency among a number of women, especially in rural Zambia, not delivering from health centers, especially as they got older, and cited long distances to Centers as one of the key reasons. However, people living in provinces and large towns along the railway line have better access to health centers. In urban areas, 99 percent of households are within 5 kilometers of a health facility, compared with only 50 percent of households in rural areas (ZDHS, 2001/2002). As a result, more survey in Zambia reveal that majority of women who die from obstetric causes in Zambia are in the middle- to poor-income groups. Only 3% of maternal deaths occur among women in high-income categories. ZDHS (2001/2002).

While not downplaying the facts above, it is also important to note that, in advancing the argument of a mother’s importance in determining child’s survival in relation to the father, Mosley and Chen notes that fathers are only likely to influence the child only through education and income effect especially where the father is the income earner in a home, and may have little direct impact on the child. Given that therefore, just like education, household income or wealth’s influence is more likely to provide a good and comfortable environment for the mother, and the child then benefits through trickle down effects. However, having little or no education, or being poor is least likely to stop a mother from seeking basic health needs for their baby, especially in Zambia where Government has scrapped off user fees and provides pre-natal and post-natal care for pregnant and new mothers respectively.

2.4.3. Community Level Variable

These are factors that affect a given community at large, and includes the ecological setting such as climate, soil, rainfall, temperature, altitude and seasonality; the political economy, i.e physical infrastructure like electricity, water, sewerage, telephone systems, etc.

a. Cultural and Environmental Factors

Environmental contamination refers to the transmission of infectious agents to children and mothers. The four categories representing the main routes whereby infectious agents are transmitted to the human host are air, food, water, and fingers. (Mosley and Chen 1984).

Zambia being a multi-cultural society with 72 different tribes and ethnic groups has a number of engrained cultural and religious practices traditionally undertaken by different groups and tribes that have an adverse impact on health, including the early marriages of the females, polygamy, genital mutilation, and sexual cleansing of widows, (where widow has sexual intercourse with one of the relatives of the deceased). (ACCA) April, 2013.). Thus although Mosley and Chen classified this factor under the individual variables, where it affects one's norms and attitudes, and ultimately health outcomes, the cultural set up in Zambia is such that individual cultures and tribes are often clustered in specific provinces and areas, and their behaviors often influenced by similar cultures within those areas.

These different cultures in Zambia affect everything people think and do, from what they eat, to who they allow to be a healer. Thus culture in Zambia shapes people's health as much as their genes do. (Zambia National Health Policy, 2012). Lalou (1997) affirmed that in the early stages of life, cultural or environmental factors contribute to childhood deaths by influencing the mother's health either directly or indirectly.

Statistics from the Central Statistics Office indicate that only 41% of homes have access to safe water, while 25% of homes have no toilet facilities. Of the people with no toilet facilities, 37% of them are from the rural areas while only 2% are from the urban areas. This often leads to high prevalence of infectious diseases among both the adults and the infants that are in their care. It has been estimated that 80% of preventable diseases in Zambia relate to poor sanitation. (MoH, 2011).

Regarding cultural influences in Zambia, Kapungwe (2005) carried out a study on quality of child health care and under five mortality in Samfya and Kawambwa district in Luapula Province, diarrhea and malaria were established as the leading causes of child deaths, and the diseases were largely as a result of poor care by their parents, but most importantly adherence to traditional beliefs that often hindered them from seeking professional heath care.

Central Statistics estimates that indicate that although 94% of women sought antenatal care during pregnancy, only 19% presented in their first trimester, resulting in the omission of key interventions. Fewer than half of the women (46.5%) had a delivery assisted by a nurse, midwife or physician and only 39% sought postnatal care within two days of the birth. Further, the proportion of women who chose to give birth attended by a skilled health personnel was only 31% from the rural compared with 83% from the urban areas. While this could be as a result of various constraints such as distance to the health center in the rural areas, traditional beliefs played a large role. (CSO, MoH 2011). The 1998 UNFPA-supported study reveal that women in Zambia complain of bad attitudes by health care workers. Some say the nurses shout at mothers for not buying things like razor blades, baby clothes, and gloves (hospitals no longer provide these items). The presence of male nurses is also off-putting.

In another study carried out in Katete District in Eastern Province, an interview with midwives, revealed that even though distance, user fees and transportation costs are some of the hindrances for women visiting health centers to deliver, traditional and cultural beliefs seem to be adding to women shunning the health centers. In this study, women stated that it was uncomfortable to have male nurses examining them claiming that culturally, it was taboo for any man besides your husband to see anything above the knees.

2.4.4. Healthy Systems Variables

These are usually based on institutionalized or imposed actions by the Government aimed at ensuring that every individual gets the health services. They basically form disease control measures mandated by Government law. Besides the socioeconomic, biological, environmental and cultural factors like the previous models reviewed above, Mosley and Chen added the health system variables to the factors influencing the health outcome of the baby. In Zambia children are expected to go for vaccination before the age of five. However, to a larger extent this depends on the mother of the child and it's not imposed by the Government as suggested by Mosley and Chen.

2.5. Regional Differences in Child Mortality

The models of determinants of health above reveal to us not only relationships between health outcomes on one hand, and socioeconomic, demographic, environmental and biological factors on the other, but to an extent reveal sources of the deep inequalities that exist in societies, in as far as both demand and supply of health is concerned.

The trends, which triggered this study, seem to suggest an existence of an association between these phenomenons. This therefore raises an empirical question, i.e. what kind of relationship exists between child mortality in each of the provinces, and the socioeconomic, demographic and cultural intricacies amongst the provincial regions of the country? How does this relationship influence the variations in child deaths observed among these?

Using the Demographic Health surveys and other census data, and applying different econometric models of analyzing child survival, several studies across the globe have attempted to examine the factors impacting childhood mortality, and their influence in mortality variations among different geographical regions in the same country (Tulasidhar, 1993; Mustafar, 2008 and Adedimi, 2014). Evidence from these studies reveal varying findings on the impact of such factors on child deaths both in terms of magnitude and direction of influence.

In trying to understand the persistent gaps in child survival interventions in Zambia, Macwang'i and Phiri, 2008 did a study on the differentials in under 5 in Zambia. The study focused on levels and patterns of under-five mortality rates by age as well as distribution between and within geographical areas.

The data analysis was done using the 1992, 1996, 2001/2, and 2007 Zambia Demographic Health Surveys. The data was triangulated with other sources of data from Census of population and housing and Information Systems Statistical Bulletins.

The study established that various factors contribute to differentials in levels of mortality by age and geographical areas. Factors causing the differentials included poor targeting and coverage, shortage of human resources for health, inadequate infrastructure mainly for communication, poor health seeking behavior especially in rural areas, cultural practices such as care of the new born and nutritional habits and socio economic status including education level.

However, the shortcomings of the study was that it was mostly based on observations and descriptive analysis of datasets over a long period of time, but did not use statistical tools for analysis. Thus besides giving a broad picture of variations in mortality rates, and informing us that poor policy intervention as well as differences in socioeconomic status among different individuals has resulted in different mortality rates around the country, the results of the studies did not point to us which specific regions are affected by given factors and to what extent. However, the study revealed a lot of important elements necessary for policy targeting on specific areas, and this makes it a good study.

Motivated by the high child mortality rates in Nigeria, and the socioeconomic, and cultural differences amongst the various regions in the country, Adedini et al., (2014) carried out a study on regional variations in Infant mortality in Nigeria. The objective was to establish how individual and community characteristics among mothers influenced infant mortality in Nigeria, and the extent to which these characteristics influenced variations observed in child mortality in Nigeria. Using survey data from the 2008 Nigeria Demographic and Health Survey, they performed a Cox Proportional Hazard analysis to address their research question. Their findings revealed that, apart from sex, both community-level variables such as region, place of residence, community infrastructure, and community hospital; and individual level factors such as age, sex, birth order, birth interval, education and wealth index are all important determinants of child deaths in the Nigeria.

Further, the findings established that community level characteristics are significant in explaining differences in child mortality among regions (12-60 months), while individual characteristics are important in explaining variation in infant mortality (0-11 month) rates. This finding emphasizes the need to breakdown the impact of individual as well as that of community level factors in tackling the problems of regional differentials.

Adedini et., al (2014) findings further indicated the importance of mother's care during the period of child infancy, and how the dynamics change as the child grows. These findings are more cardinal for policy makers for they were able to break down the factors into micro units. This becomes vital for directing policy to specific needs broken down to individual, community as well as particular age groups.

Akuma (2013) did a similar study in Kenya as the one done by Adedini etal., 2014. The study was analyzing the differentials between regions classified as high and low mortality regions among the infants. A logistic regression model was run on the 2009 Kenya Demographic Health Survey, to determine the odds ratio of child deaths in the presence of the socio economic, demographic control variables. Their findings indicated that low education attainment, low socio economic status, and short interval births lead to observed higher levels of infant mortality in the high mortality regions. The study did not establish any significant association between infant mortality and demographic factors such as of maternal age, type of toilet, source of water for drinking, type of material used for the main floor, religious affiliation and ethnicity for the mother. However, the study established significant association between infant mortality and birth interval in high mortality regions.

Though this study did not establish a relationship between childhood mortality and all the individual and community variables as espoused by the health determinants models, to a lager extent the study agreed technically with a study done in Nigeria by Adedini et., al, 2014 in that this study specifically undertook to analyze the infants (Age group 0-11moths). And the findings suggest that only individual and household factors were seen to influence child deaths in Kenya. The study however, did not make any distinctions if there were any common factors specifically associated with either the high or low mortality regions.

Similar findings with Akuma (2013), were established by Alves and Belluzzo (2005), who analyzed infant mortality trends and differentials in Brazil using panel data during a 40 year period. The study established that both per capita growth and increase of education levels are important factors in determining the childhood mortality differentials among different regions, also supporting the fact that health determinants affect child mortality differently depending on the stage of a child, i.e. either infant or child.

It is cardinal to take note that social characteristics anywhere are not absolute, but dynamic. As such, studies on regional variations do not only indicate to us how infants and children are affected differently by socioeconomic variables, they also show how some factors may have influence in one area of the same country, and completely insignificant in another. This characteristic of such studies makes it a powerful tool for policy makers to focus on the relevant areas and avoid wastage of national resources. For example, in a study aimed at examining the relative importance of the major bio-social, demographic, and economic factors associated with infant mortality in Kenya, Mustafa and Odimegwu (2008) got results contrary to the hypothesis that higher socio economic status is associated with lower child mortality rates. In their findings, socio economic status, proxied by wealth index showed inconsistent relationship with infant mortality. While mortality rates were highest among the poorest, it was higher amongst the richest than those in the middle class. This goes to show how we cannot casually rely on literature, both theoretical and empirical that was done in one part of the world, to infer to our own country's characteristics when formulating policy.

2.6. Conclusion

Particularly guided by the Mosley and Chen (1984) model of child survival, this chapter made an attempt to draw lessons from theoretical models of determinants of health, in order to gain understanding on how demographic, biological, socioeconomic and cultural factors influence health outcomes, with particular emphasis on child mortality as a health outcome.

Using country characteristics for Zambia, the chapter hypothesized how these demographic, biological, socioeconomic and cultural factors at different levels in the country result in to some possible health outcomes or indicators in the country, while at the same time drawing evidence from the existing theory and empirical studies to demonstrate how such country characteristics are likely to lead to health outcome differentials among the different regions of the same country.

Finally, the revelations in both the theoretical and empirical literature above were useful in setting a fertile ground for such a study in Zambia, where the subject has not been exhaustively tackled. The following chapter will therefore try to shape the methodology used to achieve the objectives of this study, outlining clearly the factors hypothesized by the study to influence child mortality outcomes in Zambia.

CHAPTER THREE

METHODOLOGY

3.0. Introduction

The following Chapter outlines the methods and procedures that were followed in order to achieve the stated objectives of the study. The Chapter also outlines in detail the data sources, the variables of interest and what they purported to measure and the model used in analyzing the data. The choice of the model was mainly determined by both the theoretical and empirical literature already reviewed.

3.1. Data Sources

This study used a cross-sectional study of the 2013/14 Zambia Demographic Health Survey (ZDHS) data taken from the children (Under five) records, accessible from Central Statistics of Zambia. The Zambia Demographic Health Survey is part of the World wide Demographic Health Survey DHS) Programme, designed to collect data on health indicators such as fertility, family planning, as well as maternal and child health. (ZDHS, 1992). The latest of these survey was thus carried out in the year 2013/2014. The Zambia Demographic Health Surveys are conducted by a combination of various Organization in partnership with one another, and these include: Central Statistics Office (CSO), Tropical Disease Research Centre (TDRC), University Teaching Hospital (UTH), Ministry of Health (MoH), and the Demography Department at The University of Zambia (UNZA). (ZDHS, 2013/14). Other data used in this study for triangulation purposes, was accessed from various sources such as Central Statistics Office, Ministry of Health, World Bank Economic Indicators, etc.

3.1.1. Sampling Method and Sample Size

The Zambia Demographic Health Survey is a nationally representative sample that collects information on mothers aged 15-49. The survey sets are subjected to rigorous sampling methods to make them suitable for any statistical analysis. In Zambia the survey was done across all the 10 provinces in the country. The survey consists of three datasets namely mothers’ record, household record as well as children’s record. This study conveniently targeted the children records (CR) from the survey. The children records collects data for children born five years before the survey, and tracks their status whether they died or were still surviving by the time the survey was carried out. The sample size of the study comprises of a total number of **13457** children.

The survey used a 2-stage stratified random sampling design. In the first stage, the study selected **700** clusters across the country with **4,998** urban households and **8,459** rural households. In the second stage, individual households were selected from these listed clusters. The sample comprised of **1,171** households in Central Province, **1,176** Copperbelt, **1,635** Eastern, **1,559** Luapula Province, **1,181** Lusaka, **1,252** Muchinga Province, **1,528** Northern**, 1,381** Northern Western Province and **1,488** from Southern Province. Eligible for this study were all women aged between 15-49 years old. This makes the data representative.

The children records contain all the detailed information for the respondents and the children that were born from these mothers five years prior to the study. These include the socioeconomic characteristics of the mother such as wealth index, education, literacy level, access to electricity, their place of residence, and their literacy levels; demographic factors such as sex of the baby, age of the mother; Health seeking behavior such as giving birth at the hospital, child spacing, number of children one woman has, and at which age she has them.

The Mosley and Chen (1984) framework that motivates this study proposes **14** proximate determinants through which background social, economic, cultural and health system variables influence child mortality (Hill. K, 2003; Mosley H, 1984). Given this framework therefore, the data collected by the Zambia Demographic Health Survey became appropriate for addressing the research such as this one which was looking at factors influencing child mortality in the country.

3.1.2. Data Quality

The Zambia Demographic Health Surveys (DHS) undergo vigorous data quality control procedures to ensure reliable data is obtained. Data from ZDHS is thus representative of the Zambian population and is consistent with the census figures from the Central Statistics Office.

The assessment of 2013/2014 Zambia Demographic Health Survey indicates that most of Households with missing data were deleted from the sample while the percentage of the missing data on the captured households ranged from 0.04% to 0.92 % (ZDHS, 2013/14). These figures suggest that there were not much omissions, displacement or misreporting of births or deaths, making the data more reliable.

3.2. Statistical Analysis

The subject of child mortality has been extensively studied in various parts of the world and, while these studies have more or less followed similar conceptual frameworks, they have all employed different statistical models in trying to address the problem of child mortality. However, the following models have predominantly been used for the study of child mortality:

3.2.1. Cox Hazard Proportional Model

The Cox model is a statistical approach that is applied for the analysis of survival data. The model analyzes the time to event of a unit, while at the same time it explores the effects of different independent variables on the probability of survival. (Walters, J, 2001). The Cox is similar to Logistic regression models except that the dependent variable in the model is a hazard function at time ***t***, and it's a combination of time and event happening. Empirical studies done in Africa and elsewhere have used the model in estimating child survival because of its ability to analyze deaths of different age groups at the same time, e.g. such studies have analyzed variations of both infant and child mortality (Adedini A, 2014; Akuma, 2013 and Sahu et al., 2014).

The Cox Model is specified thus;

$$\lambda(t,X) = \lambda_0 (t)\ \exp(\beta_1 X_1 \ldots \ldots + \beta k X k), \text{ where;}$$

Where X = (X_1, X_2, X_3…..) are the explanatory variables.

λ_0 (*t*) is the baseline or underlying hazard function representing how the risk changes with time and corresponds to the likelihood of the individual child dying (or an event happening) holding all the explanatory variables constant.

Exponential (*Exp*) represents the effects of a collection of explanatory (Xi) variables and comes via multiplicative way. The regression coefficients $\boldsymbol{\beta}_{1,\ldots n}$ gives the expected change in the hazard ratio or probability of survival in relation to changes in these explanatory variables.
To estimate the coefficients β or effects of each factor in a multiple regression model, Cox (1972) proposed a partial likelihood function based on a conditional probability of failure. Using this model, probability of a child dying was viewed as event failure and regarded as the hazard. Thus this model is appropriate for a deeper analysis of the survival rates of children.

However, this particular study was mainly interested in establishing the determinants of child mortality in the country and among its provinces, as well as establishing whether differences observed among provinces could be explained by these factors. Thus a simple logistic regression model that uses binary outcomes to determine outcomes of qualitative nature was preferred for this study.

3.2.2. Logistic Regression Models

Logistic models are generally known for their appropriateness in predicting qualitative variables that are binary or dichotomous in nature (Gujarat, 2004). Since this study was analyzing child mortality which took two values namely 0 for a surviving child and 1 for one that died, to determine the influence of various factors on the risk of the child dying, a multivariate logistic regression model was appropriate for this study. The model was used in this study to estimate the odds of dying for an under five child, given the socio economic, demographic and cultural environment within which the mother of the child resides. Both descriptive and parametric estimations were used in this study.

Descriptive Statistics

The descriptive analysis involved running the frequencies and percentages of the variables. This was done to show the distribution of respondents by the sample characteristics.

Parametric Estimation

To specifically achieve the objectives set out in this study, the following procedures were performed:

a. In determining factors influencing childhood mortality rates in the country, a regression model was run in which all the hypothesized variables were regressed on child mortality to establish those that significantly influenced childhood mortality in the country. A manual backward and forward stepwise regression process was followed in coming up with most relevant variables to include in the model. The process involved dropping and adding variables in the model while at the same time testing for the fitness of the model.

b. In determining factors associated with childhood mortality in different provinces, ten (10) separate models for each province were run in which childhood mortality was regressed against these variables. A stepwise regression process was also applied on each of these models and fitness for each model tested as well.

c. Finally, to establish the extent to which these factors could explain the childhood mortality variations observed among provinces, marginal effects, which measure the instantaneous change in childhood mortality resulting from each of these factors, were analyzed in each of the provinces and comparisons made in the changes between the low mortality and high mortality regions.

Model Specification

The logistic regression model takes the general form:

P[Y] = $\left[\frac{1}{1+e^{-(\beta_0+\beta_1 X)}}\right]$, which can similarly be written as:

P [Y] = $\left[\frac{e^{\beta_0+\beta_1 X}}{1+e^{\beta_0+\beta_1 X}}\right]$**…………………………………..………………………..Equation (i) where,**

P[Y] is the probability of an event happening.

e is the Base of natural logarithms, with a standard value of 2.71828.

β_0 and β_1 are parameters estimated from the data.

X represents the variables explaining the probabilities in the model. (Gujarat, 2003).

Deriving the model

In its non-linear form, the model cannot be used to estimate parameters, thus the model can be converted to make it suitable for estimations. However, given that the probability [P] of an event happening is bound between 0 and 1, the probability of an event not happening will be given by [1-P]. Thus, if probability of an event happening is $\left[\frac{1}{1+e^{-(\beta_0+\beta_1 X)}}\right]$, then the probability of an event not happening will be given by;

1- P = $\left[\frac{1}{1-e^{(\beta_0+\beta_1 X)}}\right]$**……………………………………………………………...equation (ii)**

$\frac{P}{1-P}$ **=** $\left[\frac{1+e^{\beta_0+\beta_1 X}}{1+e^{-(\beta_0+\beta_1 X)}}\right]$ **=**$[e^{\beta_0+\beta_1 X}]$ **…………………………………………….….equation (iii)**

$\frac{P}{1-P}$ are the odds ratio of the probability of an event happening to the probability that it will not happen. Taking the natural logs into the above equation gives the Logistic equation;

L*i* = In $\left[\frac{P}{1-P}\right]$ **= β0+ β1X…………………………………………….…...equation (iv)**

This makes the log of odds ratio linear in X and the parameters, and suitable for use in analysis involving linear relationships such as this study.

Features of the model in relation to the childhood mortality rates.

a. The probabilities are not linear though logit is linearly related with explanatory variables.
b. The model allows the inclusion of as many variables as dictated by the underlying theory which is ideal for the child mortality study being undertaken with a total of sixteen variables.
c. If the Logit (L) is positive, it implies that an increase in one unit of a given variable, increases the odds of a child dying, and when it’s less than 1, then the odds of a child dying decreases as the value of an independent variable increases.

3.3. Definition, Measurement and Justification of Variables

Formally, the childhood mortality model was specified as follows;

$$U5M = \text{In}\left[\frac{P}{1-P}\right] = \beta_0 + \beta_1 Pro + \beta_2 Res + \beta_3 Sex + \beta_4 Age + \beta_5 Educ + \beta_6 Lit + \beta_7 Wlth + \beta_8 D\_Place + \beta_9 Mdwife + \beta_{10} Bord + \beta_{11} Interv + \beta_{12} Rel + \beta_{13} Ethn + \beta_{14} Water + \beta_{15} Toilet + \beta_{16} electr$$

(Akuma, Joseph Misati,2013), where,

Under five mortality (U5M)

Also known as childhood mortality, combines the infant mortality (0-11 moths) as well as the child mortality (12-60 months). Under five mortality in this case is the outcome variable indicating whether the child died during this period of study or was alive by the time the study was done. This variable is represented by the binary codes 0 for a child that did not experience death by the end of the study period, and 1 for the child that experienced death. The DHS was carried out in the year 2013/2014, and thus it captured all children that were born as early as January 2008. This variable was expected to be influenced by the different explanatory variables both at national and provincial levels.

3.3.1. Explanatory Variables

These were variables that were expected to predict or influence the death of the children across the country as well as in each of the provinces. These variables were selected based on the Mosley and Chen (1984) conceptual framework that motivated this study.

Province (Pro)

Refers to the province or region from which the Individuals in the sample were interviewed. Zambia is divided in to ten (10) provinces with inhabitants that are different in terms of their culture and style of life. These include Central, Copperbelt, Eastern, Luapula, Lusaka, Muchinga, Northern, North Western, Southern and Western Province, and are coded according to their sequence in alphabet. Provincial characteristics are different across the country, and these characteristics are defined by the factors affecting different individuals such as education levels,

cultural beliefs, individual behaviors, and thus different provinces are therefore expected to experience different child mortality rates because of these different provincial characteristics.
This variable is of prime importance as the objective of this study is on the childhood mortality differentials observed among these provinces.

Table 3.0. Summary of the Variables & Value Labels

EXPLANATORY VARIABLES AND THE RESPECTIVE VALUE LABLES		
No.	**VARIABLE**	**VALUE LABELS**
1	**Province**	"Central"=(1), "Copperbelt"=(2), "Eastern Province"=(3), "Luapula"=(4), "Lusaka"=(5), "Muchinga"=(6), "Northern"=(7), "North Western"=(8), "Southern"=(9), and "Western"=(10)
2	**Residence**	"Urban"=(1), "Rural"=(2)
3	**Sex of the Child**	"Male"=(1), "Female"=(2)
4	**Maternal Age Group**	"15-19"= (1), "20-24"=(2), "25-29"=(3), '30-34"=(4), "35-39"=(5), "40-44"=(6), "45-49"=(7)
5	**Maternal Highest Education Level**	"No Education"=(0), "Primary Education"=(1), "Secondary Education"=(2),
6	**Literacy**	(1) Able to read" (2) "Unable to read"
7	**Wealth Index**	"Poor"=(1), "Middle Class"=(2), "Rich"(=3),
8	**Place of Delivery**	"Home"=(1), "Public Hospital"=(2), "Private Clinic/Hospital"=(3)
9	**Mid Wife**	"Yes" = 1, "No" = (2)
10	**Birth Order**	"First"=(1), "2nd-4th"=(2), "5th-6th" "=3, "7+" =4
11	**Birth Interval**	"x<24"=(1), "x≥24" =(2), where x defines the period between two siblings
12	**Religion**	"Christian"=(1), "Non-Christian" =(2)
13	**Ethnicity**	(1) Bemba (2) Tonga (3) Luba-Lunda (4) Kaonde (5) Lozi (6) Nyanja (7) Mambwe
14	**Drinking Water**	(1) Unprotected Well (2) Piped Water (3) Protected Well (4) Other Sources
15	**Toilet Facility**	(1) Flash toilet (2) Pit Latrine (3) Bush
16	**Owns Electricity**	(0) No (1) Yes

Type of Residence (Res)

Residence referred to the place in which the child resides, and is categorized as urban or rural. The fundamental differences in the socio economic set up between rural and urban makes this variable important in determining the different mortality rates in these areas. Poverty levels are relatively high in rural compared to urban, and as such a priory expectations were that mortality would be more pronounced in rural areas, where residents are disadvantaged in terms of their socioeconomic standing as well as their accessibility to health services.

Sex

Sex refers to the gender of the child under study and it's a dummy variable categorized as male or female. With male children deaths expected to be experienced more than the female ones, apriori expectations were a higher rate of mortality infants among the male children compared to the female ones.

Maternal Age Group (Age)

Refers to the age group of the mothers of the children under study. The mothers included in this study ranged from the age of 15 to 49. This study hypothesized that mothers who are older would be more caring to their infants than the young mothers. In this study, this variable was changed from a continuous variable and grouped into 5 year categories. This was necessary as the study intended to analyze the effects of specific age categories on the child mortality. Categorization of this variable was also guided by empirical literature reviewed in this study which revealed that socio economic factors affecting child mortality are not absolute. They vary as the child grow. For example, while some studies revealed that child mortality was high with young mother, others found that it was high with much older mother, and others found that both the very young and very old age group significantly influenced child mortality rates (Nsemukila, 2006; Lukama, 2015; and Mustafa and Odimegwu, 2008). Because of the above reasons, using categorized values for this particular variable became necessary for a more comprehensive interpretation of the results.

Maternal Education (Educ)

This referred to the highest level of education attained by the biological mother of the child under study. From the dataset for ZDHS this variable was already categorized into four categories namely Education", "Primary", "Secondary and "Tertiary". Meaning at the time of interview, the data was captured in categories rather than as continuous. However, for the purpose of this study the variable was re-categorized into three groups namely "No Education", "Primary" and "Secondary or better". This was necessary to do because the number of subjects in the tertiary category was too small. Besides, the behavior or characteristics of individuals with secondary does not differ so much with those with tertiary education thus it became convenient to combine these two. This study hypothesized that the higher a mother goes in terms of education, the more likely they are able to have more resources, both in terms of material and knowledge to take care of their infants.

Literacy (Lit)

Fundamentally related to the variable education but different in principle, the variable literacy was categorized as either “able to read” or unable to read”. This variable was important to include in the model independently of the maternal education because while education’s influence on child mortality is expected to come through improving the social status of an individual, literacy has a direct influence on child deaths as literate mothers are able to access information on health from different sources of literature. Thus, while one may not have a higher level of education to give them a good job that would eventually earn them a high standard of living, being literate would enable them have knowledge and ultimately live a healthy life style for both their benefit and that of the infant. Further, there were mothers who did not have a formal education, but were able to read, and those who had primary education but could not read. Thus it became necessary to capture this variable independent of the variable “Education”.

Wealth Index (Wlth)

Wealth Index measures someone’s level of income and expenditure. It is therefore a proxy for socio economic status of an individual. The index is constructed using house hold assets data such as ownership of television, radio, the type of house one stays, etc. to come up with different classifications of social classes such as “Poor”, “Middle Class” and “Rich”. However, the construction of this index and categorizing of the classes was already done by the survey and this study used the categorized data as it was. The apriori expectations of this study were that households with more wealth were less likely to experience childhood deaths because of their ability to take proper care of their infants.

Place of Delivery (D_Place)

Refers to the place where the child was born and could either be at home or a health facility. Birth could have taken either at a Public Hospital, home, etc. However, for purposes of this study, the variable was grouped in two, namely: Home and Health Centre. Apriori expectations of the study were that child mortality would be higher among people who deliver outside a health center where there is no proper care from a professional health practitioner.

Mid Wife (MdWife)

This variable referred to whether a mother was attended to by a nurse or health personnel at the time of delivery or not. It is also important to note that in some community health posts especially in the rural areas, there is a shortage of qualified mid wives, and as such, casual workers in these community health posts are forced to attend to delivering mothers. Because of the above stated, it was not automatic then that all pregnant mothers that delivered at a health Centre, were attended to by qualified midwives. It therefore became necessary to use this variable in the model together with the variable "Place of Delivery" even though they seem related on the face value.

Birth Order (Bord)

Referred to the order in which the children were born from the same mother classified as first birth order, "2-4th birth order", "5th-6th birth order" and "birth order 7+". The study hypothesized that the first born child is more likely to die compared to the subsequent children. This is also in relation to the level of care that the first born gets from a less experienced mother, compared to the subsequent children that are born as the mother grows old.

Birth Interval (Interv)

This refers to the space between one child and the previous one, and is classified as either >24 months or ≥24. Apriori expectations of the study were that Infants that are given care for a shorter period by their mothers before another sibling is born would have less chances of surviving compared to those who are sparsely distributed. Thus birth interval was expected to be negatively related to child mortality rates.

Religion (Rel)

Referred to the religious inclination of the mother of the baby under study, and was categorized into Christians and Non-Christians. This is a culturally related variable which helps measure the attitude and beliefs of mothers. This eventually influences, among others, the size of the family individuals decide to have, the type of health care facilities they will demand, as well as their general health seeking behavior.

Ethnicity (ethn)

Zambia being a multicultural society, has so many tribal groupings. The groups have been organized for this study as follows: Bemba and Mambwes which is predominantly in the Northern, Luapula and Muchinga Provinces of Zambia, Tongas which are mostly concentrated in the Southern Region, Luba/Lunda and Kaonde who are also predominantly found in the North Western Region of the country; Lozis that are found in the Western Province and Nyanjas that inhabited in the Eastern Province. Lusaka, Copperbelt and Central Provinces are cosmopolitan in nature and are found with a mixture of different ethnic groups. These groups have different cultural beliefs that influence their health, and health seeking behavior in various ways. This complex nature of these ethnic groups justifies the need to establish their individual influence on child mortality in the country.

Toilet Facility (Toilet) &

The physical environment in which mothers live and their children grow up in is important in determining their health. Thus, the type of toilet being used by the household, classified as a Flush toilet, Pit latrine or Bush. Apriori expectations were that children whose mothers use flush toilets are less likely to die compared to those that use pit latrine and the bush.

Drinking Water (Water)

Referred to the source of drinking water used by the mother and it was classified as Unprotected Well, Piped, and Protected Well. Apriori expectations were that children whose mothers use unprotected water would experience more death compared to those that used protected source of water.

Electricity

Referred to whether a household had access to electricity in a home or not. Access to electricity to an extent measures how well to do is the family, and improves on, among other things, access to information through electronic media, as well as other health benefits like possession of home equipment such as refrigerators used for the preservation of foods to keep them fresh.

3.4. Conclusion

This chapter outlined the methods and procedures that were followed in modelling the study as well as estimating the model. The Logistic Regression model was identified as the appropriate model for estimating the regional variations in the child mortality because of its simplicity in analyzing qualitative data such as that of child mortality rates, as well converting nonlinear to linear estimations. The following chapter will focus on the estimations meant to address the questions and objectives raised in the first chapter, using the statistical methodology already elaborated in this chapter.

CHAPTER 4

ESTIMATIONS, INTERPRETATIONS & ANALYSIS OF THE FINDINGS

4.0. Introduction

This particular chapter gives a detailed analysis of the findings of the study. Using model specifications and methods elaborated in the previous chapter, the chapter estimates factors that influence childhood mortality in Zambia. Further, the chapter estimates the influence of these factors on childhood mortality in each individual province, thereby demonstrating how these factors explain the variations in the mortality rates across all the provinces of the country.

4.1. Descriptive Statistics of Child Mortality in Zambia

A total of 13457 children were included in the sample, drawn from the ten (10) provinces of the country, of which 37.1% (4998) were from the urban area, while 62.9% (8459) were sampled from the rural area. 49.26% of the children were female while 50.7% were male, and a substantial proportion of these children (31.49%) were born at home instead of a health Centre, with 68.51% of them born either at a private clinic or public hospital. The average child birth order from the sample was found in the third and fourth born category (mean 2.3), and the average spacing or interval between these children and their siblings was 29 months.

The children in the sample were born from mothers whose age ranged from 15 to 49 years old, with the average age for all the mothers being 28.8 years. Majority (98.9%) of these mothers were Christians while the remaining were either Muslims, or other unstated religious Organizations. Prime age for most mothers when they gave birth was around the age group between 25 and 29 years old. The mean socio status for the mothers is 1.8, representing those that fall between poor and middle class. Further, 66.9% of the children were born from mothers that had not attained secondary school education. 52% mothers were either only able to read parts of sentence, or unable to read at all.

A total of 723 deaths were recorded from the sampled subjects, representing an average of 5% of the total sample. Find Table 4.0 for the detailed descriptive statistics.

Table 4.0. Frequency Distribution Table

VARIABLE	FREQUENCY DISTRIBUTION	PERCENTAGES	VARIABLE	FREQUENCY DISTRIBUTION	PERCENTAGES
RESIDENCE			**LITERACY**		
1. Urban	4,998	37.14	1. Able to read	5,850	43.50
2. Rural	8,459	62.86	2. Unable to read	7,599	56.50
SEX			**WEALTH INDEX**		
1. Male	6,828	50.74	1. Poor	6,414	47.66
2. Female	6,629	49.26	2. Middle class	3,064	22.77
TOTAL	13,457	100	3. Rich	3,979	29.57
DELIVERY					
1. Health Facility	9,308	69.17	**RELIGION**		
2.Home	4,149	30.87	1. Christian	13,278	98.67
MIDWIFE			2. Non-Christian	179	1.33
1. Yes	573	6.14	**ETHNICITY**		
2. No	8,762	93.86	1. Bemba	4,769	35.44
Birth Order			4. Kaonde	882	6.55
1. 1st Born	2,855	21.22	5. Lozi	922	6.85
2. 2nd - 4th	6,159	45.77	6. Nyanja	2,612	19.41
3. 5th - 6th	2,484	18.46	7. Mambwe	1,053	7.82
4. 7th +	1,959	14.56			
INTERVAL			1. Unprotected Well	3,144	23.36
1. <24 months	1,654	12.29	2. Piped Water	4,475	33.25
2. ≥ 24 months	11,803	87.71	3. Protected Well	5,403	40.15
AGE					
1. 15-19	962	7.15	**TOILET FACILITY**		
2. 20-24	3,215	23.89	1. Flash toilet	1,151	8.55
3. 25-29	3,497	25.99	2. Pit Latrine	9,719	72.2
4. 30-34	2,804	20.84	3. Bush	2,587	19.2
6.40-44	905	6.73			
7. 45-49	218	1.62	**ELECTRICITY**		
TOTAL	13,457		0. No	10,693	79.46
EDUCATION			1. Yes	2,408	17.89
0. No Education	1,509	11.22	Missing	356	2.46
1. Primary	7,481	55.64	**TOTAL**	13,457	100
2. Secondary or better	4,456	3,314			

4.2. Statistical Tests and Results Estimations

Before undertaking the estimations, different diagnostic tests were carried out and the decision on which tests to be carried out was guided by literature on logistic models involving individual samples, as well as the instructions in the statistical package Stata 12.0.

4.2.1. Multi collinearity Test

To ensure that the independent variables were not linearly related, a multi collinearity test was conducted before using them in any regression. This is because if the pairwise correlations among explanatory variables or zero order correlation coefficient between two variables is high, then multi-collinearity becomes a serious problem (Gujarati, 2004). Thus to get rid of this possible perfect linear relationship among the variables in the model, a pairwise correlation matrix was conducted. As a result of this test, the variable Birth Order was found linearly related to "Maternal age" with a correlation coefficient value of 0.7746. See the pairwise correlation Table in the Appendix 1D. This figure is too close to 0.8 and was resulting in spurious findings. To remedy this problem birth order was dropped from the variables included in the final regressions of the main model analyzing factors influencing childhood mortality in the country. The choice of which variable to drop was just done randomly since from both the theoretical and empirical literature, the two variables similarly provided important explanations in influencing childhood mortality. However, in the subsequent models for provinces, Birth Order was used, though not simultaneously with maternal age.

4.2.2. Misspecification Test

Due to omitted variables, as well as the non-linear functions of the variables already included in the model, the structural model may be misspecified (Wooldridge, 2002). To address this problem, a link test was conducted for the major model in the study. This test ensured that the right forms of dependent and independent variables were included in the model; that no important variable was left out in the model, and that the relationship between these independent and the dependent variable is linear. The hypothesis for the test was specified as follows:

H0: Model is not misspecified.

H1: Model is misspecified

Since the model in the analysis of the study was specified as linear, in a situation where there are variables that are not linearly related to the dependent variable "Childhood Mortality", then the results of the regression would be spurious or biased. As such, in a link test output, the important result is the one indicating the significance of the powered values represented by "htsq". For a smaller P-Value< 0.05 on the "hatsq", we reject the null hypothesis that states that the model is not misspecified. For a larger P value P>0.10, we fail to reject the null hypothesis, and this is a desirable outcome as it indicates that we don't have any nonlinear functions in our model. Refer to Appendix. 1A and 1C for detailed results of the link tests conducted.

4.2.3. Heteroscedasticity

Cross Sectional data is susceptible to problems of heteroscedasticity in which error terms are often not distributed with constant variance. (Gujarati, 2004). However, in analyzing the post estimation tests for logit and probit regression models, William, (2009) argued that in such models, the dependent variable is a probability value which incorporates uncertainty. This uncertainty in the probabilities comes from all the variables not included in the model. As such, once the dependent variable has been defined as the probability of an event given the control variables in the model, then the problem of heteroscedasticity is dealt with, and thus the result of a logistic model gives accurate description of what's been found in the data. However, to satisfy curiosity, a test for heteroscedasticity with a command "Estat Hottest" was run in stata after running the model. This command gave an error feedback "r321" indicating that the command was invalid.

4.2.4. Goodness of fit

The conventional $\mathbf{R^2}$ is generally used as a measure of goodness of fit as it demonstrates the predictive power of the explanatory variables on the outcome variable. However, binary regressant models give a pseudo R^2 which is particularly not useful in deciding the strength of the model (Gujarati, 2004). Thus a Hosmer-Lemeshow goodnes of fit test (Hosmer, Lemeshow, and May 2008) was conducted for all the regression models used in this study. This test assesses whether the observed event rates match the expected event rates in subgroups of the model population. The test was specified as follows:

H0: The model does not fit the data

H1: The model fits the data.

A small P-Value, with an alpha level <0.05 meant that the null hypothesis leads to the rejection of the null hypothesis which says the model does not fit the data.

In the estimated main model, 9320 observations were in the final analysis. The Likelihood Ratio Chi2 Value was 68.25 with a Probability value of 0.0000. The Hosmer-Lemeshow goodness of fit Pearson Chi2 Value was 5307 with a P-Value of 0.0006. The small P-values for the Likelihood ratio and Goodness of fit tests implied that the model significantly fit the data and that the variations observed in the child mortality variable "Died" were explained by the independent variables in the model at 1% significant level.

4.2.5. Stepwise Regression Analysis

In order to determine the relevant variables to include in the regression models, manual backward and forward stepwise regression was performed for all the regression models in the study, in which the choice of predictive variables were decided by initially adding all the variables in the model, and eliminating them one by one, as well as testing the strength of the model at each addition and elimination, and repeating this process until no further improvement of the model was possible. This statistical process ensures that any undesireable combination of some explainatory variables does not produce spurious results, and performs almost a similar function with multicollinear test (Gujarati, 2004). In this study it was however done even after the multicollinear test to ensure that if there are any variables that were closely related but were left out by the multicollinerity test do not negatively affect the output results.

Thus, after performing the manual backwards stepwise regression process in a model containing all the variables, the variables "Sex" and "Source Drinking Water" were dropped out from the main model. These two variables repeatedly compromised the fitness of the model in that their inclusion in the model resulted in a very large insignificant P-Value of the Hosmer-Lemeshow goodness-of-fit test making the model unfit and unreliable for estimations. However, the two variables were later re introduced when running the provincial models.

4.3. Findings

Table 4.3. Output Results of Factors Influencing Childhood Mortality In Zambia.

VARIABLE	ODDS REPORTING			PREDICTIVE PROBABILITY	
	ODDS RATIO	Std. Err	P-VALUE	MARGINS	Std Err
PROVINCE (Central)				0.02550	0.00567
2. Copperbelt	1.48538	0.4417	0.183	0.03728	0.00679
3. Eastern	1.81994**	0.5333	0.041	0.04519**	0.00727
4. Luapula	1.69788*	0.48344	0.063	0.04233*	0.00699
5. Lusaka	1.26894	0.38493	0.432	0.03208	0.00599
6. Muchinga	1.17233	0.36159	0.606	0.02973	0.00579
7. Northern	1.11154	0.33261	0.724	0.02824	0.00524
8. N/Western	1.10474	0.3391	0.746	0.02808	0.00546
9. Southern	1.25492	0.3665	0.437	0.03174	0.00567
10. Western	0.97217	0.3214	0.932	0.02482	0.00562
RESIDENCE(Urban)				0.04556	0.00469
2. Rural	0.54646***	0.1509651	0.000	0.02559***	0.00227
AGE (15-19)				0.04015	0.00692
2. 20-24	0.68242*	0.1509651	0.084	0.02783*	0.00349
3. 25-29	0.68848*	0.1520455	0.091	0.02808*	0.00340
4. 30-34	0.78128	0.1765808	0.275	0.03171	0.00404
5. 35-39	0.91513	0.2187412	0.711	0.03689	0.00542
6.40-44	0.80978	0.2393639	0.475	0.03282	0.00728
7. 45-49	3.13050***	0.9724546	0.000	0.11412***	0.02466
EDUCATION(No educ)				0.02697	0.00541
1. Primary	1.06196	0.2262885	0.778	0.02857	0.00247
2. Secondary +	1.6167*	0.459099	0.091	0.04263*	0.00534
LITERACY (Can't read)				0.03790	0.00443
2. Can read	0.78394	0.137074	0.164	0.03004	0.00255
WEALTH INDEX (Poor)				0.03343	0.00396
2. Middle Class	0.99546	1.1718601	0.979	0.03329	0.00397
3. Rich	0.95362	0.206588	0.826	0.03195	0.00401
DELIVERYPLACE				0.03111	0.03111
2. Home	1.23761	0.1784443	0.139	0.03813	0.03813
MIDWIFE				0.03145	0.00186
1. No	1.8053***	0.370913	0.004	0.05499***	0.00999
B/INTERVAL				0.04507	0.00267
2. ≥ 24 months	0.68374**	0.1160339	0.025	0.03140**	0.00190
RELIGION(Christian)				0.03211	0.00183
2. Non-Christian	2.8106***	0.9315789	0.002	0.08414***	0.02462
ETHNICITY	0.9894	0.0301123	0.726		
TOILET(Flush)				0.0222885	
2. Pit Latrine	1.5248*	0.3574705	0.072	0.0334558*	0.00047
3. Bush Facility	1.8116**	0.5122101	0.036	0.0394161**	0.00230
ELECTRICITY					
1. Yes	1.0592	0.120431	0.613		
CONSTANT	0.0614***	0.0318232	0.000	-	-

LOGISTIC REGRESSION OUTPUT : Number of Observations = 9320 Pseudo R^2 = 0.0297 LR Chi2 = 79.88 Prob > Chi2 = 0.000
Log-Likelihood = -1306.3774
GOODNESS-OF-FIT TEST: Number of observations = 9320 Number of covariates = 5337 Pearson Chi2 (5307) = 5646.85
Prob> Chi2 0.0006

Significance Level: * P<0.1 ** P<0.05 *** P<0.01

In interpreting the results, factor variables were used because of the nature of study which required to have specific explainations of individual categories that influenced child mortality. e.g, influence of certain specific age groups on child mortality. Further, both odds ratios and predicitive probabilities were used in presenting the results of the findings.

In a reduced regression model, 12 of the initial 16 explanatory variables were analyzed. From these, a number of factors were found associated with child mortality rates in the country, at 5% significant level. These factors were either positively related with child deaths, (Odds ratio greater than one), or negatively related with child deaths, (Odds ratio less than one).

4.3.1. Province

The output for the variable Province was not analyzed in detail since the mortality rates for each province was already given in the background of the study. However, it was important to include in the model as it improved the strength of the fitness of the model.

4.3.2. Place of Residence

Residence was categorized as Urban and Rural, and urban was used as the reference category for this variable. The results indicated that the predictive margins or probability of dying for a child in the urban area was 0.04556 or 4.556% compared to a predictive probability of 0.02559 or 2.559% for a child in rural area. The Odds ratio for a child in rural area was 0.54646. This result means that compared to a child born by a mother residing in urban area, the odds of dying, for a child born from a mother residing in rural area reduces by 45.4%, and this difference is statistically significant at 5% level of significance. ($P<0.01$). This result was not consistent with our apriori expectations, considering that rural population is more vulnerable to negative socio economic woos that affect the country. As such mortality rates among children would ideally be expected to be lower among the urban population. However, this result could be explained by the concentration levels of the population in urban compared to those in rural areas. While only two provinces out of 10 i.e. 1:5 are predominantly urban, nationally, the proportion of population in urban is 40%, compared to rural (CSO, 2011), giving a proportion of 2:3. These statistics indicate that the urban areas in Zambia could be too congested, and thus accounting for the high levels of childhood mortality compared to the rural.

4.3.3. Mother's Age.

Age for the mother was categorized in seven (7) groups, and the "15-19" age group was used a reference age category. The odds of a child dying, given the age of the mother, was compared with this age category reference, and its predictive probability of a child value was 0.04015. This implied that the predictive probability of a child dying when they are born by a mother in this age category was 4.015%. The output results showed a weak negative association with (P<0.1) between child mortality and the children born from mothers in the age category "20-24" and in the age category "25-29" with predictive probability values of 0.0278 and 0.02808 respectively. The odds ratio for the "20-24" age category was 0.68242 while that for the "25-29" age category was 0.68848. However, the results revealed a strong positive association between child deaths and children born by mothers in the age category "45-49", with a predictive probability value 0f 0.11412 and odds ratio of 3.13. These results implied that compared to children born from mothers in the age "15-19", the odds of dying for a child born from a mother belonging to the age categories "20-24" and "25-29" reduced by 31.76% and 31.15% respectively and this difference was statistically significant at 10% for both categories. Further, that compared to the child born from a mother in the age category "15-19", the odds of a child dying when they are born from a mother in the age category "45-49" age category increased by 213%. This difference was statistically significant at 1% level (P<0.01). This finding was contrary to apriori expectations of the study which postulated that mother's ability to care for the child improves with age. The results were also contrary to Nsemukila (1996) who established that children born from younger mothers were at higher risk of dying compared those from older mothers. However, several other studies from a variety of countries relating maternal age to various aspects of pregnancy and child development suggest that maternal age is a central variable influencing pregnancy outcome and that Child mortality increases, to an important extent, with births to very young or to very old mothers. (Nortman, 1974; Petridou et al., 1996; Reynolds, Wong & Tucker, 2006). The argument made by these studies then becomes consistent with both the findings of this study and those made by Nsemukila (1996) in Zambia.

A further analysis of the descriptive characteristics of these mothers actually reveal that illiteracy was highest among the older mothers with 53.7% among the "40-44" and 47.25 % among the "45-

49” unable to read a full sentence, compared to the 33.4% and 34.7% for the age groups “15-19” and “20-24” respectively. Further, the health practices of the older age group were very poor with 44% of them delivering their babies at home compared to only 19.7% of “15-19” age group that delivered their children at home. Thus this age group was exposed to health risk through their health practices. This fact could therefore explain these findings.

4.3.4. Maternal Education.

Reference category for the variable was “No education” and the predictive probability for this category was 0.02697 meaning the probability of a child dying when they are born by a mother who is not educated at all was 2.697%. The study aimed at comparing the odds of a child dying for a child born from mothers in this category and those from mothers that have attained a minimum education of primary school or better. Education however, only showed a weak positive association between child deaths and those born from the mothers who have attained secondary education with a predictive probability of 0.04263 and odds ratio of 1.6167. This results means that compared to the child born from a mother who has never been to school, the odds of a child whose mother has attained secondary education increased by 61.67%. However, the difference for this finding was very weakly associated at 10% significant level. This finding was contrary to apriori expectations of child deaths reducing with higher levels of education. Nevertheless it can only be hypothesized in this paper that given these results, while education may be linked with economic well-being of individuals in the country, and thus the ability to buy health and health care services, maternal care cannot be directly dependent on their level of education, and instead, basic knowledge which enables them to understand the risk of maternal age at first pregnancy, lack of family planning, lack of risk factors, and harmful practices during labor and delivery. Thus, as postulated by Rubalcava and Tervel, 2004, maternal cognitive ability is rather an important factor in improving child health, unlike formal schooling. This maternal ability is more instinctive in nature and does not require one to acquire education.

Following, this theory, a relationship would have then been expected between child deaths and literacy levels. However, the results of the study did not find a significant relationship with literacy either. This could also be explained by the peculiarity of literacy levels among the different provinces which neutralize the influence of this variable on child mortality and makes it unobservable at country level.

4.3.5. Wealth Index

Wealth index was used as proxy for socio economic status, and was expected to strongly influence child deaths in the country and across province with different economic backgrounds. The category "Poor" was used as a reference category to compare the odds of dying for children in the middle and rich classes of society. However, this variable showed no significant association with child deaths at all levels of social categories. This was also not consistent with apriori expectations of the study. This could be attributed to the fact that even though majority of mothers in Zambia are economically poor, they still manage to attend child health programmes such as antennal clinic, giving birth at a health Centre and being attended to by a health personnel. This is because of the introduction of the 1995 Basic Health Care Package (BHCP) policy in Zambia that aims at bringing quality basic health care services for common illness as well as addressing the inequality in access to these health services (2011-2015 NHPS, 2010). To this effect, child survival in Zambia becomes more dependent on the amount of time a mother dedicates to caring their child than the amount of wealth owned by households. Results from similar studies elsewhere have established ambiguous findings, e.g Mustafa and Odimegwu (2008) in Kenya established that while mortality rates were highest among the poorest, it was higher amongst the richest than those in the middle class; Other studies of mortality differentials among individuals by social or economic class in countries with as different characteristics as India and United States consistently reveal lower mortality rates among the upper classes. (Kitagawa and Hauler 1973; Vaidyanathan 1972). Access to electricity, which can also be used as a proxy for socio economic standing in society was not significantly influencing child mortality in the country.

4.3.6. Attendance by Midwife & Place of Delivery

Child delivery had categories "Health Centre" and "Home" with health Centre being the reference category, while being attended to by a midwife during child delivery was categorized by "yes" and "no" responses. A "yes" response was the reference category and had the predictive probability of 0.03145. Place of delivery did not show any statistically significant influence on child deaths, while not being attended to by a midwife during the time of birth showed an increased predictive probability of 0.05499 and an odds ratio of 1.8053 with a significant level of 0.004. This result indicates that the odds of a child dying, given that the mother was not attended to by a mid-wife during the delivery of this child increased by 80.53% compared to one that was attended to, and this difference is statistically significant at 5% level with (P<0.01). Though the multicollinearity test did not show any association between these two variables, their attributes seemed complimentary. As the descriptive statistics show, 30.83% of mothers gave birth or delivered their children at home as opposed to going to a health Centre. This increased the risk of child death because of not receiving the professional procedure and care required at the time of delivery.

4.3.7. Birth Interval

Categorized as "<24" for children that were spaced in less than 24 months between them and the previous child, and ≥ 24 for those whose interval between them and the previous child was 24 months or more. "<24" category was the reference category for this variable. The study established that in Zambia, the predictive probability of a child dying if the interval with the previous sibling was less than 24 months was 0.04507, and when the child was born after 24 months the predictive probability dropped to 0.03140, and the odds of dying for a child who was born 24 months or more after the previous one was 0.68374, with a P-Value of 0.025. This result means that compared to a child whose spacing with the previous sibling is less than 24 months, the odds of dying for a child born after 24 months or more after the previous sibling, reduces by 31.63%. This difference is statistically significant at 5% level of significance (P<0.05). Intuitively, as expected by this study, children that are well-spaced between them with at least an interval of ≥ 24 months allow for sufficient time for the mother to give adequate care to one child and therefore improve their well-being and reduce the risk of dying unlike those with an interval less than 24 months. These results were also in tandem with Nsemukila (1996) who established a strong association with child mortality by the length of the preceding birth interval in a study of child survival in Zambia. In his study, mortality was found to be lowest among children with birth intervals of at least 36 months.

4.3.8. Religion and Ethnicity

Religion was categorized as "Christian" and "Non-Christian", and Christian was used as a base category to compare mortality rates among children born from Christian mothers and those born from non-Christian mothers. Results revealed that the predictive probability for a child born from a Christian mother was 0.03211, while for the one born from a non-Christian mother was 0.08414, with an odds ratio of 2.8106 and a P-Value of 0.002. This means that compared to children born from Christian mothers, the odds of dying increases by 2.81 or 181% for children born from non-Christian mothers. These results were expected given that Zambia being a country that was declared as a Christian nation, with a diverse of 72 tribes, religion and culture play a crucial role in people's health lives with activities that include early marriages, polygamy, genital mutilation, including even alcohol and drug abuse among mothers, which consequently affects the early stages of a child's life. Christian values as espoused in many denominations therefore teaches against some of these health hazards and this indirectly improves on the health of the mother and baby. These religious and cultural beliefs are more engrained in some provinces than the others. Ethnicity did not however, show any significant relationship with child mortality at national level.

4.3.9. Toilet Facility

This variable was categorized in "Flush Toilet", "Pit Latrine", and "Bush Facility". Flush toilet was used as the reference category and the other categories were analyzed in relation to this category. The predictive probability values for the three categories were 0.0223, 0.033456, and 0.039416 for flush, pit latrine and bush toilet facilities respectively. The odds results indicated a weaker and positive association ($P<0.1$) with the category pit latrine with odds ratio 1.5248, but a stronger positive association with the bush facility with the odds ratio of 1.8116. This result indicates that compared to mothers who use a flush toilet, the odds of dying for children whose mothers use "Pit Latrine" increased by 52.2% while those that used "bush facility" increased by 82.3%. This difference is statistically significant at 5% significant level. This finding was consistent with apriori expectations. Water, air, food and fingers are the main routes through which infectious agents are transmitted to human beings, and thus poor sanitation adversely affects the health of a child in the early stages of life. The results reflect the extent to which poor sanitation and toilet facilities are influencing deaths among infants in the country. This is so mainly in the urban areas where compounds are mushrooming and sanitation drainages are very poor, increasing the risk of contaminating water borne diseases such as diarrhea and cholera.

4.4. Factors Associated With Child Mortality Rates among Provinces

In order to establish factors that are associated with child mortality rates in each individual province as well as the extent to which these influence the different levels of child mortality observed among different provinces, ten separate logistic regression models were run for each province. This process involved applying backwards and forward step wise regression in order to arrive at the relevant variables in each of these, and at the same time ensuring the goodness of fit of these models. Both odds ratios and marginal effects were computed in this analysis. See detailed regression models in Appendix **C1 to C10.**

In *Central Province,* Source of water, ethnicity and birth interval were all associated with a 39% and 17.9% and 45.39% reduction in the odds of a child dying respectively. However, this result was statistically significant at (P<0.01) for source of water, (P<0.05) for ethnicity and weakily associated with interval at (P<0.1) significant levels respectively. A unit increase in the mother's age was associated with a 30.7% increase in the odds of a child dying. This was statistically significant at P<0.01.
In the *Copperbelt,* a unit increase in maternal age increased the odds of a child dying by 59.3%. This result was statistically significant at 1% level of significance. Further, the results revealed that not being attended to by a midwife increased the odds of a child dying by 3 times as much as one that has been attended to by a midwife, albeit with a weak association of (P<0.1).

In Eastern Province, not being attended to by a midwife increased the odds of a child dying by 3.53 times or by 253% while spacing children with a space more than 24 months reduced the odds of child dying by the odds of a child dying by 55.8%. These changes were statistically significant at 1% and 5% respectively.

Table 4.4.: Factors Associated With Child Mortality among Provinces

	LOW MORTALITY REGION					HIGH MORTALITY REGION				
VARIABLE	**Copper belt**	**NORTH WEST**	**LUSAKA**	**SOUTH**	**WEST**	**CENTRA**	**NORTH**	**MUCHI**	**LUAPUL**	**EASTERN**
RESIDEN	0.7517 (-0.008)	0.6280 (-0.0195)	0.4534 (-0.0339) **	0.4679 -(0.0335) ***		1.64298 (0.0186)	0.56587 (-0.0282)		1.4517 (0.0122)	
DELIVER	1.0481 (0.0012)				2.3508 (0.0155)		1.1382 (0.0064)		1.90379 (0.0211) *	1.1499 (0.0050)
MIDWIF	3.01517 (0.0292) *				0.0503 (-0.1244)				0.3672 (-0.0329)	3.5312 (0.0452) ***
INTERVA	2.4183 (0.0234)				0.1310 (-0.0368) ***	0.5461 (-0.0227) *		0.4937 (-0.0318) **	0.3448412 -0.0349135) ***	0.4417 (-0.0293) **
BIRTH ORDER			0.7832 (0.0105)	0.7963 (-0.0101)				0.7322 (-0.0140) **		0.7078 (-0.0124)
AGE	1.5925 (0.0123) ***		1.1539 (0.0061)		0.9361 (-0.0012)	1.3075 (0.0101) ***				1.3185 (0.0099)
EDUCATI					1.9858 (0.0124)					
LITERACY	0.6966 (-0.0096)	1.9889 (0.0288) **					2.3409 (0.0422) ***		0.7187 (-0.0108)	
Wealth Index	1.0633 (0.0016)	1.3922 (0.0139) *			1.3371 (0.0053)					
RELIGION					11.5346 (0.0443) ***				7.8767 (-0.0349) ***	
ETHNICITY	0.9525 (-0.0013)	1.0772 (0.0031)				0.8210 (-0.0074) **			1.06036 (0.0029)	
WATER	1.1496 (0.0037)									
TOILET	1.5674 (0.0119)				1.3692 (0.0057)			1.3841 (0.0146)	1.3117 (0.0135)	
ELECTRICITY	0.7597 (-0.0073)					1.2309 (0.0078)			1.8961 (0.021) ***	

SIGNIFICANCE LEVELS : * = P<0.1 ** = P<0.05 ***= P<0.01
Marginal Effects values in parenthesis

In Luapula, delivering a child at home, not belonging to the Christian religion, and access to electricity increased the odds of a child dying by 90%, 687% and 89% respectively. The result for delivering home was statistically significant at 10% while Religion and access to electricity were both significant at 1% level. However, Birth Interval reduced the odds of dying in Luapula by 65.5% and this was statistically significant at 1% level.

In Lusaka, being resident of rural was found to be significantly associated with a 54.7% reduction in the odds of a child dying with a 5% significant level.

In Muchinga Province, increased birth order and birth interval was associated with a reduction in mortality rates by 26.8% and 50.6% respectively both with a 5% level of significance.

In *Northern Province,* being resident in the rural was associated with a reduction in the odds of a child dying by 43.4% while being illiterate (unable to read) was associated with 134% increase in child deaths. These results were statistically significant at 5% and 1% significant level respectively.

In North Western being illiterate (Unable to read) increased the odds of a child dying by 98.9% at 5% significant level while belonging to the middle class or better increased the odds of a child dying by 39.2% albeit with a weak association of 10% significance level.

In *Southern Province* being resident in rural and access to electricity reduced the odds of a child dying by 53.21% and 48.34% respectively and these results were statistically significant at 1% and 5% significant level respectively.

In *Western Province* Being a non-Christian increased the odds of a child dying by 11.4 times while birth interval of 24 months or more reduced the odds of a child dying by 86.9% both factors with a significant level P <0.01.

4.4.1. Analysis of factors influencing child mortality rates among the various provinces

A critical analysis of the factors associated with child deaths revealed that these factors differ from province to province. The preliminary findings above demonstrated the fact that because demographic characteristics for different regions are not homogenous, even their influences on mortality rates in different regions will differ. Further, a combination of these factors ultimately determine the levels of mortality rates countrywide. Besides the factor "access to electricity", which revealed contrary outcomes for Luapula Provinces and Southern Province showing opposite influence on child mortality for these two provinces, all other factors showed the same trends with the results observed at national level, in terms of the direction of the relationship between these factors and childhood mortality. Further, contrary to apriori expectations, being resident in the rural area continued exhibiting a reduction in the odds of dying in Southern, Northern and Lusaka Provinces. See detailed regression models in Appendix B1 to B10 for detailed regression models.

4.5. Mortality Variations among Provinces

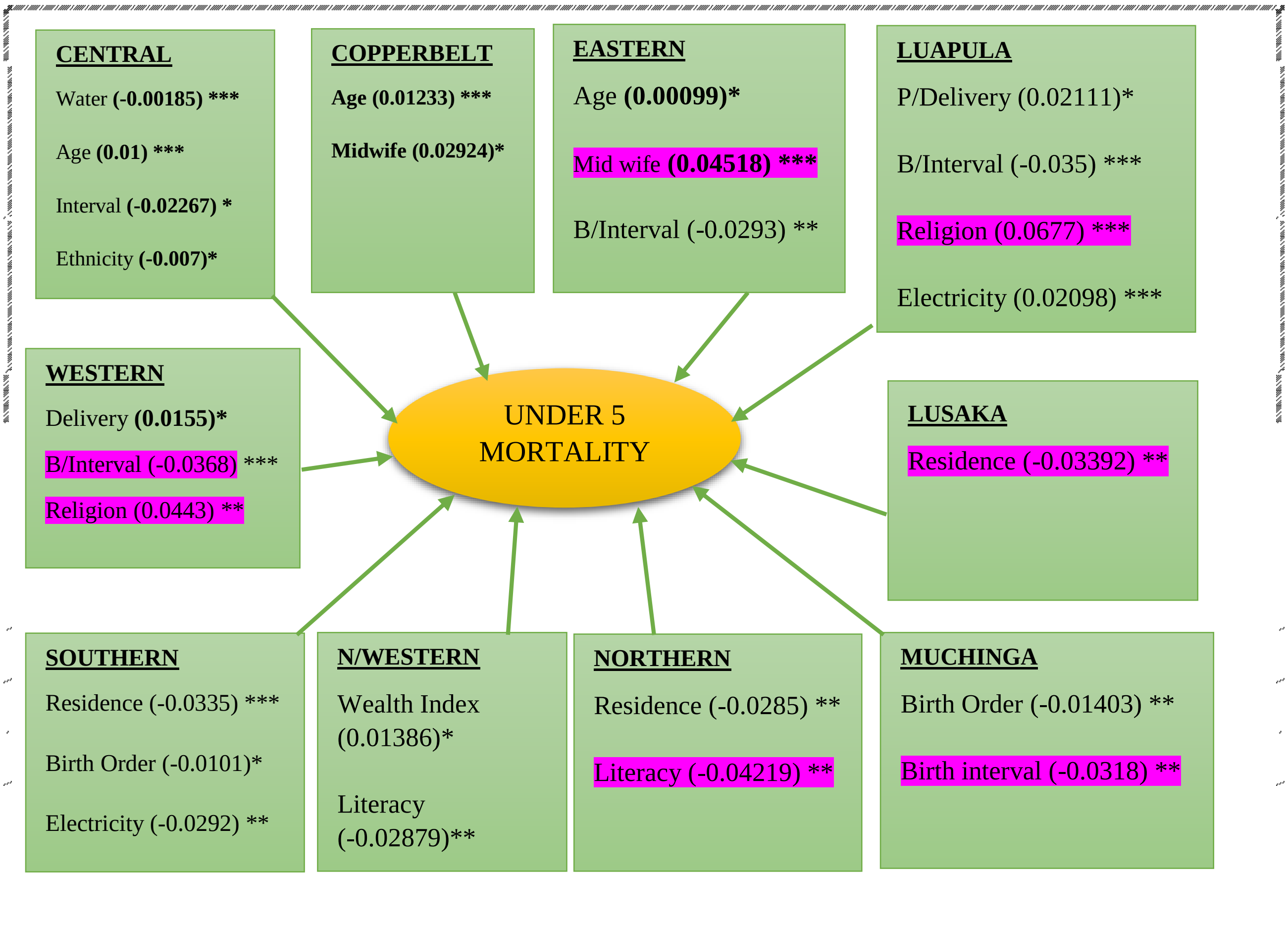
Having established the various factors that are associated with child mortality in various provinces, as well as the parametric estimation of those that impact on child mortality in the country, including their magnitude and direction of effect, this section demonstrated the extent to which the regional variations in mortality rates observed among provinces in Zambia could be explained by the established factors affecting the mortality rates in the provinces.

4.5.1. Analysis of the Changes

Figure 4.5 below presents marginal effect of all the factors that were found to be significantly influencing the child mortality rates among the ten provinces of the country. The values of the marginal effects measure the average marginal changes in mortality rates in these provinces resulting from a unit increase of each of these factors. Positive signs indicate that mortality rates were increasing with every unit increase of the independent variable, while negative signs indicate that mortality rates were decreasing with every unit decrease of the respective factor.

From the background statistics in the ZDHS report, Eastern, Luapula and Northern Provinces have comparatively higher levels of child mortality with all of them having mortality rates higher than 85 deaths per 1000 lives. Eastern and Luapula top this list at 115 and 98 respectively. From the above results, the socio economic and demographic analyzed have a bigger marginal effect on these provinces. On the other hand, Copperbelt, North Western, Southern and Lusaka are on the relatives lower side with all of them having mortality rates lower than 70 deaths per 1000 live births. And a valuation of the demographic and socio affecting child mortality in these provinces revealed that these provinces are less affected by these factors with smaller magnitudes or marginal effects on variables affecting these provinces, most of which affect mortality rates negatively, that is they reduce mortality rates in these provinces.

Fig 4.5: A Summary of the Marginal Effects of Various Factors on Childhood Mortality among Provinces.



SIGNIFICANCE LEVELS: * = P<0.1 ** = P<0.05 ***= P<0.01

Highlighted areas indicating factors and provinces where the magnitudes of change are extremely high

A critical analysis of the marginal changes among the factors in Fig 4.5 above reveals that among the low mortality provinces, the highest change on the levels of child mortality resulting from these factors was 0.0339 or 3.39% in Lusaka for the type of residence variable. This figure however, was negatively associated with child mortality, implying that its effect was a reduction in child mortality. However, bigger marginal changes were observed in high mortality provinces as a result of certain significant factors. For example, in Eastern Province, which is the highest mortality region, marginal changes in mortality rates as a result of a mother not being attended to by a midwife was as high as 0.0452 or 4.52% and this was causing child mortality to increase. Similar extreme changes were also observed in Luapula where religion had a marginal effect of 0.0677 on child mortality, representing 6.8% marginal changes. In Northern Province literacy had a marginal effect of 0.042 0r 4.2% marginal changes on child mortality. Similarly, Western Province which has relatively high mortality rates had high magnitudes of mortality changes as a result of certain socio economic factors. This pattern reveals that the high mortality rates observed in certain provinces are a result the level of influence of these factors.

Based on the above findings and observations therefore, this study concluded that the socio economic, demographic and cultural factors in Zambia do explain or are responsible for the variations in child mortality observed among the various individual provinces in the country.

4.6. Conclusion

This chapter presented detailed estimations and analysis of child mortality in Zambia focusing on factors that influence child mortality in the country as a whole, those that are associated with child mortality rates in specific individual provinces, as well as demonstrating how these factors could explain the childhood mortality rates observed among these provinces using the marginal changes in child mortality as a result of these factors among the different provinces.

The presentation was done in two stages namely: (i) Estimations of childhood mortality in the whole country by including all the hypothesized factors in a model where childhood mortality was the dependent variable. This was done in order to establish those factors that significantly affect child mortality in the country. (ii) Analysis of factors associated with childhood mortality among provinces was done by running ten separate models for each province to filter out specific variables affecting mortality rates in each individual province. This was performed to demonstrate the fact that factors that affect different provinces within the same country are not homogeneous and therefore analyzing the problem of childhood mortality using national figures may result in policy insufficiency.

Finally, using the marginal effects or changes of child mortality in the provinces as a result of changes in the socio economic and demographic factors, the magnitude of changes among the high mortality provinces were compared to the magnitude in the changes among the low mortality regions. This was done to help determine whether these factors could help explain the child mortality differences observed among the different provinces. Of particular interest were the following factors: birth interval, attendance by the midwife, religion, type of residence and literacy as they comparatively had high magnitudes in influencing child mortality rates in different provinces. And the provinces influenced most by these were Eastern, Luapula, Muchinga, Northern, Lusaka and Western Provinces.

The next Chapter will present a summary findings and conclusion of this study as well as recommending appropriate policies aimed at addressing the problems of child mortality as revealed in this study, particularly focusing on the differences in incidences observed across provinces.

CHAPTER 5

SUMMARY FINDINGS & POLICY RECOMMENDATIONS

5.0. Introduction

This chapter gives a summary of the main findings of the study, the policy implications based on these findings as well as the recommendations of the study.

5.1. Summary Findings

This study set out to achieve three main objectives namely: To establish determinants of childhood mortality in the country, to establish which of these determinants influence childhood mortality among different provinces; and to establish if these demographic and socio economic factors are responsible for the regional variations in childhood mortality rates observed among the different provinces of the country.

Results estimated from the logistic regression revealed that at national level the following factors were increasing the odds of a child dying before attaining the age of five years; Being born from older mother in the age category of "45-49", not belonging to a Christian religion, and using "Bush toilet or other sources" of toilet facility. On the other hand, the following factors were associated with the reduction in child deaths before the age of five years old: Being born from a mother residing in the rural area, being attended to by a midwife during child births or being born 24 months or more after the previous sibling. This implied that the risk of child deaths reduced with these factors. A weak association was revealed with education. No significant influence was established on child mortality for the following factors: Literacy, wealth index, place of child delivery, ethnicity, and access to electricity.

Secondly, in analyzing factors influencing childhood mortality rates in individual provinces, the study revealed that factors associated with child deaths differed from province to province. Further, the study also revealed that some of the factors that were not found significantly influencing childhood mortality at national level, had influence in certain province. For instance, literacy influenced childhood mortality in the Northern and North Western Provinces, Wealth Index had influence in the North Western Province, albeit with a weak association. The study also established that ethnicity influenced childhood mortality in the Central Province, even though at national level it was found not significantly influencing child mortality.

The implication of the above findings demonstrated the fact that ultimately, even though some factors may be having a lot of influence on childhood mortality in certain provinces the country, the influence may be suppressed when looking at the aggregate effects on mortality rates at national level. This therefore calls for disaggregated analysis of policies in order to address the problems of childhood deaths comprehensively.

In determining whether the socio economic and demographic factors could explain the childhood mortality variations observed among the provinces, the marginal changes in child hood mortality as a result of these factors were compared between the high mortality provinces and the lower ones. Through this, the study established that the marginal changes in childhood mortality as a result of these factors was much bigger in high mortality provinces than in lower ones. For example, extreme changes of 6% and 4.5% in mortality as a result of Religion and attendance by a midwife, was observed in Luapula and Eastern Province respectively. The study therefore concluded that these socio economic, demographic and cultural factors are important in explaining the variations in childhood mortality observed among the different provinces.

5.2. Policy Implications

Given the above findings, Government decentralization policies that were adopted in 2002 meant to bring administration of Government Policies to local authorities is highly recommended. This will ensure that all the health benefits from Government programs such as community health education programmes and distribution of health goods such as family planning pills accrue to all individual mothers across all the provinces.

Further, Government should consider including all the factors established by the study in their effort to address problems related to childhood mortality in the country. Specifically, the Government could look at the following:

- **Type of Residence**

With the limited resources available for the socioeconomic requirements for the whole nation, Government and stakeholders could focus their efforts towards targeted areas where child mortality are more prevalent. And from the findings, the problem is more prevalent in the urban areas than it is in the rural areas. Though this study has hypothesized congestion in urban areas as a possible reason for the increased odds in child death among the urban compared to the rural areas, Government needs to invest more into research to establish why the pandemic is more pronounced in the urban than rural areas. Further, Government needs to look the problem of water & sanitation as well as toilet facilities in urban areas as this has potential to exasperate efforts to remedy the problem of child deaths in towns, especially with many shanty compounds' that are crowded around cities. This is in view of the fact this factor showed consistency in the country and in all the provinces where it was significant.

- **Maternal Age & Attendance by Midwife.**

The finding of the study established that children born from older mothers, particularly in the age group "45-49" are at a higher risk of dying before the age of five. In addition to the background statistics reported in this study, the 1998 UNFPA-supported study identified a tendency among women as they grow older and with high parity, to deliver at home without any assistance, maybe because of long distances and the costs associated with delivering at health centres, and cultural barriers of not wanting to be attended to by male nurse. To counter these challenges, Government could increase the relative number of outreach areas and delivery sites in certain provinces where such factors are major influences of the increases in child deaths. This should be backed by enough staff to operate in these outreach centers, so as to reduce distances to the health Centers. This will effectively help reduce long distance movements to delivery centers and ultimately address the problem of many mothers not being attended to by qualified health personnel. In addition, while focusing on this age group, efforts in this area needs to be directed specifically towards Central Province, Copperbelt and Eastern Province where the problem is also compounded by the problem of mothers not being attended to by health professionals, with particular interest to Eastern Province where the factor most child deaths are being caused by not being attended to by midwives.

- **Birth Interval and child order**

  Besides maternal age and attendance by midwife, the factor "Birth Interval" was one of the predominant factors affecting child mortality across the country and in provinces such as Muchinga, Western and Luapula Provinces while birth order significantly affected child mortality in Muchinga and Southern Province. This is also predominant among the less educated and mothers as shown by the descriptive statistics. These two factors are indicators of poor child spacing, early age marriage and pregnancies. Thus, NGOs that are into the business of distributing family planning pills, should equitably distribute these according to the provincial needs. For example they could allocate more to the three provinces named above as the most affected where childhood mortality is influenced by short child intervals.

- **Literacy**

  Though education and literacy were not found significant in the regression model for the country, literacy was significantly associated with child mortality in Northern and North Western Province, and more so with large magnitude. This variable effectively addresses all the factors outlined above in that mothers need to know how to read and use information to help them engage in appropriate health behavior that in turn will not risk the health status of their babies. Thus, rather than the nation worrying about educating women in the country, an exercise that is long term, costly and tedious, stakeholders such as Care International of Zambia, which specialise in child and maternal health programmes could focus on simple maternal education aimed at improving literacy levels, and enlightening mothers, both young and old on the importance of avoiding health risky behaviour such as early pregnancy, poor family planning, and delivering a child from home without a professional health personnel attending to them.

- **Religion and Ethnicity**

  Culture and religion is very cardinal in the country Zambia. This can be seen in the findings of this study. Besides being highly significant at national level, religion is associated with child deaths in Western and Lupula Province where its marginal effects on child mortality is significantly very high. This is because culture and Religion in Zambia shape the community attitudes, belief and values, which in turn influence individual and family behaviour, and ultimately determine the health of the children. The Government, through the Ministry of Traditional and Religious Affairs could continue engaging traditional and Christian leaders, to ensure that Government at some level, is involved in the traditional and religious activities that take place in these local communities and religious organisations. This will promote and uphold the religious and ethical values amongst the Zambian community, which in turn will foster health behaviour among them.

5.3. Limitations of the Study & Possible areas of study

- The subject of child mortality has a long history in Zambia, and as such the factors affecting child mortality could be dynamic and vary over time. Given this therefore, studying cross section surveys limits the effects to a point in time.

- Sample selection were already done since the study was using an existing dataset, thus the researcher had little room to decide sample sizes. E.g, the selection of place of residence was highly skewed towards the rural subjects against the urban ones in a ratio of 63:37 respectively. Further, the variable "Wealth Index" was already constructed by the survey and thus this study just took it as given.

- Besides the influence of these demographic and socioeconomic factors on child mortality in the country, other studies could look at how policy has influenced the variations of child mortality rates over a longer period of time.

5.4. Conclusions

This study established that different biological, demographic and socioeconomic factors are associated with child mortality rates in the country at large. Secondly, the study revealed that factors that affect individual provinces are not homogenous, but vary from one province to the other. Finally, the established that factors that have higher magnitudes in terms of their effects on child mortality in Zambia were significant and predominant in high mortality regions. These include Religion, Birth Interval, Literacy and Type of residence. This effectively demonstrated the fact that the child mortality variations observed among the provinces are explained by these factors.

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APPENDICES

APPENDIX A: Multicollinearity Test

	reside~e	sex	Agecat	educ	literacy	Wealth~x	delive~e
residence	1.0000						
sex	-0.0024	1.0000					
Agecat	0.0623	-0.0028	1.0000				
educ	-0.3247	0.0013	-0.2209	1.0000			
literacy	-0.2407	-0.0099	-0.1180	0.6567	1.0000		
Wealth_Index	-0.6455	-0.0041	-0.0288	0.4294	0.3489	1.0000	
delivery_p~e	0.2857	0.0104	0.1072	-0.2581	-0.1972	-0.2992	1.0000
mid_wife	-0.0963	-0.0011	-0.0070	0.0798	0.0604	0.0973	-0.1408
birthorder~t	0.1873	0.0062	0.7746	-0.3275	-0.2105	-0.1672	0.1814
BirthInter~l	-0.0601	-0.0037	-0.0081	0.0602	0.0541	0.0676	-0.0706
Religion	-0.0061	0.0114	0.0174	-0.0436	-0.0381	-0.0103	0.0096
ethnic	-0.0319	0.0042	-0.0377	-0.0326	-0.0194	0.0496	-0.0631
drinkingwa~r	0.5037	-0.0061	0.0368	-0.2592	-0.1894	-0.5100	0.2339
toiletfaci~y	0.3934	-0.0076	-0.0156	-0.2802	-0.1977	-0.4318	0.1906
ownselectr~y	-0.3297	-0.0154	-0.0760	0.2598	0.2005	0.4403	-0.1560

	mid_wife	birtho~t	BirthI~l	Religion	ethnic	drinki~r	toilet~y
mid_wife	1.0000						
birthorder~t	-0.0343	1.0000					
BirthInter~l	0.0311	-0.1296	1.0000				
Religion	-0.0505	0.0135	0.0000	1.0000			
ethnic	-0.0060	-0.0498	0.0282	0.0524	1.0000		
drinkingwa~r	-0.0694	0.1425	-0.0519	-0.0159	-0.0973	1.0000	
toiletfaci~y	-0.0476	0.0913	-0.0349	0.0062	0.0513	0.4250	1.0000
ownselectr~y	0.0393	-0.1700	0.0318	-0.0003	0.0335	-0.0720	-0.0963

	ownsel~y

APPENDIX B: Main Model

```
. logistic died i.province i.residence i.Agecat i.educ i.literacy i.Wealth_Index i.delivery

Logistic regression                               Number of obs   =       9320
                                                  LR chi2(29)     =      79.88
                                                  Prob > chi2     =     0.0000
Log likelihood = -1306.3774                       Pseudo R2       =     0.0297
```

died	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
province						
2	1.485377	.4417138	1.33	0.183	.829298	2.660496
3	1.81994	.5332963	2.04	0.041	1.024778	3.232096
4	1.697881	.4834419	1.86	0.063	.971723	2.966689
5	1.268937	.3849282	0.79	0.432	.7002136	2.299585
6	1.172326	.36159	0.52	0.606	.6404796	2.14581
7	1.111537	.3326067	0.35	0.724	.6183259	1.998159
8	1.104739	.3391038	0.32	0.746	.6053131	2.016226
9	1.254919	.3664966	0.78	0.437	.7079849	2.224372
10	.9721723	.3213678	-0.09	0.932	.5085859	1.858327
2.residence	.5464621	.0889454	-3.71	0.000	.3972039	.7518075
Agecat						
2	.6824151	.1509651	-1.73	0.084	.4423279	1.052817
3	.6884788	.1520455	-1.69	0.091	.4465899	1.061383
4	.7812753	.1765808	-1.09	0.275	.5016708	1.216716
5	.9151288	.2187412	-0.37	0.711	.5728243	1.461985
6	.8097791	.2393639	-0.71	0.475	.4536893	1.445355
7	3.130516	.9724546	3.67	0.000	1.702947	5.754807
educ						
1	1.061957	.2262885	0.28	0.778	.699403	1.61245
2	1.616719	.459099	1.69	0.091	.9266572	2.820654
2.literacy	1.275616	.2230463	1.39	0.164	.9054908	1.797032
Wealth_Index						
2	.9954592	.1718601	-0.03	0.979	.7096899	1.396299
3	.9536201	.206588	-0.22	0.826	.6236989	1.458062
2.delivery_pl~e	1.237608	.1784443	1.48	0.139	.9329377	1.641774
2.mid_wife	1.805264	.3709125	2.88	0.004	1.206845	2.700411
2.BirthInterval	.6837361	.1160339	-2.24	0.025	.4902695	.9535472
2.Religion	2.810635	.9315789	3.12	0.002	1.46783	5.381872
ethnic	.9894009	.0301123	-0.35	0.726	.9321076	1.050216
toiletfacility						
2	1.524832	.3574705	1.80	0.072	.9631027	2.414191
3	1.81162	.5122101	2.10	0.036	1.040883	3.153061
ownselectricity	1.05918	.1204131	0.51	0.613	.8476194	1.323546
_cons	.0274064	.0141767	-6.95	0.000	.0099436	.0755371

APPENDINDIX B2: Goodness of fit & Link test

Logistic model for died, goodness-of-fit test

```
       number of observations =        9320
 number of covariate patterns =        5337
           Pearson chi2(5307) =        5646.85
                  Prob > chi2 =          0.0006

. linktest

Iteration 0:   log likelihood = -1346.3186
Iteration 1:   log likelihood = -1329.3673
Iteration 2:   log likelihood = -1305.8049
Iteration 3:   log likelihood = -1305.7604
Iteration 4:   log likelihood = -1305.7604

Logistic regression                               Number of obs   =       9320
                                                  LR chi2(2)      =      81.12
                                                  Prob > chi2     =     0.0000
Log likelihood = -1305.7604                       Pseudo R2       =     0.0301
```

died	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_hat	.1270084	.8152474	0.16	0.876	-1.470847	1.724864
_hatsq	-.1430856	.1320101	-1.08	0.278	-.4018206	.1156495
_cons	-1.284044	1.248589	-1.03	0.304	-3.731235	1.163146

Appendix B3: Predictive Margins for the Main Model

```
. . margin province residence Agecat educ literacy Wealth_Index delivery_place mic

Predictive margins                              Number of obs    =       9320
Model VCE    : OIM

Expression   : Pr(died), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
province						
1	.0255042	.0056679	4.50	0.000	.0143954	.0366131
2	.0372821	.0067883	5.49	0.000	.0239773	.050587
3	.0451913	.007266	6.22	0.000	.0309502	.0594324
4	.042325	.0069911	6.05	0.000	.0286226	.0560273
5	.0320756	.0059896	5.36	0.000	.0203363	.0438149
6	.0297282	.0057905	5.13	0.000	.018379	.0410773
7	.0282436	.005241	5.39	0.000	.0179715	.0385157
8	.0280772	.005463	5.14	0.000	.0173698	.0387846
9	.0317359	.0056805	5.59	0.000	.0206023	.0428696
10	.0248177	.0056212	4.41	0.000	.0138002	.0358351
residence						
1	.0455642	.0046997	9.70	0.000	.036353	.0547754
2	.0255959	.0022727	11.26	0.000	.0211414	.0300504
Agecat						
1	.0401529	.006918	5.80	0.000	.0265939	.053712
2	.027834	.0034996	7.95	0.000	.0209749	.0346931
3	.0280728	.0034039	8.25	0.000	.0214013	.0347444
4	.0317098	.0040359	7.86	0.000	.0237996	.0396199
5	.036898	.0054166	6.81	0.000	.0262817	.0475143
6	.0328203	.0072817	4.51	0.000	.0185483	.0470922
7	.1141247	.0246586	4.63	0.000	.0657947	.1624547
educ						
0	.0269648	.0054127	4.98	0.000	.0163562	.0375735
1	.0285697	.0024688	11.57	0.000	.0237308	.0334085
2	.0426294	.005337	7.99	0.000	.032169	.0530897
literacy						
1	.0300391	.0025526	11.77	0.000	.0250361	.035042
2	.0378992	.004434	8.55	0.000	.0292087	.0465897
Wealth_Index						
1	.0334319	.0039639	8.43	0.000	.0256628	.041201
2	.0332868	.0039652	8.39	0.000	.0255151	.0410586
3	.0319474	.0040114	7.96	0.000	.0240852	.0398096
delivery_place						
1	.0311129	.0021093	14.75	0.000	.0269788	.035247
2	.0381337	.004336	8.79	0.000	.0296353	.046632
mid_wife						
1	.0314544	.0018565	16.94	0.000	.0278157	.0350931
2	.0549981	.0099919	5.50	0.000	.0354144	.0745818
BirthInterval						
1	.0450709	.006667	6.76	0.000	.0320038	.0581379
2	.0313998	.0019013	16.51	0.000	.0276733	.0351264
Religion						
1	.0321072	.0018307	17.54	0.000	.0285191	.0356953
2	.0841404	.0246169	3.42	0.001	.0358922	.1323887
toiletfacility						
1	.0222885	.0046801	4.76	0.000	.0131157	.0314614
2	.0334558	.0023018	14.53	0.000	.0289443	.0379673
3	.0394161	.0060115	6.56	0.000	.0276338	.0511984

APPENDIX C1: Odds Ratios & Marginal Effects for Central Province

```
. logistic died residence  drinkingwater  sex Agecat   ownselectricity BirthInterval   ethnic  if province==1

Logistic regression                               Number of obs   =       1171
                                                  LR chi2(7)      =      23.50
                                                  Prob > chi2     =     0.0014
Log likelihood =  -213.1443                       Pseudo R2       =     0.0522
```

died	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
residence	1.642983	.603663	1.35	0.177	.7996234	3.37583
drinkingwater	.6099464	.1175112	-2.57	0.010	.4181198	.88978
sex	1.479204	.4168468	1.39	0.165	.8514428	2.569809
Agecat	1.307514	.1247661	2.81	0.005	1.084483	1.576413
ownselectricity	1.230912	.3084298	0.83	0.407	.7532535	2.011466
BirthInterval	.5460506	.1828356	-1.81	0.071	.2832845	1.052551
ethnic	.8210483	.0716379	-2.26	0.024	.6919902	.9741761
_cons	.0579905	.0629551	-2.62	0.009	.0069069	.4868899

```
. estat gof
```

Logistic model for died, goodness-of-fit test

```
       number of observations =       1171
 number of covariate patterns =        433
             Pearson chi2(425) =        545.15
                   Prob > chi2 =          0.0001

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .03898469
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.	]	X
reside~e	.0186018	.01357	1.37	0.170	-.007997	.045201	1.70026
drinki~r	-.018522	.0069	-2.69	0.007	-.032042	-.005002	2.30999
sex	.0146677	.01046	1.40	0.161	-.005828	.035164	1.49957
Agecat	.0100454	.00345	2.92	0.004	.003292	.016798	3.3988
ownsel~y	.0077835	.00936	0.83	0.406	-.010559	.026126	.244236
BirthI~l	-.0226679	.01246	-1.82	0.069	-.047094	.001758	1.85226
ethnic	-.0073871	.00309	-2.39	0.017	-.01345	-.001324	2.47481

APPENDIX C2: Odds Ratios & Marginal Effects for Copperbelt Province

```
. . logistic died residence  Agecat  literacy Wealth_Index delivery_place mid_wife BirthInterval ‹

Logistic regression                               Number of obs   =        858
                                                  LR chi2(11)     =      22.98
                                                  Prob > chi2     =     0.0178
Log likelihood = -125.14986                       Pseudo R2       =     0.0841
```

died	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
residence	.7517158	.4261208	-0.50	0.615	.2474788	2.283333
Agecat	1.592503	.2006751	3.69	0.000	1.243994	2.038648
literacy	.6965552	.3174823	-0.79	0.428	.2850934	1.701861
Wealth_Index	1.063305	.3750399	0.17	0.862	.5326344	2.122689
delivery_place	1.048123	.5084246	0.10	0.923	.4050519	2.712152
mid_wife	3.015167	1.784312	1.86	0.062	.9453401	9.616888
BirthInterval	2.418342	1.851404	1.15	0.249	.5393437	10.84351
ethnic	.9525318	.0858578	-0.54	0.590	.79828	1.13659
drinkingwater	1.149559	.2839345	0.56	0.573	.7084173	1.865405
toiletfacility	1.567391	.6833936	1.03	0.303	.6668798	3.683895
ownselectricity	.7597017	.2593054	-0.81	0.421	.3891405	1.483132
_cons	.0003105	.0008144	-3.08	0.002	1.82e-06	.0530915

```
. estat gof
```

Logistic model for died, goodness-of-fit test

```
       number of observations =        858
 number of covariate patterns =        549
             Pearson chi2(537) =        657.96
                   Prob > chi2 =          0.0003

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .02723807
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.	]	X
reside~e	-.0075619	.01502	-0.50	0.615	-.037001	.021877	1.38695
Agecat	.0123288	.00313	3.94	0.000	.006193	.018465	3.35548
literacy	-.0095812	.01203	-0.80	0.426	-.033168	.014006	1.27855
Wealth~x	.0016264	.00935	0.17	0.862	-.016692	.019944	2.38811
delive~e	.0012454	.01285	0.10	0.923	-.023943	.026434	1.20629
mid_wife	.0292426	.01587	1.84	0.065	-.001854	.060339	1.04779
BirthI~l	.0233983	.01991	1.18	0.240	-.015627	.062423	1.88928
ethnic	-.0012886	.00238	-0.54	0.589	-.005961	.003384	2.73776
drinki~r	.003693	.00655	0.56	0.573	-.009152	.016538	1.96737
toilet~y	.0119077	.01147	1.04	0.299	-.010568	.034383	1.70396
ownsel~y	-.0072819	.00903	-0.81	0.420	-.024983	.010419	.495338

APPENDIX C3: Odds Ratios & Marginal Effects for Eastern Province

```
. logistic died  Agecat delivery_place mid_wife  birthordercat BirthInterval if province ==3

Logistic regression                               Number of obs   =       1151
                                                  LR chi2(5)      =      11.65
                                                  Prob > chi2     =     0.0399
Log likelihood = -190.51781                       Pseudo R2       =     0.0297
```

died	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Agecat	1.318494	.2239636	1.63	0.104	.945127	1.839356
delivery_place	1.149926	.4220191	0.38	0.703	.5601211	2.360794
mid_wife	3.531179	1.549312	2.88	0.004	1.494353	8.344228
birthordercat	.70797	.189369	-1.29	0.197	.4191158	1.195902
BirthInterval	.4416462	.1778802	-2.03	0.042	.2005577	.9725452
_cons	.0364891	.0385534	-3.13	0.002	.0046005	.2894147

```
. estat gof
```

Logistic model for died, goodness-of-fit test

```
       number of observations =      1151
 number of covariate patterns =        83
             Pearson chi2(77) =        99.55
                  Prob > chi2 =         0.0430

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .03719496
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.	]	X
Agecat	.0099015	.00596	1.66	0.097	-.001789	.021592	3.29105
delive~e	.0050028	.01313	0.38	0.703	-.020731	.030737	1.19374
mid_wife	.0451809	.0155	2.91	0.004	.014796	.075566	1.05387
birtho~t	-.0123676	.00946	-1.31	0.191	-.030909	.006174	2.33275
BirthI~l	-.0292668	.01413	-2.07	0.038	-.056969	-.001565	1.88879

APPENDIX C4: Odds Ratios & Marginal Effects for Luapula Province

```
. . logistic died residence  literacy  delivery_place mid_wife BirthInterval Religion  ownselectricity if province==4

Logistic regression                               Number of obs   =       1018
                                                  LR chi2(7)      =      21.89
                                                  Prob > chi2     =     0.0027
Log likelihood = -164.07027                       Pseudo R2       =     0.0625
```

died	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
residence	1.451698	.5544124	0.98	0.329	.6867476	3.068707
literacy	.7187374	.2449854	-0.97	0.333	.3684969	1.401867
delivery_place	1.903793	.6886611	1.78	0.075	.9369442	3.86835
mid_wife	.3672158	.3816211	-0.96	0.335	.0478992	2.815232
BirthInterval	.3448412	.1293065	-2.84	0.005	.1653639	.719114
Religion	7.876678	5.529726	2.94	0.003	1.989608	31.18306
ownselectricity	1.896099	.4447819	2.73	0.006	1.19726	3.002849
_cons	.0333151	.0523984	-2.16	0.031	.0015271	.7268092

```
. estat gof
```

Logistic model for died, goodness-of-fit test

```
       number of observations =      1018
 number of covariate patterns =        48
             Pearson chi2(40) =        61.01
                  Prob > chi2 =         0.0177

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .03394501
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.	]	X
reside~e	.012223	.01244	0.98	0.326	-.012168	.036614	1.64637
literacy	-.0108301	.01108	-0.98	0.328	-.032552	.010892	1.49705
delive~e	.0211136	.01164	1.81	0.070	-.0017	.043927	1.24165
mid_wife	-.032852	.0337	-0.97	0.330	-.098906	.033202	1.04617
BirthI~l	-.0349135	.01201	-2.91	0.004	-.058447	-.01138	1.87819
Religion	.0676812	.02351	2.88	0.004	.021597	.113765	1.01473
ownsel~y	.0209807	.00762	2.75	0.006	.006054	.035908	.137525

APPENDIX C5: Odds Ratios & Marginal Effects for Lusaka Province

```
. . logistic died residence Agecat birthordercat  if province==5

Logistic regression                               Number of obs   =       1181
                                                  LR chi2(3)      =       8.15
                                                  Prob > chi2     =     0.0430
Log likelihood = -224.29786                       Pseudo R2       =     0.0178

------------------------------------------------------------------------------
        died | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   residence |   .4534354   .1560727    -2.30   0.022     .2309571    .8902243
      Agecat |   1.153897   .1560439     1.06   0.290     .8852326    1.504101
birthordercat|   .7832009   .1796519    -1.07   0.287     .4996009    1.227787
       _cons |    .139387   .0754835    -3.64   0.000      .048224     .402885
------------------------------------------------------------------------------

. estat gof

Logistic model for died, goodness-of-fit test

       number of observations =      1181
 number of covariate patterns =        42
             Pearson chi2(38) =        57.53
                  Prob > chi2 =         0.0219

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .04490979
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
reside~e |  -.0339241      .01394   -2.43   0.015  -.061255 -.006593   1.34632
  Agecat |   .0061399      .00576    1.07   0.287  -.005156  .017436   3.26164
birtho~t |  -.0104816      .00977   -1.07   0.283  -.029629  .008665         2
------------------------------------------------------------------------------
```

APPENDIX C6: Odds Ratios & Marginal Effects for Muchinga Province

```
. . logistic died birthordercat  BirthInterval  toiletfacility if province==6

Logistic regression                               Number of obs   =       1252
                                                  LR chi2(3)      =       8.93
                                                  Prob > chi2     =     0.0302
Log likelihood = -245.25081                       Pseudo R2       =     0.0179

------------------------------------------------------------------------------
        died | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 birthordercat |   .7321618   .1081444    -2.11   0.035     .5481252    .9779899
 BirthInterval |   .4936632   .1639671    -2.13   0.034     .2574599    .9465681
toiletfacility |   1.384106   .4173929     1.08   0.281     .7664427    2.499532
         _cons |   .1929828   .1950325    -1.63   0.104     .0266242    1.398816
------------------------------------------------------------------------------

. estat gof

Logistic model for died, goodness-of-fit test

       number of observations =      1252
 number of covariate patterns =        20
             Pearson chi2(16) =        33.29
                  Prob > chi2 =         0.0068

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .04722115
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
birtho~t |  -.0140262      .00642   -2.19   0.029  -.026601 -.001452   2.31789
BirthI~l |  -.0317595      .01463   -2.17   0.030  -.060427 -.003092   1.86901
toilet~y |   .0146246       .0135    1.08   0.279  -.011836  .041085   2.09984
------------------------------------------------------------------------------
```

APPENDIX C7: Odds Ratios & Marginal Effects for Northern Province

```
. logistic died residence literacy delivery_place ethnic toiletfacility if province==7

Logistic regression                               Number of obs   =       1528
                                                  LR chi2(5)      =      20.87
                                                  Prob > chi2     =     0.0009
Log likelihood = -328.95636                       Pseudo R2       =     0.0307

------------------------------------------------------------------------------
        died | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   residence |   .5658732   .1373086    -2.35   0.019     .3517028    .9104631
    literacy |   2.340871   .5912372     3.37   0.001     1.426883    3.840314
delivery_place |   1.138188   .2696348     0.55   0.585     .7154275    1.810765
      ethnic |   1.060359   .0407188     1.53   0.127     .9834806    1.143246
toiletfacility |   1.311659   .3853216     0.92   0.356     .7375074    2.332789
       _cons |   .0151748   .0116335    -5.46   0.000     .0033772    .0681842
------------------------------------------------------------------------------

. estat gof

Logistic model for died, goodness-of-fit test

       number of observations =      1528
 number of covariate patterns =        59
             Pearson chi2(53) =        83.83
                  Prob > chi2 =         0.0044

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .05235096
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
reside~e |  -.0282474      .01184   -2.39   0.017  -.051449 -.005046   1.66819
literacy |   .0421947      .01182    3.57   0.000   .019025  .065364   1.54254
delive~e |   .0064214      .01174    0.55   0.585  -.016595  .029438    1.4411
  ethnic |   .0029075      .00189    1.54   0.124  -.000799  .006614   3.07592
toilet~y |   .0134589      .01453    0.93   0.354  -.015026  .041944   2.07592
------------------------------------------------------------------------------
```

APPENDIX C8: Odds Ratios & Marginal Effects for North Western Province

```
. logistic died residence literacy Wealth_Index ethnic if province ==8

Logistic regression                               Number of obs   =       1377
                                                  LR chi2(4)      =      13.10
                                                  Prob > chi2     =     0.0108
Log likelihood = -258.35034                       Pseudo R2       =     0.0247

------------------------------------------------------------------------------
        died | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   residence |   .6280253   .2041735    -1.43   0.152     .3320842    1.187698
    literacy |   1.988959   .5623558     2.43   0.015     1.142769    3.461733
Wealth_Index |   1.392205   .2792625     1.65   0.099     .9396384    2.062746
      ethnic |   1.077179   .1112151     0.72   0.471     .8798408    1.318778
       _cons |   .0160578     .01609    -4.12   0.000     .0022531    .1144439
------------------------------------------------------------------------------

. estat gof

Logistic model for died, goodness-of-fit test

       number of observations =      1377
 number of covariate patterns =        56
             Pearson chi2(51) =        42.90
                  Prob > chi2 =         0.7828

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .04379135
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
reside~e |  -.0194786      .01347   -1.45   0.148  -.045885  .006928   1.62672
literacy |   .0287928      .01141    2.52   0.012   .006432  .051153   1.43936
Wealth~x |   .0138555      .00826    1.68   0.094  -.002342  .030054   1.71169
  ethnic |   .0031131      .00432    0.72   0.471  -.005352  .011578   3.34423
------------------------------------------------------------------------------
```

APPENDIX C9: Odds Ratios & Marginal Effects for Southern Province

```
. logistic died residence birthordercat ownselectricity if province==9

Logistic regression                               Number of obs   =       1488
                                                  LR chi2(3)      =      13.02
                                                  Prob > chi2     =     0.0046
Log likelihood = -290.64399                       Pseudo R2       =     0.0219
```

died	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
residence	.4678574	.1272371	-2.79	0.005	.2745511	.7972669
birthordercat	.7962798	.1102197	-1.65	0.100	.6070771	1.04445
ownselectricity	.5166346	.1570878	-2.17	0.030	.2846869	.9375611
_cons	.3512488	.1865845	-1.97	0.049	.1240091	.994892

```
. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .04627792
```

variable	dy/dx	Std. Err.	z	P>|z|	[95%	C.I.]	X
reside~e	-.0335256	.01153	-2.91	0.004	-.05613	-.010921	1.69288
birtho~t	-.0100544	.00601	-1.67	0.094	-.02183	.001721	2.25739
ownsel~y	-.0291484	.01288	-2.26	0.024	-.054384	-.003913	.271505

APPENDIX C10: Odds Ratios and Marginal Effects for Western Province

```
. logistic died educ  Agecat Wealth_Index delivery_place mid_wife BirthInterval Religion  toiletfacility  i

Logistic regression                               Number of obs   =        801
                                                  LR chi2(8)      =      19.25
                                                  Prob > chi2     =     0.0136
Log likelihood = -87.565131                       Pseudo R2       =     0.0990
```

died	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
educ	1.985839	.9063261	1.50	0.133	.8118207	4.857667
Agecat	.9360782	.1578999	-0.39	0.695	.6725575	1.302851
Wealth_Index	1.337113	.5097427	0.76	0.446	.6333845	2.822725
delivery_place	2.350814	1.26249	1.59	0.111	.8205135	6.735203
mid_wife	.5030471	.3995981	-0.86	0.387	.1060357	2.38652
BirthInterval	.131011	.0758411	-3.51	0.000	.0421264	.4074373
Religion	11.53459	10.74711	2.62	0.009	1.857433	71.62933
toiletfacility	1.36921	.728159	0.59	0.555	.4828286	3.882819
_cons	.0095028	.0257396	-1.72	0.086	.000047	1.920617

```
. estat gof
```

Logistic model for died, goodness-of-fit test

```
       number of observations =       801
 number of covariate patterns =       237
            Pearson chi2(228) =       299.95
                  Prob > chi2 =         0.0010

. mfx

Marginal effects after logistic
      y  = Pr(died) (predict)
         =  .01845003
```

variable	dy/dx	Std. Err.	z	P>|z|	[95%	C.I.]	X
educ	.0124239	.00796	1.56	0.118	-.00317	.028018	1.19725
Agecat	-.0011963	.00304	-0.39	0.694	-.007162	.00477	3.27341
Wealth~x	.0052611	.00681	0.77	0.440	-.008083	.018605	1.57928
delive~e	.0154794	.00938	1.65	0.099	-.002898	.033856	1.28464
mid_wife	-.0124426	.01427	-0.87	0.383	-.040402	.015517	1.12484
BirthI~l	-.0368073	.01146	-3.21	0.001	-.059263	-.014351	1.94881
Religion	.0442844	.01763	2.51	0.012	.009731	.078838	1.01748
toilet~y	.0056907	.00956	0.60	0.552	-.013052	.024434	2.43695