THE UNIVERSITY OF ZAMBIA

DIRECTORATE OF RESEARCH AND GRADUATE STUDIES

SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

DEPARTMENT OF POPULATION STUDIES

MASTER OF ARTS IN POPULATION STUDIES

TRENDS IN BIODEMOGRAPHIC DETERMINANTS OF NEONATAL MORTALITY IN ZAMBIA: 1992-2007

BY

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A DISSERTATION SUBMITTED TO THE UNIVERSITY OF ZAMBIA IN PARTIAL FULLFILMENT OF REQUIREMENTS OF A DEGREE OF MASTER OF ARTS IN POPULATION STUDIES

DECLARATION

I, **Chinyama K. Lukama** do declare that this dissertation represents my work, has not been previously submitted for a degree at this University or any other institution in the world and does not incorporate any published work or material from another written work.

Signature: ___________

Date: 31st July, 2014

DEDICATION

I dedicate this paper to my son Kakoma Chinyama Lukama and the Zambian neonates.

CERTIFICATE OF APPROVAL

This dissertation of **Chinyama K. Lukama** is approved as fulfilling part of the requirements for the award of the degree of Master of Arts in Population Studies at the University of Zambia.

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ACKNOWLEDGEMENTS

I wish to thank Dr. Buleti Nsemukila for his professional guidance and tireless encouragements from the onset of this study to the end. You were always accessible and open for profession guidance and all I can do is wish you the continued God's blessings. I am greatly indebted to MEASUREDHS which provided me with the necessary datasets for my study. I would also like to express my gratitude and appreciation to all those who in one way or the other supported me morally during the course of my study. To my parents (David and Evelyn), family members and friends who especially encouraged me to work harder, I am humbly grateful for your support.

ABSTRACT

Neonatal mortality has been one of the major factors used in evaluating the effectiveness of the health systems in any country and is also a barometer in assessing changes in the health status of women. Trends in determinants of neonatal mortality have become even more important in influencing policies that are aimed at enhancing survivorship of neonates. This study examined the trends in bio-demographic determinants of neonatal mortality in Zambia from 1992 to 2007. The study used data from the Zambia Demographic and Health Surveys of 1992, 1996, 2001-2 and 2007. Logistic regression method was used to determine the influence of each of the bio-demographic determinants on neonatal mortality within the context of the Mosley-Chen child survival framework. Neonatal mortality reduced during the period 1992 to 2007. The results reveal that among bio-demographic factors, size of a child at birth, type of birth, preceding birth interval, number of living children of a mother and mothers parity were important determinants of neonatal mortality from 1992 to 2007. Sex of a neonate only influenced neonatal mortality from 1992 to 1996 but its influence significantly reduced in 2001-2 and 2007. In conclusion, the study confirms some of the findings of the 1992 study which looked at the same variables except for birth interval which were no significantly related to neonatal mortality in the subsequent years. It is also clear from this study that younger mothers, especially adolescents and the youths are delaying child bearing until when they are older resulting in the reductions of higher risks associated with neonatal mortality in Zambia. These results therefore build on the already existing knowledge and could be very useful in targeting workable programs which would enhance neonatal survivorship in Zambia.

LIST OF ACRONYMS

AIDS	Acquired Immune-Deficiency Syndrome
BoZ	Bank of Zambia
CBoH	Central Board of Health
CDC	Centre for Disease Control
CSA	Census Supervisory Area
CSO	Central Statistical Office
DCI	Development Cooperation of Ireland
DFID	United Kingdom Department of International Development
DHMT	District Health Management Team
DHS	Demographic and Health Survey
EDHS	Ethiopia Demographic and Health Survey
EU	European Union
GDP	Gross Domestic Product
GRZ	Government of the Republic of Zambia
HCC	Health Centre Committee
HDI	Human Development Index
HIPC	Highly Indebted Poor Country
HIV	Human Immune Virus
HMIS	Health Management Information System
HSSP	Health Services and Systems Program
HTM	Hospital Management Team
JICA	Japan International Co-operation Agency
MACEP	Malaria Control and Evaluation Partnership in Africa
MDG	Millennium Development Goal
MMD	Movement for Multiparty Democracy
MoH	Ministry of Health
NASF	National Strategy Framework

NHC Neighbourhood Health Committee

NHSP National Health Strategy Plan

NORAD Norwegian Development Agency

PAGE Program for Advancement of Girls Education

PASW Predictive Analysis Software

PHO Provincial Health Office

PRSP Poverty Reduction Strategy Paper

SAP Structural Adjustment Programs

STI Sexually Transmitted Infection

SWAP Sector Wide Approach

TB Tuberculosis

TDRC Tropical Diseases Research Centre

UN United Nations

UNZA University of Zambia

UNDP United Nations Development Program

UNFPA United Nations Population Fund

UNICEF United Nations Children Emergency Fund

UNZA The University of Zambia

USAID United States Agency for International Development

WHO World Health Organization

ZDHS Zambia Demographic and Health Survey

ZANARA Zambia National Response to HIV/AIDS

ZCCM Zambia Consolidated Copper Mines

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CHAPTER ONE: INTRODUCTION

1.0: BACKGROUND

Neonatal mortality has been used to explain the health of the populations worldwide and is also one of the major indicators of the general health and socio-economic status of the population especially children. Several frameworks like the Millennium Development Goals (MDG's) have specifically embraced the aspect of reduction of under-five mortality to lower levels within which neonatal mortality is a subset. One of the most pronounced targets of the Millennium Development Goals (MDG's) that were introduced in 2000 at the United Nations Millennium summit was to reduce infant and child mortality rates by two-thirds from the 1990 levels by the year 2015 (UN Report, 2010: 26). The target for Zambia, in line with the MDG number four which looks at reducing child mortality, is to reduce under-five mortality rate from 119 in 2009 to 63 in 2015 (SNDP, 2011: 89). It is within this specific MDG target that the aspect of reducing neonatal mortality is part. This is because neonatal mortality has been identified and still remains a very key factor in the evaluation of the health sector performance of any country.

The Zambian government and other cooperating partners have made efforts in reducing neonatal mortality. Some of the strategies put in place include encouraging girl child education which delays fertility thereby reducing the proportion of births born from very young mothers. This consequently reduces neonatal mortality because research has revealed that neonates born from very young mothers have higher chances of dying (Carla, 2003). Other strategies include investing in the health sector to improve infant and maternal health, increasing access to ART and VCT to pregnant women in order to prevent mother to child transmission of HIV/AIDS and expand access to maternal, new born and child health services including immunization, safe delivery and basic emergency obstetric care (SNDP, 2011: 85). Among many other strategies also is the improvement of the availability, access, use, and quality of maternal health care (antenatal and post-natal) to all pregnant women and increase the access and availability of contraception. In addition, several efforts from both the government and private sector in Zambia are being put in place to reduce poverty levels at the individual, household and national levels by encouraging political will towards efforts that are aimed at reducing poverty, effective implementation, monitoring and evaluation of programs and focusing on the pro-poor growth (PRSP, 2004: 4). Private sector has been actively involved in promoting programs that are aimed at reducing poverty levels in Zambia. This is because poverty has a huge influence on all levels of mortality including the neonates. All these strategies are important and have played a major role in impacting on neonatal mortality in Zambia.

1.1: GEOGRAPHY OF ZAMBIA

Zambia is a republic in South Central Africa with an area of 752,614 km^2. Most of Zambia is high plateau with a flat or gently undulating terrain. Elevations average between about 1,100 and 1,400 m. Mountains in the northeast exceed 2,000 m. Major rivers are the Zambezi in the west and south and its tributaries, the Kafue in the west and the Luangwa in the east; and the Luapula and Chambeshi, in the north. Lake Bangweulu, in the north, is surrounded by a vast swampy region. Lake Kariba is a large reservoir formed by Kariba Dam on the Zambezi River. Although lying within the Tropic Zone, much of Zambia enjoys a pleasant subtropical climate because of the high altitude. Annual rainfall ranges from 750 mm in the south to 1,300 mm in the north. Nearly all of the rain falls between November and April (Microsoft Encarta, 2012)

1.2: HEALTH DELIVERY SYSTEMS AND REFORMS IN ZAMBIA: 1990-2010

During the Kenneth Kaunda regime between 1964 and 1990, the management of health facilities was semi-autonomous. As a result of this policy, in the early 1990s under the Movement for Multi-Party Democracy, new legislation mandated the formation of District Health Boards in all districts to oversee health services at the district level. Specifically in 1992, the Government of Zambia initiated health sector reforms aimed at decentralizing health service delivery to the district levels, integrating relevant services, and focusing on preventive rather than curative care. The reforms were aimed at improving primary health care and implementing a basic health care package of high-impact interventions through the public health system. These reforms were implemented under the framework of the Sector Wide Approach (SWAP), which called for resources from government and other stakeholders to be pooled and coordinated to ensure efficient resource utilization. In 1993, the government introduced cost sharing through user fees, with exemptions for children under five and adults over 65, and for certain priority services such as maternal and family planning services, immunizations, and chronic diseases, including HIV/AIDS (PRSP, 2002). This change was intended to help reduce the burden of health expenditure on government. However, this policy change was not as effective as was expected and therefore there was need to have another policy shift within the health sector (Chankova, 2006).

In this regard, the National Health Service Act of 1995 called for a significant change in the role and structure of the Ministry of Health and established an autonomous health service delivery system. In response, the Central Board of Health (CBoH) was created to "monitor, integrate, and coordinate the programs of the Health Management Boards." As a result, the Ministry of Health (MOH) was no longer directly involved in health service delivery, with its role limited to policymaking and regulation of the health sector (Bossert et al., 2000). However, the quality of health services continued to be low, owing to the deterioration of facilities and equipment, shortages of drugs, and a poorly staffed, inefficient, predominantly publicly owned health system. The government continued to implement the medium-term sector strategy, adopted in 1995, which focused on providing essential and cost-effective health care services, building districts' capacity to manage health services, improving logistical and information systems, developing human resources, and increasing local involvement in the development of health services. The major policy issues in the health sector over the medium term concerned the allocation and use of public resources. The allocation of resources to non-personnel costs in the health sector had declined in real terms over the past, even though the budget allocation to health services had stayed at about 12 per cent of government outlays, excluding debt service (IMF, 2001).

Zambia was one of the countries affected by the Highly-Indebted Poor Country (HIPC) requirements on government budget limits. A freeze on appointments in the public sector, including the healthcare sector, took effect in 2003 in compliance with HIPC requirements. This also affected the operations of the health sector in providing services to the population. In this regard, several cooperating partners came on board to assist the government provide health services. For instance, the United States Aid for International Development (USAID) initiated the Health Services and Systems Program (HSSP) which was a bilateral program providing support to the health sector at the central, provincial, and district levels to strengthen systems and to expand coverage and improve the quality of health services throughout all provinces in Zambia. Health Services and Systems Programme was initiated in 2004 with a budget of US$42 million. The project's technical staff had expertise in HIV/AIDS, reproductive health, child health, malaria, health financing, drugs and logistics, strategic information, and research and evaluation. Tasked with strengthening the public health system and improving service delivery in key priority areas, HSSP provided technical assistance in sector planning, human resources, health financing, drug management and logistics, and the Health Management Information System (HMIS). Priority areas for service delivery included HIV/AIDS, reproductive health, safe motherhood and child health (Chankova, 2006).

In June 2005, the government announced a policy of free provision of Ante-Retroviral Therapy (ART) in public health facilities, which added to the demands on the health workforce in the country. In early 2006, user fees were abolished at rural public health facilities. Another major change was the dissolution of the Central Board of Health (CBoH), whose functions have since reverted to the Ministry of Health (MoH). The government in 2006 further formulated the National Health Strategic Plan (NHSP). The NHSP 2006-2010 promoted access, as close to the community as possible, of high quality, cost-effective health services that contribute to achieving the MDGs for health and national health priorities. The NHSP identified child health, nutrition, reproductive health, HIV/AIDS, sexually transmitted infections, tuberculosis, and malaria as public health priorities. Related to these priorities, the Ministry of Health aimed to reduce the under-five mortality from 168 per 1,000 live births to 134 by 2011 and to 63 by 2015 and increase access to integrated reproductive health and family planning services. In addition, it aimed to reduce maternal mortality ratio from 729 per 100,000 live births to 547 by 2011 and to 162 by 2015, halt and begin to reduce the spread of HIV/AIDS and STIs by increasing access to quality HIV/AIDS and STI interventions and halt and reduce the incidence of malaria by 75% and mortality due to malaria in children under five years of age by 20 per cent (USAID, 2009). In conjunction with the development of the NHSP, the MOH restructured the organization of the health sector to support the decentralization of planning and service delivery, including the authority delegated for key management tasks, and approximately 60 per cent of resources sent to district level. Several other strategic plans were also created in order to improve health care. One of them was 2006-2010 National HIV/AIDS/STI/TB Strategic

Framework (NASF) whose priority interest was to intensify prevention of HIV, expanding treatment, care, and support for people affected by HIV/AIDS, mitigating the socioeconomic impact of HIV/AIDS, strengthen the decentralized response by mainstreaming HIV/AIDS, improving the capacity for monitoring by all partners and integrate advocacy, and coordination of the multi-sectoral response (USAID, 2009).

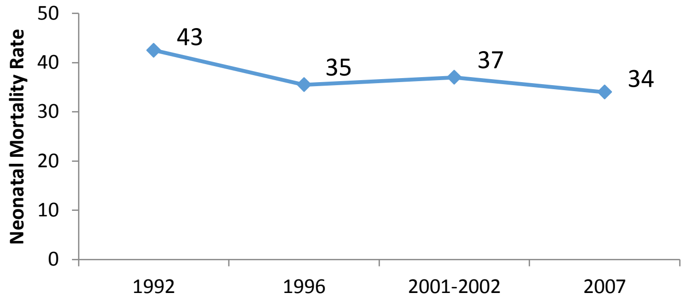
All these major shifts in policy and management of the health sector had improved the health care systems over the 1990-2010 period. However, the health sector continued to experience major challenges which influenced the effectiveness of the systems that were put in place. These challenges included lack of human resource due to factors like brain drain and mortality most especially resulting from HIV/AIDS. Other challenges included lack of adequate infrastructure, drugs, inadequate funding and monitoring and evaluation systems in place to ensure accountability of resources.

1.3: LEVELS AND TRENDS IN NEONATAL MORTALITY IN ZAMBIA (1990 – 2010)

Neonatal mortality is defined by the World Health Organization as the number of deaths during the first 28 completed days of life per 1,000 live births in a given year or period (WHO, 2012). Neonatal deaths may be subdivided into early neonatal deaths, occurring during the first seven days of life, and late neonatal deaths, occurring after the seventh day but before the 28 completed days of life. It should be noted that it is a challenge in population based surveys such as the ZDHS to establish a death which occurred within exactly 28 days of birth. Therefore, for this purpose, this research considered the deaths that occurred within one month of birth as neonatal deaths.

According to the Zambia Demographic and Health Survey Report (ZDHS, 2007), neonatal mortality generally recorded a 20 per cent reduction between 1992 and 2007 from 42.5 deaths per thousand live births in 1992 to 34 deaths per thousand live births in 2007. Figure 1 below shows the trend of neonatal mortality over the 1992-2007 periods.

Figure 1.1: Neonatal Mortality Rates in Zambia (1992-2007)



Source: ZDHS Report, 2007: 121

From figure 1.1, it is clear that neonatal mortality has generally been declining. Despite the general decline, it can be noted that the decline was less than that in other countries in the region like Botswana (reduced to 19 neonatal deaths per 1000 live births) and Namibia (17 neonatal deaths per 1000 live births). This general decline in neonatal mortality in Zambia, however, could be explained by, among other factors, general improved health care systems and general efforts by different sectors to improve women's health status.

CHAPTER TWO: PROBLEM STATEMENT, JUSTIFICATION AND RESEARCH OBJECTIVES

2.0: STATEMENT OF THE PROBLEM

Despite the many efforts that were aimed at improving child survival in Zambia like improvement in medical technology, increased availability of medical facilities and many others, Zambia still remained among the countries with the highest levels of neonatal mortality in Central and Southern Africa in the period 1990 to 2010. Below is a table showing estimates from selected countries from the region showing the trends in neonatal mortality.

TABLE 2.1: TRENDS IN NEONATAL MORTALITY RATES IN SELECTED COUNTRIES: 1990-2010

Country	1990	1995	2000	2005	2009	2010	% Change
Malawi	44	42	38	33	28	27	38.6
Namibia	25	24	26	22	18	17	28.0
Zambia	40	40	37	35	31	30	25.0
Angola	51	49	46	44	42	41	19.6
Botswana	22	27	31	33	20	19	13.6
Zimbabwe	27	32	34	31	28	27	0.0
South Africa	18	19	22	22	18	18	0.0

Source: UNICEF Mortality Estimates (2011)

The table above shows that Zambia's neonatal mortality rates had remained high as compared to other countries within the region like Malawi and Namibia. The figures are consistent with the estimates reported in the Demographic and Health Survey Reports (1992-2007). There are many studies which have been undertaken in other parts of the world in order to establish the trends in determinants of neonatal mortality, particularly the bio-demographic factors. Among these studies include the study by Deepak Paudel (2013) who investigated trends and determinants of neonatal mortality in Nepal using 2001, 2006 and 2011 Nepal Demographic and Health Survey data. Some of these studies have served as a basis for policy formulation and analysis. This is possibly the case for Zambia since bio-demographic factors play a key role in determining neonatal mortality. For Zambia, however, only one study by Nsemukila (1992) attempted to determine the trends using ZDHS data, but could not analyse data specific to neonatal mortality only. This study used 1992 Demographic and Heath Survey data to study the determinants of child survival of which the bio-demographic factors influencing neonatal mortality was part of the study. Since then, no study of similar nature had been undertaken. Having established this gap, it was therefore necessary to undertake a study to establish the trends in bio-demographic factors influencing neonatal mortality over the long period (1992 to 2007) in Zambia, now that Demographic and Health Survey data has been collected for more than ten years.

2.1: PROBLEM JUSTIFICATION

The significance of undertaking this study is to give insights on the trends in bio-demographic factors influencing neonatal mortality in Zambia. Generally, the study contributes to the huge body of knowledge that is relevant in reducing infant and child mortality in line with the fourth Millennium Development Goal. In addition, very few studies in Zambia have applied the Mosley and Chen Child Survival framework to investigate neonatal mortality determinants. This study attempts to assess how applicable the Mosley and Chen Child Survival framework is on Neonatal mortality in the Zambia.

2.2: RESEARCH OBJECTIVES

General Objective: To investigate trends in Bio-Demographic factors influencing Neonatal Mortality in Zambia.

Specific Objectives: The specific objectives are to investigate the trends in the influence of the following bio-demographic factors on neonatal mortality:

1. Age of mother
2. Sex of a neonate
3. Parity
4. Number of living children of a mother
5. Birth order of a neonate
6. Preceding birth interval
7. Birth type
8. Size of a neonate at birth

2.3: STATEMENT OF HYPOTHESIS

From the research objectives, the following hypothesis can be derived:

1. Bio-demographic factors are highly likely to influence neonatal mortality

CHAPTER THREE: LITERATURE REVIEW, PROBLEM ANALYSIS AND VARIABLE IDENTIFICATION

3.0: REVIEW OF LITERATURE

3.1: EMPIRICAL REVIEW

Several studies have been undertaken with the aim of establishing the trends in bio-demographic factors that influence neonatal mortality. One of the studies in this line was undertaken in India in Gujarat and its neighbouring state of Maharashtra from 1992 to 1995. The main objective of the study was to investigate the determinants and causes of infant mortality in these areas (Gandotra, 1992). The study used cross sectional and longitudinal approaches as well as qualitative approaches particularly focus group discussions. Maternal age had a stronger link with neonatal mortality. The study revealed that neonates born from teen mothers had a higher risk of dying in these two areas under investigation. It also further revealed that births to mothers in the older age group (30+) also had a higher risk of death. Thus, the risk of neonatal death seemed to have been higher when the mother was either very young or relatively older (Gandotra, 1995).

Birth order of the neonate also had an influence on neonatal mortality over the long period of time. Findings indicated that first births had higher risks of dying than second or third births. The risk of neonatal mortality among second or third births was lower. This risk of neonatal mortality increased with an increase in parity. This was found to be true for four or higher order births in both Gujarat and Maharashtra. In addition, one major demographic variable that was investigated was the birth interval. Besides birth order, shorter birth interval (below 18 months) between the two live births was also found to have been playing a significant role in higher risk of neonatal mortality as compared to the neonates where the interval was longer than 18 months. This factor was found to be an important determinant of neonatal mortality in both Gujarat and Maharashtra. Thus, unless a spacing of more than 18 months is maintained between the two pregnancies, the risk of neonatal mortality becomes high (Gandotra, 1992). Birth weight of babies was also found to be influencing neonatal deaths. It was observed that mortality among those babies who had a birth weight of less than 2,400 grams in Gujarat as well as Maharashtra was higher than among those babies with more than 2,400 grams. Goro (2007) also used data from the 1993, 1998 and

2003 Demographic and Health Survey of Ghana in order to investigate the determinants of infant and child mortality in three regions. Using multivariate logistic regression, one major bio-demographic factor that significantly determined neonatal mortality was birth order of the child.

Imad El Awor (2009) and others investigated the determinants and risk factors of neonatal mortality in the Palestanian occupied territory of the Gaza strip. The study established the higher risk of neonatal mortality in babies with low birth weight than in those with normal birth weight. Christiana (2008) in her study of the determinants of neonatal mortality in Indonesia also found out that neonatal mortality was higher among infants with shorter birth intervals , males infants and smaller than average sized infants . Another study was carried out in Bangladesh and it used the 2007 Bangladesh Demographic and Health Survey data to investigate the effect of maternal education on neonatal mortality in Bangladesh. Among many factors, maternal age and birth order were important determinants of neonatal mortality in Bangladesh (Mostafa, 2012). Kamal (2012) in his study to investigate the socio-economic correlates of infant and child mortality in Bangladesh established a higher neonatal mortality among infants with mothers with a higher number of children ever born.

Deepak and others (2013) used Nepal 2001, 2006 and 2011 Demographic and Health Survey data to investigate the trends and determinants of neonatal mortality in Nepal. Findings revealed higher neonatal mortality for first or fourth or higher birth order than for second and third births. The study further revealed a higher mortality for neonates with less than two years birth interval than those with more than two years. Others including Arshad (2002) with the use of 1991 Pakistan Demographic and Health Survey data to investigate the determinants of neonatal and post-neonatal mortality in Pakistan revealed that preceding birth interval was a major factor determining neonatal mortality. Low birth weight was also found to be an important cause of neonatal mortality by Upadhyay (2011) in his study on the determinants of neonatal mortality in rural Haryana in India.

Carla (2003) investigated the determinants of neonatal and post-neonatal mortality in the city of Sao Paulo using information from the Information System on Live Births (SINASC) and Information System of Mortality (SIM) from 2008 birth cohort whose mother's place of residence in 1998 was the city of Sao Paulo. The study revealed that female infants had a lower odds of dying in neonatal as compared to male infants. Infants below 3000 grams had a higher odds of dying in neonatal period than those above 3000 grams and infants of young adolescent mothers had 53% increased odds of dying in neonatal period as compared to infants of mothers 20-24 years. There was no significant effect of parity on the odds of dying in the neonatal period (Carla, 2003).

Another study investigated the determinants of neonatal mortality in Tunisia. This study followed a prospective cohort compiling all live births reported between January 2007 and December 2008 at Charles Nicolle hospital in Tunis. Though the results of the study could not be extrapolated to the whole Tunisian population, it revealed higher neonatal mortality among males (64.7%) than females (35.3%) with the odds ratio of 1.83 for males compared to 1.00 for females (Emira, 2010). Ezra and Gurum (2002) used a logistic regression model to investigate the impact of birth interval on infant and child mortality in the context of communities characterized by high reproductivity, prolonged breast feeding practice, and poor living conditions in Ethiopia. The results revealed that short birth interval (less than 18 months) were significantly associated with neonatal mortality. They further observed that those born from younger mothers (15-19 years) and oldest mothers (35-49 years) had higher chances of death than those born from mothers aged 25-34 years. Okantey (2012) in his study of the determinants of neonatal mortality in Ghana also found that maternal age and size of birth were significant contributors to neonatal mortality.

Desta Mekonnen (2011) also established several factors as influencing neonatal mortality. His study was undertaken for Ethiopia. His study examined and identified the important determinants of Infant and Child mortality in Ethiopia. The 2000 and 2005 Ethiopia Demographic and Health Survey (EDHS) data were used. The main aim of his study was to investigate the association between infant and child mortality and socio-economic and bio-demographic factors in Ethiopia and distinguish which of these factors were more pronounced in the reduction of infant and child mortality between 2000 and 2005. The data consisted of a national representative sample of household level data. The results of the study established a strong link between birth order and neonatal mortality. Generally, those born from lower birth orders (e.g order 1) had higher chances of dying than those from higher orders. The increase in the preceding birth interval also reduced the risk of mortality.

Kumar and Gemechis (2010) used data from Ethiopia DHS survey (2005) and employed cross tabulation technique to examine the selected socioeconomic, bio-demographic and maternal health care factors that determine child mortality in Ethiopia. The results showed that among other variables, birth interval with preceding birth and mothers' education had a significant impact in lowering the risk of child mortality. The result confirmed that the child mortality risk associated with children of less than 2 years of birth interval with previous child was highest (15 per cent) and lowest (4. 2 per cent) for the children whose birth interval was 4+ years. Birth order also was an important determinant of neonatal mortality in Ethiopia.

Similarly in Kenya, Mustafa and Odimegwu (2008) investigated 2003 DHS data set for children by using logistic regression models. They examined socioeconomic determinants of infant mortality rate for both urban and rural settings. One major result was that sex of the child in urban areas and birth order and birth interval in rural areas were important determinants of the risk of neonatal mortality. Muntago (2004) used data from 2003 DHS in Kenya to investigate the impact of socioeconomic and environmental variables of infant and child mortality in urban areas of Kenya. The results showed that neonatal mortality was lower for those who were of birth order 2-3, birth interval more than 2 years, single births, living in wealthier households, had access to drinking water and sanitation facilities, and users of low polluting fuels as their main source of cooking. However, maternal age, maternal education and gender of the child had no significant association with child mortality (Muntago, J, 2004).

Mturi and Cartis (1995) made use of Demographic and Health Survey data for Tanzania to study the determinants of infant and child survival in Tanzania. By using the hazard model, they found that short birth interval was associated with a higher risk of death at infancy. Kombo and Ginneken (2009) using the results of 2005-06 Zimbabwean DHS investigated the maternal, socioeconomic and sanitation factors on infant and child mortality by using Cox regression model. They found evidence of birth order (6+) with short preceding interval significantly associated with high risk of neonatal mortality. Multiple births tended to increase neonatal mortality. On the other hand, the expected U-shape relationship between birth order and infant and child mortality, and mothers age and infant and child mortality did not conform to their analysis, that children who were first born and those born to mothers aged 40-49 years were found to decrease infant neonatal mortality. The results suggested that the influence of birth order, preceding birth intervals, maternal age, and type of birth and sanitation factors have a pronounced effect on neonatal mortality.

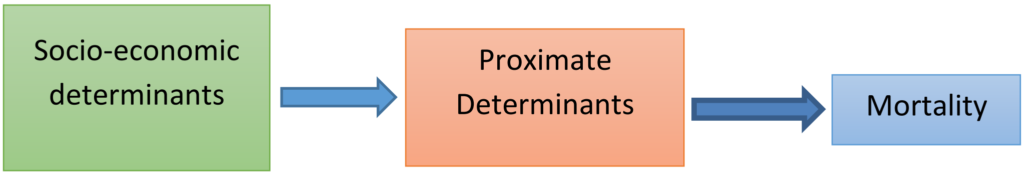
Nsemukila (1996) in his study of the factors influencing Child Survival in Zambia established several bio-demographic factors to have been influencing neonatal mortality. In his study, it was established that higher mortality risk was associated with small birth weights. Neonates with small birth weights had higher chances of dying than those with normal weights. Findings revealed that small births were five times more likely to die during neonatal period compared to average sized births. The findings also 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 and 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 (Nsemukila, 1996). Further analysis revealed that longer birth intervals were associated with a lower risk of mortality. He also found a stronger relationship between the age of a mother at birth and the neonate’s risk of dying. Analysis revealed that births to younger mothers were at higher risk of dying than those from older mothers.

The birth order of a neonate is one of the major bio-demographic factors that have been established to have an influence on neonatal mortality. Nsemukila further established a strong link between birth order and the risk of dying. The births in the first order had a higher risk of dying than those in higher orders. In his analysis, he further established that male births were more likely to die than female births in the first few weeks after birth.

3.2: MOSLEY AND CHEN CHILD SURVIVAL FRAMEWORK

Researchers have used a number of different frameworks to analyse the impact of different factors on child survival. Among these researchers Mosley and Chen (1984) and Schultz (1984) classified the determinants of infant and child mortality as exogenous (socioeconomic or extrinsic) such as cultural, socioeconomic, community and regional determinants and endogenous (bio-medical or intrinsic) such as maternal, environmental, nutrition, injuries and personal illness. Socio-economic factors affect infant and child mortality indirectly; they operate through the proximate factors while proximate determinants affect infant and child mortality directly (Mosey and Chen, 1984; Schultz, 1984). Below is figure 3.1, a summarized conceptual framework which shows how socio-economic factors operate through proximate determinants to influence mortality.

Figure 3.1: Summary of Mosley and Chen Framework



Source: Mosley and Chen, 1984.

This study is based on this framework of child mortality for developing countries proposed by Mosley and Chen (1984) for the analysis of the impact bio-demographic factors on neonatal mortality. Mosley and Chen (1984) categorized a set of proximate determinants into five general groups that directly affect infant and child mortality. The five grouped proximate determinants that directly affect infant and child mortality are: (i) Maternal factors: age, parity and birth intervals: - these factors have an impact on infant and child mortality through affecting maternal health, (ii) Environmental contaminations: hygiene factors, water and sanitation: each factor spread or transmits infectious disease to mothers or children, (iii) Nutrient deficiency (calories, protein and micro nutrient deficiency): the deficiency of nutrients decreases the probability of child survival, (iv) Injury: this is related to physical, burn and poisoning injury. Injuries have an impact on the infant and child mortality and more pronounced in the infanticide period and (v) Personal illness control (Immunization, bed net, malaria prophylaxis etc.): this includes both traditional and modern preventative measures to avoid disease during pregnancy and child births and the quality of preventative measure are important. Personal illness control factors have an influence on pregnancy outcome and child survival through its effect on both mothers and children (Mosley and Chen, 1984 P 25-42).

This research only concentrates on bio-demographic factors which include age of mother at birth, sex of the neonate, parity, number of living children of a mother, preceding birth interval, birth order, birth type and birth size. It is also worth noting that on a broader sense, Mosley and Chen framework is regarded as a Child Survival framework, but also encompasses infants within which the neonates are a subset, hence making it appropriate for this study.

There are notable limitations with the Mosley and Chen child survival framework. Firstly, modelling proximate determinants on background variables (e.g socio-economic variables) provides important insights on how to improve health systems which would enhance child survival. However, this does not provide a direct indication of the potential health gain. Some proximate determinants, particularly environmental contamination, are difficult to measure satisfactorily and therefore might not be easy to directly measure the proximate determinant through which environmental contamination might influence child mortality. The other challenge is that the death of a child is far more complex because it is a result of cumulative series of biological factors rather than a single event. Thus this framework might not be very helpful in quantifying the individual component contribution to mortality like the Bongarts (1978) model of fertility (Mosley and Chen, 1984).

In addition, although the model identifies individual factors (such as knowledge/beliefs, attitudes/values, and economic resources) and community factors (such as ecological setting, facilities and political/economic structure) as the major socio-economic determinants, recent studies are less clear in explaining how individual factors, particularly knowledge/beliefs and attitudes/values influence child health and mortality through child care. For instance, how does maternal education fully explain its influence on child survival in a predominantly rural community where other members of the extended family (kinship) are equally responsible for child care and general kinship welfare and survival? It should be acknowledged that the social behaviour which is basically made up of cultural beliefs and attitudes, as seen in individual factors are difficult to measure, especially from conventional retrospective surveys such as World Fertility Survey (WFS) and Demographic Health Survey, DHS (Nsemukila, 1996: 13). Another major inadequacy within the Mosley-Chen framework is that the design tends to avoid detailed breakdown of factors such as kinship, ethnicity, religion and region and hence resort to generalizations that make little sense at national and program intervention levels. This limits detailed exploration of cultural linkages to issues such as practices involving hygiene, reproduction, breastfeeding and nutrition; practices that might partially explain certain relationships between issues such as maternal education and child survival. In addition, the Mosley and Chen framework has not explicitly introduced individual and collective behaviours within the model. Certain behaviours/lifestyles such as crowding and those relating to breastfeeding, weaning and supplementation are taken as socio-economic determinants and hence as independent variables instead of intermediate behavioural variables influenced by cultural factors such as ethnicity/kinship, religion and family size (Nsemukila, 1996: 15). Despite these shortcomings, this framework still remains appropriate for this study because it has been widely used in most child survival studies.

3.3: PROBLEM ANALYSIS

There are several bio-demographic factors that are likely to have influenced neo-natal mortality in Zambia from 1992 to 2007. These are outlined below:

(i) Age of mother at birth: age of a mother at birth plays a crucial role in influencing child mortality. Many studies have established a strong link between the age of mother at birth and neonatal mortality. Neonates from younger mothers (e.g 15-19 years) and older mothers (45-49 years) are said to have a higher chance of dying. It is for this reason that age of mother at birth may have played a crucial role in determining mortality levels from 1992 to 2007.

(ii) Sex of a neonate: several studies have established differences in levels of mortality among male and female neonates. Mortality among male neonates has been seen in most studies to be higher than that of female neonates. This relationship between sex of a neonate and mortality levels is likely to be the case with the Zambian situation during the period under study.

(iii) Parity of mother: one other likely factor that could have influenced neonatal mortality is parity. This is defined as the average number of live births a woman has ever had. Parity of a mother is also likely to influence mortality.

(iv) Number of living children of a mother: these include the number of surviving children from the total number of children ever born alive.

(v) Birth order of neonate: birth order of a neonate has also been found to have an influence on mortality of the neonate. Several studies have established a strong link between birth order of a neonate and its mortality. Neonates with a low birth order (e.g first born) are said to have a higher chance of dying than those with higher birth orders.

(vi) Birth interval: the interval between births is also very critical in determining mortality among neonates. Longer birth intervals have been found in most cases to be enhancing neonatal survivorship than shorter birth intervals.

(vii) Size of neonate at birth: the size of a neonate at birth is also one critical determinant of neonatal mortality. Neonates who have low weight at birth are said to have higher chances than those with higher weight. There is an established strong link between the weight of a neonate and neonatal mortality.

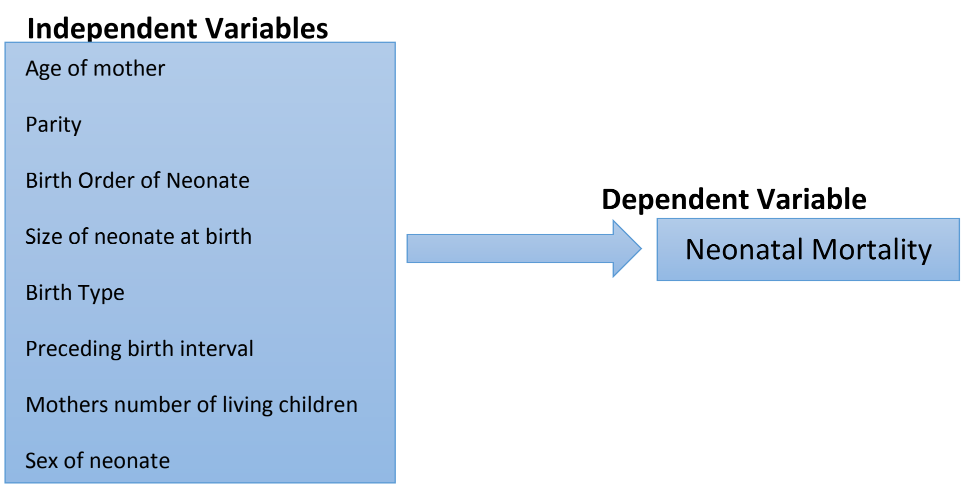
(viii) Birth type: birth type is also critical in the analysis of neonatal mortality. Several studies have revealed that multiple births have a higher likelihood of dying than single births.

Therefore, the above highlighted factors are being investigated in this study to assess their influence on neonatal mortality from 1992 to 2007 within the context of the Mosley-Chen Framework for child survival.

3.4: IDENTIFICATION OF VARIABLES

There are two different types of variables that are identified in this study. These include the dependent and independent variables. Below is a diagrammatical representation of the dependent and independent variables:

Figure 3.2: Independent and Dependent Variables



CHAPTER FOUR: DATA SOURCES, COLLECTION, PROCESSING AND ANALYSIS

4.0: DATA SOURCES

The study uses data from the Zambia Demographic and Health Surveys (DHS) of 1992, 1996, 2001-2002 and 2007. All these surveys apart from the 1992 DHS were conducted by the Central Statistical Office of Zambia. DHS 1992 was conducted by the University of Zambia. The data sets consisted of national representative samples. The Demographic and Health Surveys were designed to provide up-to-date information on the background characteristics of the respondents fertility levels, nuptiality, sexual activity, fertility preferences, awareness and use of family planning methods; breastfeeding practices; nutritional status of mothers and young children; early childhood mortality and maternal mortality; maternal and child health; and awareness, behaviour and prevalence regarding HIV/AIDS and other sexually transmitted infections. The target groups were men aged 15-59 years and women aged 15-49 years in randomly selected households across Zambia. Information about children aged 0-5 years was also collected, including weight and height. The 2001-2 and 2007 surveys collected blood samples for syphilis and HIV testing in order to determine national prevalence rates.

4.1: DATA COLLECTION

The data sets which have been used in the analysis were national representative samples. The 1992 Demographic Health Survey's data was collected from 18th January to 15th May, 1992 by the University of Zambia (UNZA) in conjunction with the Central Statistical Office (CSO) and the Ministry of Health. The sample was selected from 4240 Census Supervisory Areas (CSA's) which were stratified into urban and rural and a total number of 6709 households was selected (ZDHS, 1992: 131). The survey made use of two types of questionnaires; the household questionnaire and an individual questionnaire. A household questionnaire recorded information on the usual household members, visitors, age, sex, household composition and education levels. The individual questionnaire was used to record information from eligible women (15-49) who either slept in the household the preceding night or who were usual residents of the households. The information collected in this questionnaire also include background characteristics, reproductive histories, knowledge and use of family planning, antenatal and delivery care, breastfeeding and weaning practices, vaccination and under five health and marriages and nuptiality (ZDHS, 1992: 8-9).

The 1996 Zambia Demographic and Health Survey was also a national wide sample survey of men and women of reproductive age from both the urban and rural Zambia. It was designed to provide information on background characteristics of the respondent's reproduction, contraceptive knowledge and use and nutrition of children. Also collected was information on marriage, fertility, AIDS and other Sexually Transmitted Diseases and maternal, child and infant mortality. The main objective of the 1996 DHS was to provide the country with data useful for policy formulation and monitoring, implementation and evaluation of some major government programs and a sample of 8016 households was selected. The survey was conducted by the Central Statistical Office on behalf of the Ministry of Health with financial support from USAID, UNFPA and other organizations. Data was collected from July, 1996 to January, 1997 (ZDHS, 1997).

The 2001-2002 Zambia Demographic and Health Survey (ZDHS) was carried out by the Central Statistical Office and the Central Board of Health. It is a nationally representative sample of 7,658 women aged 15-49 years and 2,145 men aged 15-59 years. The principal objective of the survey was to provide data to policymakers and planners on the population and health situation in Zambia. Most of the information collected in the 2001-2002 ZDHS represents updated estimates of basic demographic and health indicators covered in the 1992 ZDHS and 1996 ZDHS surveys. Specifically, the 2001-2002 ZDHS collected detailed information on fertility and family planning, child mortality and maternal mortality, maternal and child health and nutritional status, and knowledge, awareness and behaviour regarding HIV/AIDS and other sexually transmitted infections. New features of the 2001-2002 ZDHS include the collection of information on violence against women and testing of individuals for HIV and syphilis (ZDHS, 2003).

The 2007 Zambia Demographic and Health Survey (ZDHS) was also a national sample survey which was designed to provide up-to-date information on background characteristics of the respondents fertility levels, nuptiality, sexual activity, fertility preferences, awareness and use of family planning methods; breastfeeding practices; nutritional status of mothers and young children; early childhood mortality and maternal mortality; maternal and child health;

and awareness, behaviour, and prevalence regarding HIV/AIDS and other sexually transmitted infections. The target groups were men aged 15-59 years and women aged 15-49 years in randomly selected households across Zambia. Information about children aged 0-5 years was also collected, including weight and height. The survey collected blood samples for syphilis and HIV testing in order to determine national prevalence rates. The sample included 7,146 women aged 15-49 and 6,500 men aged 15-59 from urban and rural areas. The 2007 ZDHS was a follow-up to the 1992, 1996, and 2001-2002 ZDHS surveys and provides updated estimates of basic demographic and health indicators covered in the earlier surveys. The 2007 ZDHS was the second DHS that included the collection of information on violence against women, and syphilis and HIV testing. In addition, data on malaria prevention and treatment were collected. The ZDHS was implemented by the Central Statistical Office (CSO) in partnership with the Ministry of Health, the Tropical Diseases Research Centre (TDRC), and the Demography Division at the University of Zambia (UNZA) from April to October 2007.

4.2: DATA QUALITY

Owing to the fact that there is no survey that is free of error, the DHS data may have some shortcomings. These shortcomings may affect interpretation of results and significantly influence the mortality estimates and levels. Retrospective surveys may have sampling errors, under-coverage errors (omission of births) and misreporting of births. It is also possible to omit eligible respondents (15-49) because some eligible women are missing at home or they just refuse to be interviewed. In terms of age, there can be misreporting of age of eligible women. This could be due to age heaping as a result of digit preferences especially digits 0, 2 and 5. In other instances, the respondents may not know the exact ages of these women, or even the women themselves may not know their exact ages. In other cases, there is a distortion of the age distribution of women by the interviewers themselves. This can be distortions with regards to eligibility. Some interviewers try to reduce work load by not interviewing these women and sometimes some women are pushed into the 50-54 age group in order to make them not eligible. In line with these shortcomings, it is always important to ensure that the data being used is of good quality such that the characteristics represent that of the population in order to make inferences. One way of doing this is through the use of external consistency checks. In this case, the DHS data was checked with regards to the distributions of the women in the reproductive age groups. The table below displays the results:

TABLE 4.1: PERCENT DISTRIBUTION OF WOMEN AGED 15 TO 49 YEARS

Age	Census (1990)	DHS (1992)	DHS (1996)	Census (2000)	DHS (2001-2)	DHS (2007)	Census (2010)
15-19	12.9	12.3	11.0	11.7	10.5	9.2	11.7
20-24	10.2	8.9	10.1	10.4	9.6	8.3	10.4
25-29	7.6	7.2	7.1	7.9	7.9	8.0	7.9
30-34	5.9	5.6	6.0	5.8	5.6	6.2	5.8
35-39	4.0	4.0	4.2	4.6	4.4	4.4	4.6
40-44	3.7	3.1	3.1	3.5	3.5	3.3	3.4
45-49	2.9	2.4	2.7	2.6	2.6	2.7	2.6

Source: Estimates from the Census and ZDHS Reports.

A close observation on the calculated age specific distribution of women reveals that the data from the surveys was consistent with that from censuses. This gave a higher level of confidence to use the DHS data because it gave an impression that the samples used in DHS's were representative of the actual Zambian population of women in the age group 15-49 years. However, there was a slight notable inconsistency in the data for the 2007 DHS specifically for the age group of 15-24 years. The difference between the actual census figure for 2010 and that of the DHS (2007) was too high especially for this age category, meaning there might have been some shifting in the younger age categories. This could also be an indication of underreporting for the ages 15-24 years from the 2007 ZDHS when compared to other sources, both census and previous ZDHS surveys. On an overall basis, the DHS data for all the years still gave a great level of confidence and validity to permit some analysis.

4.3: DATA PROCESSING AND ANALYSIS

Data processing involved separating the data on bio-demographic variables (as suggested in problem analysis) from the actual data sets to other sheets with the use of Predictive Analysis Software (PASW) version 18. Data on neonatal mortality was also separated from the data sets to a new data set and analysis within PASW was used. Binary logistic regression using the stepwise approach was also used in calculating the risk of neonatal mortality according to bio-demographic variables.

4.3.1: MODEL

For neonatal mortality, that is the child died before celebrating one month of life, the dependent variable is a binary, for which the response outcome is ''dead or alive''. The binary logistic regression was used to estimate the odds of a child dying before reaching one month of age. In this study, the dependent variable was explained by the odds ratios of the explanatory variables. The logistic regression is similar to the ordinal least square regression; however, it violates the linearity and normality assumption of the ordinary least square regression. The dependent variable noted 1 if the child died before reaching one month of age and 0 if otherwise. The general form of a logistic regression equation is as follows:

$$\text{Logit}(P) = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_pX_p$$

P: - denote the probability of the risk of neonatal mortality.

Where P is a dichotomous dependent variable with values 0 (did not die before one month of age) or 1 (died before one month of age)

$b_0 \ldots b_P$: - is the coefficient of the independent variables.

$X_1 \ldots X_p$: - denote the independent variables (biodemographic determinants of neonatal mortality).

4.4: LIMITATION OF THE DATA

Neonatal mortality data is subject to some challenges. With the fact that mortality estimates are based on retrospective birth history data that highly depends on the mother's ability to recall all live births she had, as well as birth dates and age at death, it is possible to have selective omissions from birth history data can occur. For the longer recall periods, the possibility of misreporting important information like neonatal mortality by the respondents (mothers) could be even higher. In order to minimize the likelihood of the challenge of recall of birth history information, this survey limited its analysis to births that occurred five years prior to the surveys. This is because the likelihood of recall of birth history data among mothers is higher when the period of recall is shorter and in this case, five years preceding the survey is considered here a shorter period.

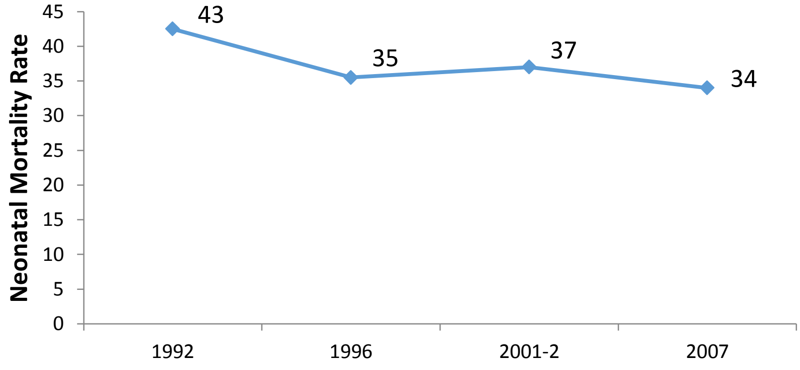
CHAPTER FIVE: PRESENTATION OF FINDINGS

5.0: INTRODUCTION

In the first section, univariate analysis (analysing neonatal mortality on each independent variable at a time) was used to describe every single bio-demographic variable in relation to neonatal mortality. This includes the use of number, percentages and rates to describe neonatal mortality with regards to all the variables. Following the univariate analysis, multivariate analysis was applied, specifically the use of Logistic Regression to determine the relationships between the dichotomous dependent variable (neonatal mortality) and the independent variables which are in this case the bio-demographic variables. In this case, the stepwise forward binary logistic regression was used to come up with the final model. Finally, a detailed discussion of the findings is done linking the theoretical framework to the findings of the study.

Neonatal mortality has been decreasing during the period 1992 to 2007. There was a 20 per cent reduction from the initial 42.5 deaths per thousand live births in 1992 to 34 deaths per thousand live births in 2007. The figure 5.1 below shows a trend reduction of neonatal mortality from 1992 to 2007.

Figure 5.1: Neonatal Mortality Rate (1992-2007)



Source: ZDHS Report, 2007: 121

5.1: BIO-DEMOGRAPHIC VARIABLES

The main bio-demographic variables that are considered in the analysis include age of mother, birth order of the neonate, type of birth, sex of a neonate, parity, mothers number of living children, size of a neonate at birth and the preceding birth interval.

TABLE 5.1: DISTRIBUTION OF BIRTHS BY BIODEMOGRAPHIC FACTORS FIVE YEARS PRECEDING THE SURVEYS

Year »	1992	1996	2001-2	2007	1992-2007	% Change	
Bio-demographic variable ˅	**%**	**%**	**%**	**%**	**Average %**	**Dec.**	**Inc.**
Age of Mother							
15-19	10	8	8	6	8	4	…
20-24	28	31	29	26	28	2	…
25-29	25	24	26	29	26	…	4
30-34	18	19	17	20	18	0	2
35-39	11	11	12	12	12	…	1
40-44	6	5	6	5	6	1	…
45-49	2	2	2	2	2	0	0
Birth Order							
Lower (1-3)	53	55	56	55	55	…	2
Middle (4-6)	28	28	29	31	29	…	3
Higher (7+)	19	16	15	14	16	5	…
Type Of Birth							
Single	96	96	97	96	96	0	0
Multiple	4	4	3	4	4	0	0
Sex of a Child							
Male	50	49	50	50	50	0	0
Female	50	51	50	50	50	0	0
Parity							
1-3	47	49	50	48	49	…	1
4-6	30	32	32	35	32	…	5
7+	23	19	18	17	19	6	…
Number of living Children							
Small (1-3)	55	59	59	56	57	…	1
Medium (4-6)	30	30	31	34	31	…	4
Large (7+)	15	11	10	10	11	5	…
Size of Child at birth							
Large	20	30	24	33	27	…	13
Average	68	56	62	56	61	12	…
Small	12	14	14	11	13	1	…
Preceding Birth Interval							
< 24 months	19	19	16	15	17	4	…
24-35 months	45	45	43	39	43	6	…
>35 months	36	37	41	46	40	…	10

Source: Estimates from the ZDHS datasets

The distribution of births by bio-demographic characteristics for the period 1992 to 2007 is in table 5.1 above. The percentage of births from women aged 15-19 years reduced from 10 per cent in 1992 to 6 per cent in 2007. On average, the births from women aged 15-19 years were about 8 per cent during the period 1992-2007. In addition, births from women in age group 15-19 years experienced the highest reduction by 4 per cent with the highest percentage of births in this age group in 1992 (10 per cent) and the lowest in 2007 (6 per cent). The births from women aged 20-24 years only reduced by 2 per cent from 28 per cent in 1992 to 26 in 2007. However, this age group had on average the highest percentage of births at 28 per cent during the period 1992-2007. In this age group, the highest percentage of births was in 1996 (31 per cent) compared to the lowest in 2007 at 26 per cent. Births from women aged 25-29 years recorded the second highest average of 26 per cent during the period 1992-2007. However, the percentage of births from these women had increased by 4 per cent from 25 per cent in 1992 to 29 per cent in 2007. Births among women aged 30-34 years and 35-39 years also recorded a percentage increase by 2 per cent and 1 per cent respectively from 1992 to 2007. Those from women aged 40-44 years were averaging at 6 per cent with a decrease of 1 per cent while births from women aged 45-49 years were on average 2 per cent of the total births and without percentage change. Below is a graph showing the distribution of births according to the age of women during the period 1992 to 2007. Figure 5.1 clearly shows that most births were from women aged 20-24 years while the lowest percentages of births were from women aged 45-45 years.

Birth order is one of the major bio-demographic factors included in the analysis. The highest overall proportion of births during the period 1992-2007 were of the lower birth order (1-3) at 55 per cent followed by births of the middle order (4-6) at an average of 29 per cent while the lowest was those births of the higher order (7+) averaging at 16 per cent. The proportion of births of order 1-3 and 4-6 increased by 2 per cent and 3 per cent respectively while that of births of the Large order (7+) declined by 5 per cent from 19 per cent in 1992 to 14 per cent in 2007. Single births were on average at 96 per cent while multiple births were on average at 4 per cent. The percentages of male and female births were equal during all the years though there was a slight difference in the numbers in 1996 (49 for males against 51 for females). In addition, there were on average more births from women with 1-3 parity at 49 per cent as compared to births from women with 4-6 and 7+ parity with averages of 32 per cent and 19 per cent respectively. The proportion of births among women with 4-6 parity had the highest increase of 5 per cent when compared to those among women with 1-3 parity with only 1 per cent increase. However, births among women with 7+ parity declined by 6 per cent over the 1992-2007 period.

Births in relation to the number of living children of a mother equally revealed that on average most of them were from women with a small number of living children with 57 per cent of the total births. This was followed by births from women with a medium (4-6) number of living children at an average of 31 per cent while the lowest percentage was from women with 7+ living children at 11 per cent. In addition, births that were categorised as large in size increased by 13 per cent from 20 per cent in 1992 to 33 per cent in 2007 while those that were average and small decreased by 12 per cent and 1 per cent respectively. Births with a preceding birth interval of more than 35 months recorded an increase of 10 per cent while those with 24-35 month and less than 24 months recorded a decrease by 6 per cent and 4 per cent from 1992 to 2007. The largest proportion of births had however an average preceding birth interval of 24 to 35 months.

TABLE 5.2: DISTRIBUTION OF RATES OF NEONATAL DEATHS FIVE YEARS PRECEDING THE SURVEYS

Year »	1992	1996	2001-2	2007	1992-2007	% Change	
Bio-demographic variable ˅	NNMR	NNMR	NNMR	NNMR	Average	Dec.	Inc.
Age of Mother							
15-19	54	62	47	48	53	11	…
20-24	53	39	39	34	41	36	…
25-29	39	33	33	28	33	28	…
30-34	36	19	35	26	29	28	…
35-39	26	35	26	39	32	…	50
40-44	43	39	46	34	41	21	…
45-49	52	34	24	37	39	29	…
Birth Order							
Lower (1-3)	48	39	38	32	39	33	…
Middle (4-6)	34	31	36	34	34	0	0
Higher (7+)	43	30	30	30	33	30	…
Type Of Birth							
Single	36	29	31	27	31	25	…
Multiple	205	189	183	142	180	31	…
Sex of a Child							
Male	51	43	38	34	40	33	…
Female	35	28	34	31	32	11	…
Parity							
1-3	45	35	36	29	36	35	…
4-6	40	35	35	35	36	14	…
7+	43	35	37	34	37	21	…
Number of living Children							
Small (1-3)	44	33	35	34	37	23	…
Medium (4-6)	21	26	22	17	22	19	…
Large (7+)	30	15	20	20	21	33	…
Size of Child at birth							
Large	23	27	23	29	26	…	26
Average	29	29	30	23	28	21	…
Small	147	72	80	75	94	49	…
Preceding Birth Interval							
< 24 months	74	46	67	50	59	32	…
24-35 months	36	30	24	23	28	36	…
>35 months	24	25	26	27	26	…	13

Source: Estimates from the ZDHS datasets

Age of the mother is one important factor that influences neonatal mortality. There were very distinct distributions of neonatal mortality rates among births from women of different age groups. Generally, neonatal mortality rates were higher among births from women aged 15-19 years with an average of 53 deaths per 1000 live births, followed by neonatal mortality among births from women aged 20-24 years and 40-44 years. Neonatal mortality was at 39 deaths per 1000 live births among women aged 45-49 yeas; 33 deaths per 1000 live births among women aged 25-29 years, 32 deaths per 1000 live births among women aged 35-39 years while the lowest neonatal mortality was 29 deaths per 1000 live births from women aged 30-34 years. Neonatal mortality recorded a general decline from 1992 to

2007 with neonatal mortality rate among births from women aged 20-24 years recording the highest decline of 36 per cent from 53 neonatal deaths per 1000 live births in 1992 to 34 neonatal deaths per 1000 live births in 2007. Neonatal mortality among births from women aged 45-49 years recorded a decline of 29 per cent, 25-29 years and 30-34 years recorded a decline in neonatal deaths by 28 per cent while neonatal mortality among births from women aged 40-44 years reduced by 21 per cent from 1992 to 2007. Neonatal mortality rate among women aged 15-19 remained the highest with the lowest reduction by 11 per cent from 54 deaths per 1000 live births in 1992 to 48 neonatal deaths per 1000 live births in 2007. Neonatal mortality among births from women aged 35-39 years recorded an increase of 50 per cent from 26 neonatal deaths per 1000 live births in 1992 to 39 neonatal deaths per 1000 live births. This could be because of the highest prevalence of HIV/AIDS among the females aged 30's. The HIV prevalence was at 26 per cent 24 per cent for the ages 30-34 and 35-39 respectively (ZDHS 2007: 228)

This general decline in the rate of neonatal mortality among several age groups of women could be attributed to the general improvements in the health status of women in Zambia over the period of study which indirectly enhanced the survivorship of neonates. One way of supporting this is to use of a standard measure of the general nutrition status which is commonly known as the Body Mass Index (BMI). The Demographic and Health Survey reports (ZDHS 2001-2, 2007) show that there had been a general decline in the proportion of the underweight women in the reproductive age group from 15% in 2001-2 to 10% in 2007 while the proportion of the overweight women in the reproductive age group increased from as low as 12% in 2002 to 19% in 2007. A general improvement in the nutrition of women suggests an improvement in the survivorship of neonates in any society because nutrition of a mother is one key factor which could affect the growth of the foetus and the quality of breast milk for the neonate. It can be argued, therefore, that the general improvement in the health status of women as measured by the Body Mass Index (BMI) could explain the general reduction of neonatal mortality rates over the period of study. Another reason which could be attributed to the reduced neonatal mortality could be the increase in the proportion of the pregnant women being attended to by skilled health personnel from 90% in 1992 to over 94% in 2007. Figure 5.2 shows the distribution of neonatal mortality rates according to age of the mother for the years from 1992 to 2007.

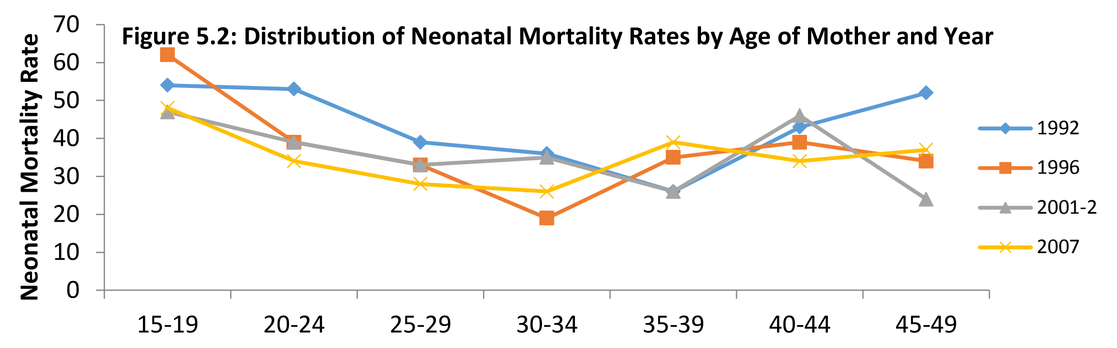


Figure 5.2: Distribution of Neonatal Mortality Rates by Age of Mother and Year

Source: Estimates from the ZDHS (1992-2007) data

Neonatal mortality with age of the mother generally exhibited a U-shape with a higher general rate among births from women aged 15-19 years which dropped with age until it reached the lowest among births from aged 30-34 years and later started to increase. This neonatal mortality pattern with age of a mother is described by the graph in Figure 5.3 which clearly shows that high neonatal mortality was associated with births from young and old mothers.

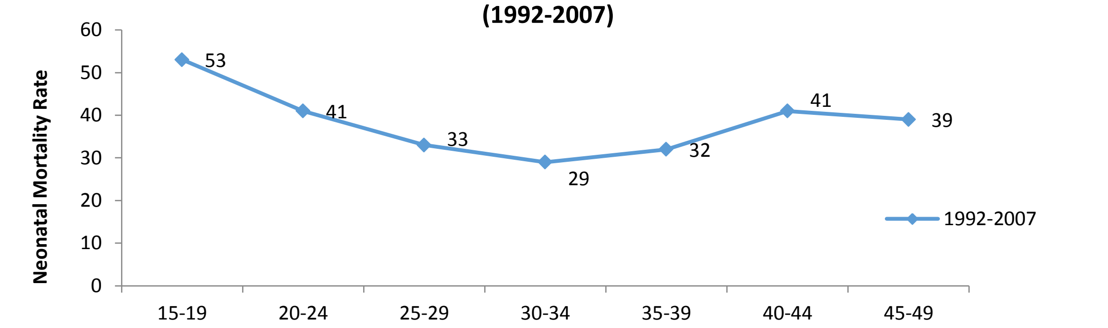


Figure 5.3: Overall Distribution of Neonatal Mortality Rates by Age of Mother (1992-2007)

Source: Estimates from the ZDHS (1992-2007) data

Neonatal mortality rates were generally higher among births of the lower birth order. These include first, second and third born neonates. On average, neonatal mortality among births of the lower birth order was about 39 neonatal deaths per 1000 live births, middle birth order with 34 neonatal deaths per 1000 live births while the lowest was among births with a higher birth order which was at 33 neonatal deaths per 1000 live births over the period 1992 to 2007. The results reveal that higher neonatal mortality was associated with lower births of small order (1-3).

Neonatal mortality rates recorded the highest decline among small birth order births with a 33 per cent decline from 48 deaths per 1000 live births in 1992 to 32 deaths per 1000 live births in 2007. This could be attributed to an increase in age at first birth from around 18 years in 1992 to 19 years in 2007 (ZDHS 1992, 2007), meaning that a larger proportion of women are having their first births when they are more mature physiologically hence the increased probability of survival of the neonates. In addition, it can be argued that the reduction in neonatal mortality could be attributed to improvements in the health care delivery systems in Zambia which saw an increase in the proportion of women receiving safe delivery and adequate postnatal care. Mortality of higher birth order also reduced by 30 per cent from 43 neonatal deaths per 1000 live births in 1992 to 30 neonatal deaths per 1000 live births in 2007. However, the figure did not record a general decline among births of the middle order over the period 1992 to 2007.

Neonatal mortality was generally about six times higher among multiple births than single births. It, however, had the highest reduction among multiple births with 31 per cent reduction from 205 neonatal deaths per 1000 births of birth multiple types in 1992 to 142 neonatal deaths per 1000 live births of multiple birth types in 2007. This again can suggest general improvements in the delivery of health care services which enhanced survivorship of multiple births in Zambia. Neonatal deaths among single births reduced by 25 per cent from 36 deaths per 1000 live births in 1992 to 27 deaths per 1000 live births in 2007. Neonatal mortality was higher among male than female births averaging at 40 for males and 32 for females. It is evident that the highest reduction is among male births by 33 per cent from 51 in 1992 to 34 in 2007 as compared to 11 per cent reduction among female births from 35 in 1992 to 31 in 2007, which implies that there had been efforts to reduce mortality among male neonates who were for a long time more likely to die than the females.

There were differences in observed neonatal mortality rates among births from women with different parities. Results reveal that on average, neonatal mortality was higher among births from women with 7+ parity. The highest reduction in neonatal mortality was recorded among births from women with 1-3 parity at 35 per cent over the period 1992-2007 compared to neonatal mortality among women with 7+ and 4-6 parity with 21 per cent and 14 per cent respectively.

Higher neonatal mortality rate was associated with births that were small in size at birth averaging at 94 neonatal deaths per 1000 live births over the period 1992-2007. This was followed by those of average size at birth at 28 neonatal deaths per 1000 live births and the lowest for births that were large in size at birth with an average of 26 deaths per 1000 live births. Those which were small and average in size at birth recorded a decline in neonatal mortality by 49 per cent and 21 per cent respectively while those that were large increased by 26 per cent. High neonatal mortality rates were also associated with less than 24 months preceding birth interval. On average, neonatal mortality among births with less than 24 months preceding birth interval was 59 deaths per 1000 live births compared to that from among births with 24-35 months preceding birth interval and over 35 months preceding interval both having an average of 28 and 26 deaths per 1000 live births, respectively. This clearly shows that longer birth spacing reduced the chances of neonatal mortality. In addition, the highest reduction in neonatal mortality was observed among births with 24-35 months preceding interval with 36 per cent reduction while those with less than 24 months preceding interval reduced by 32 per cent over the period of study. However, neonatal mortality among births with more than 35 months preceding interval increased by 13 per cent from 24 deaths per 1000 live births in 1992 to 27 deaths per 1000 live births in 2007. The general reduction in neonatal mortality with regard to the preceding birth interval could be attributed to the general increase in the use of family planning methods which resulted in an increase in the number of births with longer preceding intervals hence increasing the likelihood of the neonates to survive. This is confirmed by the increase in contraception use among women (15-49) from 15% in 1992 to 41% in 2007 (ZDHS, 2007: 74).

5.2: UNIVARIATE LOGISTIC REGRESSION ANALYSIS

This section uses univariate logistic regression in order to examine the influence of each of the predictors on neonatal mortality. In this model, the neonatal mortality was regressed with each independent variable at a time in order to examine the influence of the specific independent variable on the outcome of neonatal mortality.

Table A.1 shows the contribution of each of the independent variables to neonatal mortality in 1992. In 1992, the main bio-demographic factors that significantly influenced neonatal mortality included birth type, sex of a child, number of living children, size of child at birth and preceding birth interval. Age of mother, birth order and number of children ever born did not significantly influence neonatal mortality. However, neonatal mortality among specific age groups of women was different. Neonates from mothers aged 15-19 years were about 5 per cent more likely to die than to those born from mothers aged 45-49 years. This reduced with an increase in age of a mother with the lowest mortality being from neonates among mothers aged 35-39 years who were about 49 per cent less likely to die than neonates born from mothers aged 45-49 years. This clearly shows that neonates born from young mothers were associated with a higher risk of mortality. In terms of birth order, neonates of order 1-3 were about 10 per cent more likely to die as compared to those of order 7+. In addition, those of order 4-6 were about 78 per cent less likely to die than the neonates of order 7+. In terms of birth type, the contribution of multiple births to neonatal mortality was highly significant ($p < 0.01$). As compared to single births, multiple births were almost seven times more likely to die while at 95 per cent level of significance, male neonates were 50 per cent more likely to die than the female neonates. The contribution of the male neonates was also significant at 0.05. A small (1-3) parity of a mother was associated with a higher risk of neonatal mortality than the other categories.

Results of the number of living children indicates that neonates born from women with 1-3 number of living children were about 1.5 times more likely to die than those born from women with 7+ living children. The data clearly shows that neonates born from women with a small number of living children were associated with a higher risk of mortality and this reduced with an increase in the number of children of a mother. In terms of size at birth, the neonates who were small at birth significantly ($p < 0.01$) contributed to neonatal mortality and were about seven times more likely to die than neonates who were large in size at birth. However, the influence of the size at birth on neonatal mortality reduced with an increase in size. Preceding birth interval is an important factor in determining neonatal mortality. In 1992, the neonates with less than 24 months preceding birth interval were three times more likely to die than those with more than 35 months preceding interval and its influence was highly significant at 0.01. The results clearly show that the influence of preceding birth interval on neonatal mortality reduced with an increase on the preceding birth interval.

Table A.2 shows the results of regression of the bio-demographic determinants of neonatal mortality in 1996. The results reveal significant contributions of the of the type of birth, sex of the child, number of living children of mother, size of the child at birth and preceding birth interval to neonatal mortality. Age of mother, birth order and children ever born did not significantly influence neonatal mortality. Despite the age of a mother not significantly influencing neonatal mortality in 1996, analysis shows that the neonates born from women aged 15-19 years had the highest risk of dying. These were 86 per cent at higher risk of dying than the neonates born from women aged 45-49 years. The neonates with the lowest risk of dying were those born from women 30-34 years who were 54 per cent at lower risk of dying than those born from women aged 45-49 years. The general pattern shows a reduced risk of neonatal mortality with an increase in age up to 30-34 years then the risk start increasing. Despite not being significant, there is a clear indication that babies born from very young and older women were associated with a higher risk of dying. In terms of birth order, results reveal that births of order 1-3 were 33 per cent more likely to die than those of order 7+. Though none of the specific birth orders significantly contribute to neonatal mortality, the general pattern is that neonatal mortality reduced with an increase in birth order. In terms of parity, neonates born from mothers with 4-6 and 7+ parity were at lower risk of dying as than those born from women with 1-3 parity.

The type of birth, in particular multiple births in 1996 was significantly ($p < 0.01$) influencing neonatal mortality in 1996. Results further reveal that multiple births were more than seven times more likely to die than single births. In addition, male neonates significantly ($p < 0.01$) contributed to neonatal mortality. Male neonates were about 54 per cent more likely to die than the females. This is a clear indication that male neonates were highly associated with the risk of dying as compared to females. The risk of neonatal mortality also decreased with an increase in the number of living children of a mother. In terms of preceding birth interval, neonates with less than 24 months were significantly associated with neonatal mortality and were about 85 per cent more likely to die than those with 35 months preceding birth interval. The pattern also shows a decreased risk of mortality associated with an increase in the number of months preceding the birth.

The results for 2001-2 are presented in the table A.3. The variables which significantly contributed to neonatal mortality in 2001-2 included size of child at birth, birth type, preceding birth interval and number of living children of a mother. Sex of a child, age of mother, birth order and parity did not significantly influence neonatal mortality. Though none of the age groups of the mother significantly influenced neonatal mortality, data analysis reveals a general decreasing neonatal mortality with an increase in the age of a mother up to age 35-39 years. Births from mothers aged 15-19 years two times more likely to die as neonates than those from mothers aged 45-49 years. In short, neonates from mothers aged 15-19 years were strongly associated with the risk of dying as compared to the other age groups. In addition, none of the specific birth orders significantly contributed to neonatal mortality. However, the results reveal neonates of lower (1-3) birth orders were associated with a higher risk of dying compared to the other orders. In fact, neonates of 1-3 birth order were about 26 per cent more likely to die than those of order 7+. Birth type is also key in determining neonatal mortality. In addition, multiple births were close to seven times more likely to die as neonates than single births in 2001-2. This is a clear indication that multiple births were associated with a higher risk of neonatal death compared to single births.

The influence of sex of a child on neonatal mortality was not significant. However, a higher risk was associated with male neonates who were about 13 per cent more likely to die than females. In terms of parity, neonates born from women with 7+ parity were slightly more likely to die than those born from women with 1-3 and 4-6 parity. The influence of less than 24 months preceding birth interval on neonatal mortality was significant ($p < 0.01$) while the others were not. Neonates with < 24 months preceding interval were more than two times more likely to die than those with more than 35 years preceding interval. This, therefore, clearly shows that neonates with longer preceding birth intervals were less likely to die than those with shorter preceding birth intervals. The contribution of the births which were small in size at birth was highly significant ($p < 0.01$) and was close to four times more likely to die than births which were large. For average sized births, the influence was significant. In general, the bigger the size of child at birth, the less likely that they would die as neonates.

The 2007 results presented in the table A.4 show that the influence of age of a mother on neonatal mortality generally reduced with an increase in age of mother. Birth order influence remained insignificant while multiple births were about six times more likely to die as neonates than single births. In addition, males were associated with a higher risk of neonatal mortality than females though the influence was not significant. Other variables including small birth sizes and less than 24 months preceding birth interval were also highly significant at 0.01.

The table 5.3 shows a summary of the *B* values, odds ratios [*Exp(B)*] and significance levels of the contribution of each of the categorical variables to neonatal mortality from 1992 to 2007. In general, age of a mother did not significantly contribute to neonatal mortality though results have shown a uniform trend of births from young mothers being associated with a higher risk of neonatal mortality.

TABLE 5.3: SUMMARY OF 1992-2007 RESULTS OF UNIVARIATE LOGISTIC REGRESSION

INDEPENDENT VARIABLE V	1992	1996	2001-2	2007
	B [Odds Ratios]	B [Odds Ratios]	B [Odds Ratios]	B [Odds Ratios]
Age of Mother				
15-19	0.048 [1.049]	0.620 [1.860]	0.695 [2.004]	0.263 [1.301]
20-24	0.024 [1.024]	0.133 [1.143]	0.509 [1.664]	-0.086 [0.918]
25-29	-0.284 [0.754]	-0.032 [0.969]	0.323 [1.381]	-0.304 [0.738]
30-34	-0.368 [0.692]	-0.612 [0.542]	0.400 [1.492]	0.393 [0.675]
35-39	-0.717 [0.488]	0.005 [1.005]	0.101 [1.107]	0.035 [1.036]
40-44	-0.199 [0.819]	0.128 [1.136]	0.685 [1.984]	-0.090 [0.914]
45-49 RC	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]
Birth Order				
Lower (1-3)	0.094 [1.099]	0.285 [1.330]	0.238 [1.268]	0.058 [1.059]
Middle (4-6)	-0.247 [0.781]	0.039 [1.040]	0.191 [1.210]	0.133 [1.142]
Higher (7+) RC	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]
Birth Type				
Single RC	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]
Multiple	1.921 [6.826]***	2.051 [7.777]***	1.941 [6.964]***	1.774 [5.893]***
Sex of a Child				
Male	0.410 [1.507]***	0.432 [1.541]***	0.129 [1.138]	0.093 [1.097]
Female RC	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]
Parity				
1-3 RC	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]
4-6	-0.130 [0.878]	-0.019 [0.981]	-0.051 [0.950]	0.191 [1.211]
7+	-0.055 [0.947]	-0.006 [0.994]	0.010 [1.010]	0.163 [1.177]
Number of Living Children				
1-3	0.377 [1.459]*	0.792 [2.207]***	0.552 [1.737]*	0.564 [1.758]*
4-6	-0.365 [0.694]	0.549 [1.732]*	0.097 [1.102]	-0.146 [0.864]
7+ RC	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]
Size of Child at Birth				
Large RC	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]
Average	0.263 [1.300]	0.078 [1.082]	0.310 [1.363]*	-0.214 [0.808]
Small	1.994 [7.345]***	1.022 [2.778]***	1.327 [3.768]***	1.005 [2.732]***
Preceding Birth Interval				
< 24 months	1.176 [3.241]***	0.616 [1.852]***	0.993 [2.699]***	0.616 [1.852]***
24-35 months	0.423 [1.526]**	0.167 [1.182]	-0.061 [0.941]	-0.164 [0.849]
> 35 months RC	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]	0.000 [1.000]

*Significance values: * = p<0.1, ** = p<0.05, *** = p<0.01   RC = Reference Category*

The influence of birth order was also not significant; however neonatal mortality among multiple births was highly significant (p < 0.01) with an average of about 7 times highly likely to die than single births. Other variables which were constantly significant include number of living children of mother (0, 1-3), births which were small in size and those with less than 24 months preceding birth interval. Sex of a child (particularly males) was only significant in 1992 and 1996.

5.3: MULTIVARIATE LOGISTIC REGRESSION ANALYSIS

In the previous section (5.2), the analysis considered the influence and relationship of each independent variables with regard to neonatal mortality by regressing each of the independent variables on neonatal mortality. This section of multivariate logistic regression examines the influence of all the independent variables on neonatal mortality by using the stepwise (forward) method in coming up with the final model. The analysis further makes use of the odds ratios, though in this case with an attempt to identify any possible underlying factors which could explain the contribution of the other independent variables to neonatal mortality.

Analysis of 1992 data shows that 5.8% (Cox and Snell R^2 : 0.058) of the variation in neonatal mortality in the final model *(model 8)* is explained by the model. The Hosmer and Lemeshow goodness of fit test in model 8 of 0.069 *(>0.05)* shows that the model estimates fit the data at an acceptable level, the accuracy at 96.6% and the -2Log Likelihood of 1225.05 indicates a well fitted expanded model. Table A.5 shows the results of multivariate logistic regression in 1992. Analysis clearly shows that the size of child at birth, in particular the smaller ones contributed directly to neonatal mortality. Other variables include the type of birth (multiple), preceding birth interval (< 24 months, 24-35 months), number of living children (1-3), sex of the child (males) while results revealed that the influence of birth order was explained by parity. In addition, the parity was influencing neonatal mortality through other variables within model. In table A.6, results reveal a similar pattern to 1992. It clearly shows that birth type (multiple), birth size (small), preceding interval (< 24 months), number of living children of a mother (1-3, 4-6) and sex of a child (males) directly influenced neonatal mortality.

The 1996 model 8 revealed 97.1% accuracy and a variation of 3.6% *(Cox and Snell R^2 : 0.036)* in neonatal mortality was explained by the model. Hosmer and Lemeshow goodness of fit model of 0.283 *(>0.05)* showed the model estimates are acceptable and a -2 Log Likelihood of 1282.35 gave a good model fit. Model 8 of 2001-2 data had an accuracy of 97.1% and 4.1% *(Cox and Snell R^2 : 0.041)* of the variation in neonatal mortality was explained by the model. The model fitted well with -2 Log Likelihood statistic of 1220.89 and Hosmer and Lemeshow goodness of fit of 0.433 *(>0.05).* The statistics were similar with a 97.3% accuracy, Hosmer and Lemeshow goodness of fit of 0.085 *(>0.05)* and -2 Log Likelihood of 1046.61 while 3.8% *(Cox and Snell R^2: 0.038)* of variation in neonatal mortality was explained by the logistic model.

The 2001-2 results of multivariate analysis are presented in the table A.7. The information shows that the size of child at birth (small, average), type of birth (multiple), preceding birth interval (< 24 months) and number of living children of a mother (1-3) were significant direct bio-demographic determinants of neonatal mortality in Zambia. Sex of a child was no longer an influential factor on neonatal mortality. The influence of age of a mother was explained by birth order while that of birth order was explained by parity. The results of multiple regression for 2007 shown in table A.8 clearly show that size of child at birth (small and average), type of birth (multiple), preceding birth interval (< 24 months) and number of living children of a mother (1-3) remained significant in terms of influencing neonatal mortality. The contribution of birth order to neonatal mortality was explained by parity.

TABLE 5.4: SUMMARY RESULTS OF MULTIVARIATE LOGISTIC REGRESSION: 1992-2007

VARIABLE ˅	1992 Exp(B)	1996 Exp(B)	2001-2 Exp(B)	2007 Exp(B)
Size of Child at Birth				
Large RC	1.000	1.000	1.000	1.000
Average	1.169	0.888	1.912***	0.664
Small	6.276***	1.703**	4.423***	1.991**
Type of Birth				
Single RC	1.000	1.000	1.000	1.000
Multiple	3.739***	7.114***	6.197***	5.330***
Preceding Birth Interval				
< 24 months	2.357***	1.683**	2.991***	1.730**
24-35 months	1.683**	1.216	0.992	0.941
> 35 months RC	1.000	1.000	1.000	1.000
Number of living Children				
Small (1-3)	13.189***	24.095***	12.789***	34.990***
Medium (4-6)	1.968**	5.248***	2.428**	2.478**
Large (7+) RC	1.000	1.000	1.000	1.000
Sex of Child				
Male	1.774***	1.534**	1.311	0.885
Female RC	1.000	1.000	1.000	1.000
Age of Mother				
15-19	0.521	0.216	0.184	0.562
20-24	0.577	0.244**	0.553	0.261*
25-29	0.506	0.244**	0.628	0.310*
30-34	0.544	0.147***	0.769	0.435
35-39	0.572	0.486	0.779	0.774
40-44	0.969	0.770	1.646	0.973
45-49 RC	1.000	1.000	1.000	1.000
Birth Order				
Lower (1-3)	0.546	2.904**	1.388	0.829
Middle (4-6)	0.583	1.830	1.605	0.987
Higher (7+) RC	1.000	1.000	1.000	1.000
Parity				
1-3 RC	1.000	1.000	1.000	1.000
4-6	2.822***	4.012***	2.060**	3.252***
7+	5.302***	17.334***	6.697***	8.676***

*Significance values: * = p<0.1, ** = p<0.05, *** = p<0.01 Reference Category*

Table 5.4 above presents a summary of multivariate logistic regression findings for the contribution of each of the bio-demographic factors to neonatal mortality. The contribution of size of a child at birth (small), birth type (multiple), preceding birth interval (< 24 months), number of living children (small and medium) and parity (4-6, 7+) remained significant over the whole period of study. However, the gap between neonatal mortality for males and females was closed up, meaning that the survivorship of a male neonate improved overtime.

TABLE 5.5: COMPARISON OF UNIVARIATE AND MULTIVARIATE LOGISTIC REGRESSION, A PRESENTATION OF ODDS RATIOS [Exp(B)]: 1992-2007

VARIABLE V	1992		1996		2001-2		2007	
	UNIV.	MULTIV.	UNIV.	MULTIV.	UNIV.	MULTIV.	UNIV.	MULTIV.
Size of Child at Birth								
Large RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Average	1.300	1.169	1.082	0.888	1.363*	1.912***	0.808	0.664
Small	7.345***	6.276***	2.778***	1.703**	3.768***	4.423***	2.732***	1.991**
Type of Birth								
Single RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Multiple	6.826***	3.739***	7.777***	7.114***	6.964***	6.197***	5.893***	5.330***
Preceding Birth Interval								
< 24 months	3.241***	2.357***	1.852***	1.683**	2.699***	2.991***	1.852***	1.730**
24-35 months	1.526**	1.683**	1.182	1.216	0.941	0.992	0.849	0.941
> 35 mths RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Number of living Children								
Small (1-3)	1.459*	13.189***	2.207***	24.095***	1.737*	12.789***	1.758*	34.990***
Medium (4-6)	0.694	1.968**	1.732*	5.248***	1.102	2.428**	0.864	2.478**
Large (7+) RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Sex of Child								
Male	1.507***	1.774***	1.541***	1.534**	1.138	1.311	1.097	0.885
Female RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Age of Mother								
15-19	1.049	0.521	1.860	0.216	2.004	0.184	1.301	0.562
20-24	1.024	0.577	1.143	0.244**	1.664	0.553	0.918	0.261*
25-29	0.754	0.506	0.969	0.244**	1.381	0.628	0.738	0.310*
30-34	0.692	0.544	0.542	0.147***	1.492	0.769	0.675	0.435
35-39	0.488	0.572	1.005	0.486	1.107	0.779	1.036	0.774
40-44	0.819	0.969	1.136	0.770	1.984	1.646	0.914	0.973
45-49 RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Birth Order								
Lower (1-3)	1.099	0.546	1.330	2.904**	1.268	1.388	1.059	0.829
Middle (4-6)	0.781	0.583	1.040	1.830	1.210	1.605	1.142	0.987
Higher (7+)RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Parity								
1-3 RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4-6	0.878	2.822***	0.981	4.012***	0.950	2.060**	1.211	3.252***
7+	0.947	5.302***	0.994	17.334***	1.010	6.697***	1.177	8.676***

*Significance values: * = p<0.1, ** =p< 0.05, *** = p<0.01   RC = Reference Category*

In summary, table 5.5 above results of both the univariate and multivariate odds ratios. The size of the child at birth was a significant factor in influencing neonatal mortality. This is in particular reference to neonates who were classified as small in birth weight. The neonates with small birth weights had significantly been directly associated with the higher risk of mortality as seen in the table. However though significant, the likelihood of neonatal mortality of small births reduced from about 7 times more likely to die than large births in 1992 to about 3 times more likely to die than large births in 2007 for the univariate analysis. In a multivariate model, the likelihood of neonatal mortality reduced from about 6 times more likely to die than large births in 1992 to about 2 times more likely to die than large births in 2007. This is a clear indication that survivorship of neonates who were born small was improved over the whole period of study. In addition, it could be a reflection of the improvement in the health delivery systems and of the health status of mothers. The differences in the log odds between the univariate and multivariate is an indication that other variables within model contributed to the influence that birth size had in influencing neonatal mortality.

Birth type also directly made a contribution to neonatal mortality over the 1992-2007 period. What is clear is that multiple births were significantly associated with the high risk of neonatal mortality than single births. Generally, multiple births were more than 6 times more likely to die than single births in both the univariate and multivariate logistic model for the period 1992-2007. It is a clear indication that much was needed to be done to specifically enhance the survivorship of multiple births. In terms of preceding interval, neonates with the preceding interval of less than 24 months were constantly and significantly associated with the highest risk of dying than the others. In a univariate model, the likelihood of neonatal mortality among births with an interval of less than 24 months reduce about 3 times more likely to die than those with more than 35 months preceding birth interval in 1992 to 2 times more likely to die than those with a preceding interval of more than 35 months in 2007. There was a similar observation in the multivariate logistic model, which implies that, though significant, the likelihood of neonates with less than 24 months of preceding interval to die than those with more than 35 months revealed a reduction from 1992 to 2007. This could be a reflection of the increased desire by women aged 15-49 years to delay or postpone births, hence reducing the proportion of births with a preceding interval of less than 24 months. This is evidenced by the reduction of the percentage of births with less than 24 months preceding interval from 19 per cent in 1992 to 17 per cent in 2007 and an increase in births with more than 35 months preceding interval from 36 per cent in 1992 to 46 per cent in 2007.

The number of living children of a mother (1-3) was strongly associated with the risk of neonatal mortality. Results reveal that on average, neonates born from mothers with 1-3 living children were about 2 times more likely to die than those born from women with 7+ living children. However, after controlling for other variables in a multivariate model, neonates born from women with 1-3 living children were on average more than 21 times more likely to die than those born from mothers with 7+ living children. This is a clear indication that the influence of the number of living children of a mother on neonatal mortality was even enhanced more by other variables within the model.

In terms of sex, data has revealed that males were significantly associated with the risk of neonatal mortality in 1992 and 1996 in both the univariate and multivariate model. This, however, was not the case in 2001-2 and 2007. There were no significant differences in the log odds in terms of sex in both the univariate and multivariate models. The significant reduction in the mortality levels among male neonates in 2001-2 and 2007 could be a reflection that the survivorship of male neonates was greatly enhanced and the gap in neonatal mortality between male and female neonates was closed as seen from the reduction in the significance levels. This is also evidenced by the reduction in the gap in neonatal mortality between males and females from 51 deaths per 1000 live births for males and 35 deaths per 1000 live births for females in 1992 to 34 deaths per 1000 live births for males and 31 deaths per 1000 live births for females in 2007, indicating a reduction in neonatal mortality rate gap from 16 in 1992 to only 3 in 2007. Age of a mother and birth order was not significant in contributing to neonatal mortality in both the univariate and multivariate analysis. Parity did not have any influence on neonatal mortality in a univariate analysis but after controlling for other variables in a multivariate model, its influence was greatly pronounced.

5.4: LINKING THE RESULTS TO THE MOSLEY CHEN CHILD SURVIVAL FRAMEWORK

Mosley and Chen (1984) categorized the proximate determinants of infant and child mortality into five general groups. Among these groups are the bio-demographic factors (otherwise called maternal factors) which were identified as pathways through which all socioeconomic factors operate to ultimately influence child mortality. This has been done by Nsemukila (1996) using 1992 ZDHS data. This framework was adopted by this study to examine specifically the direct influences of the bio-demographic variables of neonatal mortality from 1992 to 2007 in Zambia. The assumption from the hypotheses is that these bio-demographic variables had been directly influencing neonatal mortality over the whole period of study.

Data revealed that variables including sex of a child, birth type, preceding birth interval, size of a child at birth and number of living children of a mother had a direct influence on neonatal mortality in 1992 while age of a mother was not a significant factor. In terms of the sex of a child, it can be confirmed by the large figures of neonatal mortality according to the sex of a child in 1992 as compared to other subsequent years. In addition, the hypothesis that neonatal mortality is high among males than females was confirmed by the huge gap in neonatal mortality between males (higher) and females (lower) in 1992 as compared to other years. In terms of the type of birth, data for 1992 revealed a strong link between birth type and neonatal mortality in Zambia. In addition, it revealed that multiple births were highly associated with the risk of neonatal mortality than single births. Birth order did not have much influence on neonatal mortality but may influence mortality later in childhood. Therefore, in as much as the Mosley and Chen child Survival framework argues that there is a direct link between these bio-demographic factors and neonatal mortality; this may not have been the case for birth order, age of mother and parity in 1992.

FIGURE 5.4: PRESENTATION OF MODEL 8 OF MULTIVARIATE ANALYSIS (1992)

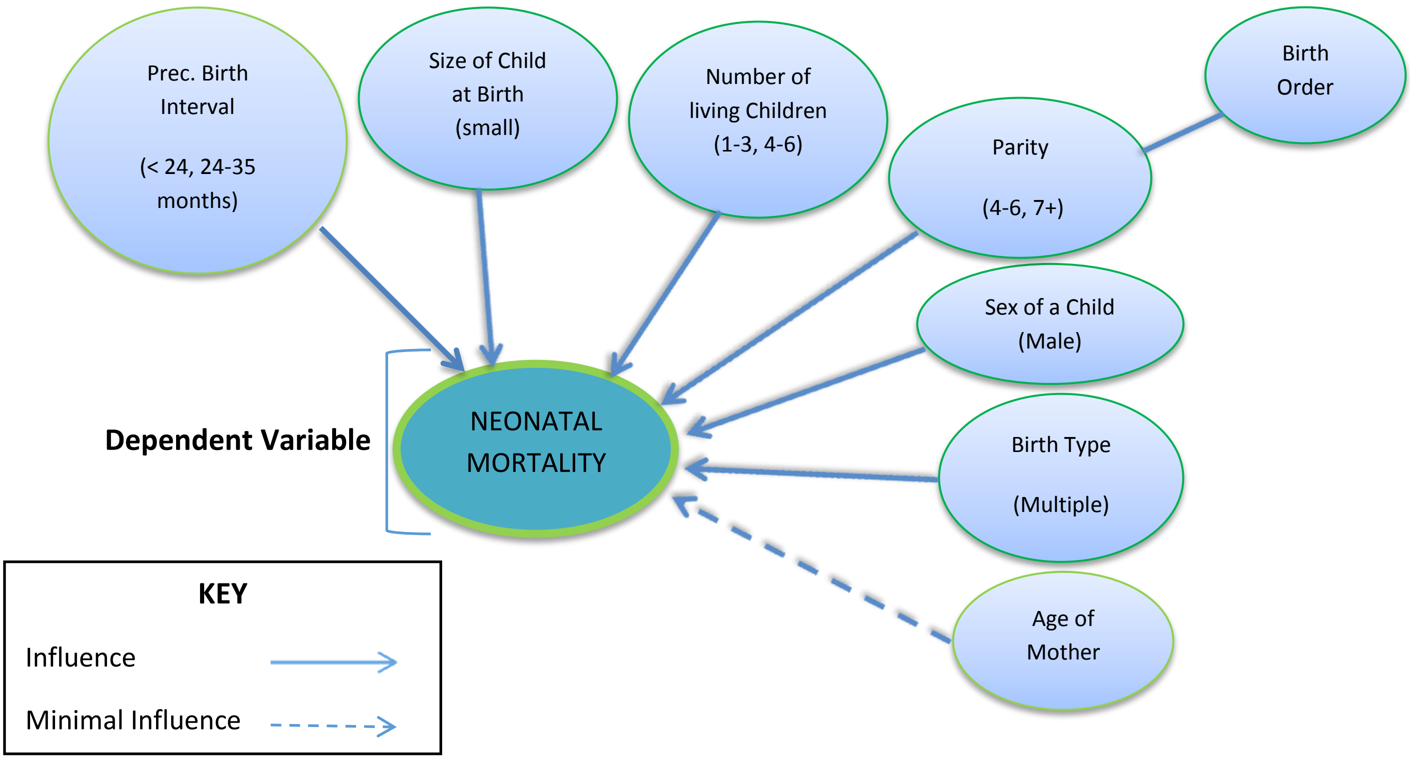
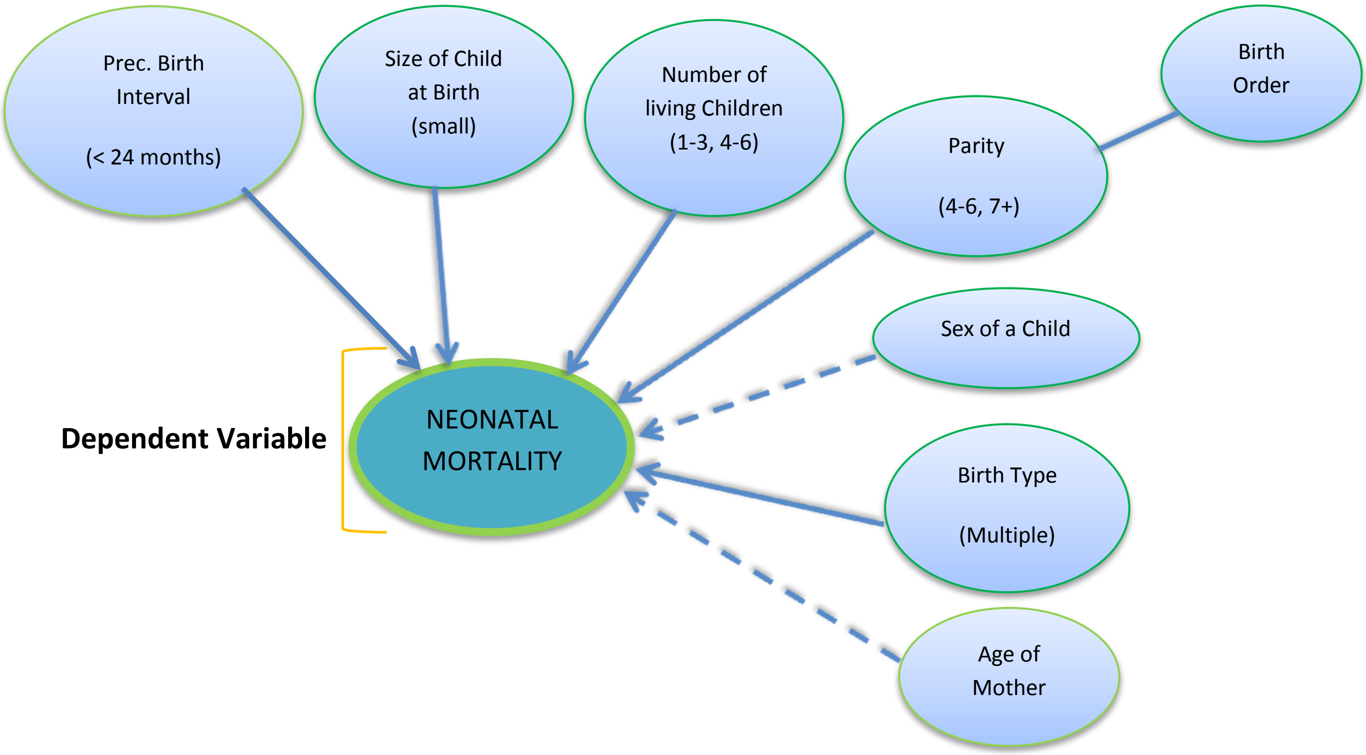


FIGURE 5.5: PRESENTATION OF MODEL 8 OF MULTIVARIATE ANALYSIS (2007)



From the figures 5.4 and 5.5, we can see that birth order, sex of a child and age of a mother had no influence on neonatal mortality in 2007 while in 1992 only age of mother and birth order did not strongly influence neonatal mortality. In 2007, age of mother did not influence neonatal mortality while the influence of birth order was explained by parity. A closer look at the results for 1992 and 2007 reveals that the odds ratios of the age of mother variable reduced from 1992 to 2007. Birth type, number of living children of a mother, size of child at birth, parity and preceding birth interval are variables which directly contributed to neonatal mortality in 2007. In terms of size of child at birth, though significant the odds ratios for the small babies reduced from 6.284 ($p < 0.01$) in 1992 to 1.923 ($p < 0.05$) in 2007. In other words, the likelihood of the neonate (small in size at birth) to die reduced from more than six times higher than the large births in 1992 to about two times higher than the large births in 2007, indicating a tangible decrease in the probability of the neonates who were small in birth size to die. This could be attributed to the increased proportion of large babies from 20 per cent in 1992 to 33 per cent in 2007 and to possible improvements in the health care provision.

The child's birth order influence remained insignificant. In addition to this, the contribution of the sex of the child to neonatal mortality was insignificant in 2001/2 and 2007 compared to 1992 and 1996. This could be because the efforts made towards improving the health of neonates especially the males who were more associated with the risk of neonatal mortality than females and it can be confirmed by the reduced neonatal mortality from 51 to 34 deaths per 1000 live births for males in 1992 and 2007 respectively and 35 to 31 deaths per 1000 live births for females in 1992 and 2007 respectively. These figures clearly show that the gap in neonatal deaths between males and females narrowed with time, hence making it a less important contributor to neonatal mortality. There are key findings that emerge from the 2007 analysis. Firstly, in as much as the hypotheses and framework suggest a direct relationship between these bio-demographic variables and neonatal mortality, this was not true in 2007 for the age of mother, birth order and sex of the child. These results could mean enhanced the survivorship of male neonates, improved nutrition among pregnant women which could explain the increased number of large babies, increased average of size at birth which helps in the reduction of the risk of babies of small birth orders to die and the desire to limit or delay births through the use of contraception which had resulted in an increase the proportion of births with a higher preceding interval hence improving the survivorship.

CHAPTER SIX: DISCUSSION OF FINDINGS AND CONCLUSION

6.0: DISCUSSION OF FINDINGS

Neonatal mortality among women of all age groups apart from 35-39 years had significantly reduced. However, the highest proportion of neonatal deaths was consistently recorded among young women (15-19 years) for the whole period of study. Despite this, there was a decline in neonatal mortality rate among women aged 15-19 years by 11 per cent though this was the lowest decline among all the age groups. There are reasons which could explain the higher proportions of neonatal deaths among women aged 15-19 years. One of them could be that they are not mature enough physiologically and are not experienced to take care of babies. Other age groups (older ages) are mature enough to take care of their babies and are physiologically fit to handle matters that relate to maternal and child health.

The notable decline of neonatal deaths among women aged 15-19 years could be attributed to programs that were aimed at improving the welfare of a girl child. Among them was the Program for Advancement of Girls Education (PAGE) which was introduced in 1996 and whose objective was to empower girls and women to fully participate in and benefit from economic and social development of the nation and to ensure the survival of girls into adulthood with particular emphasis on their protection from HIV/AIDS (Mumba 2012). This program saw the birth of other major decisions aimed at empowering women and education of a girl child including the re-admission of girls who left school after they got pregnant. These policies substantially helped to reduce the proportion of young girls who were having children, hence directly influencing neonatal mortality. This is because the fewer the number of girls having births, the lower the levels of neonatal mortality among these girls. Other developments which might have significantly helped to reduce the number of births among women aged 15-19 years were the increased contraception use among women aged 15-19 years from 3.5% in 1992 to 9.7% in 2007 and the reduced proportion of married women aged 15-19 years from 26% in 1992 to 16.9% in 2007 (ZDHS 1992, 2007). These have significantly reduced the birth rate among young girls, hence reducing the chances of neonatal mortality among these births.

Logistic regression results clearly reveal that the age of mother was not significantly associated with neonatal mortality although socio-economic factors may influence neonatal mortality through this variable. This is not attempted in this study. However, the general observations from the results reveal a reduction in the chances of a neonate to die with an increase in the age of mother. In other words, young neonates born from young mothers had higher chances of dying than those born from older mothers. The findings are in line with Gondotra (1995) findings in India's Gujarat area which revealed that neonates born from teen mothers had a higher risk on death. Similarly, Nsemukila (1996) in his study of determinants of child survival in Zambia established that births from younger mothers were at higher risk of dying than those from older mothers. The reduction in the odds ratios of neonatal deaths from young mothers over the period of study could be an indication that women delayed births hence having longer periods between births which can be confirmed as well by the increase in use of family planning methods from 1992 to 2007 which can be confirmed from the Zambia Demographic and Health Survey which records an increase in family planning use among married women aged 15-49 years from 15.2 per cent in 1992 to 40.8 per cent in 2007 (ZDHS: 75). This may directly enhance survivorship of the neonate.

There had been significant differences in the neonatal deaths among births of certain specific birth orders. The neonatal death rate was constantly highest among births of lower order (1-3) during the whole period of study. These findings are in line with Mekonnen (2011) in his study in Ethiopia where he established that those born from lower birth orders had higher chances of dying than those from higher birth orders. Nsemukila (1996) in his study of the determinants of child survival also established that the births of first order had a higher risk of dying than those in higher orders. Neonatal mortality was generally lower for birth order (4-6) and lowest for birth order (7+). This clearly reveals a reduction pattern in neonatal mortality with an increase in the birth order for the whole period under investigation. The trend reveals that neonatal mortality rate according to lower (1-3) and higher order (7+) had significantly reduced by 33 per cent and 30 per cent respectively from 1992 to 2007 while that of the medium birth order (4-6) did not show much change.

The general reduction in neonatal mortality of certain birth orders could be attributed to the reduction in fertility among women from 1992 to 2007. This is because the reduction in fertility of a woman could increase the chances of survival of the newly born. The explanation to this is that the health of a mother is a significant proxy measure of a neonates' health. For instance, neonatal mortality could be attributed to the nutrition of the mother. The health of a mother with a higher number of children, therefore, cannot be compared to that of a mother with a small number of children because the available food is shared among the many children the mother has. This compromises her health and that of a neonate hence increasing the chances of neonatal mortality. The Demographic and Health Survey (2007) recorded a reduction of about 5 per cent in the total fertility of Zambia from 6.5 in 1992 to 6.2 in 2007. In addition, this study reveals a reduction of about 5% in the proportion of births of the higher order (7+) from 19 per cent in 1992 to 14 per cent in 2007. This clearly shows that there was a substantial reduction in fertility which could have influenced neonatal mortality among births of specific birth order through the 1992-2007 period of study. The reduction in fertility could be as a result of the increase in the use of family planning methods over the 1992 to 2007 period. The use of any contraceptive method among women aged 15-49 years increased from 12% in 1992 to 30% in 2007 while Contraceptive Prevalence Rate (CPR) of modern methods increased from 7% in 1992 to 25% in 2007 (ZDHS, 2007: 72).

The increase in the Contraception Prevalence Rate (CPR) from 1992 to 2007 could be attributed to the many programs that have been implemented in Zambia during this period. The objectives of most of these programs are to enhance contraceptive choices, improve clinical and counselling skills of providers, strengthen the contraceptive logistics system and address misconceptions and biases related to contraception in communities and among providers. A lot of projects and organizations providing family planning services were established during 1992-2007. Among them are the Care Community Family Planning Project which was established in 1994, USAID-Zambia Family Planning Project established in 1993, USAID-Zambia Integrated Health Project (ZIHP) established in 1998, and Society for Family Health (SFH) and many others (USAID, 2005). All these family planning projects helped create demand generation for family planning services by enhancing Information, Education, Communication and service delivery. All these developments suggest increased efforts to make contraceptives available and accessible to all, hence the observed reduction in fertility from 1992 to 2007.

There could be other reasons explaining the significant reduction in the neonatal mortality rates of the lower and higher birth orders. One of them could be the general reforms in the health delivery systems of Zambia from 1992 to 2007. Notable among them was the decentralization of the health sector in 1992 to improve primary health care under the Sector Wide Approach (SWAP), the exemption of charges for under-five children and for other priority services such as maternal and family planning services, immunizations and chronic diseases including HIV/AIDS (PRSP, 2002). Other programs include the Health Services and Systems Program (HSSP) of 2004 whose priority areas included HIV/AIDS, Reproductive Health, Safe Motherhood and Child Health (Chankova, 2006). All these programs and many others may have strengthened the health systems in the country which had a significant impact on neonatal mortality across the large and small birth orders. The results of logistic regression of the influence of birth order of a neonate on neonatal mortality in 1992 and 2007 reveals that birth order did not significantly contribute to neonatal mortality. The influence of birth order in both 1992 and 2007 was explained by parity.

The types of births were categorized into two namely single and multiple births. Neonatal mortality rate was constantly higher for multiple births than single births from 1992 to 2007. In fact, it was about six times higher for multiple births than single births averaging 31 deaths per 1000 live single births and 180 deaths per 1000 live multiple births. This clearly shows that there were more neonatal deaths of multiple than single births for the whole period of study. Multiple logistic regression also revealed a very strong influence of birth type on neonatal mortality. For all the years under investigation, multiple births were at a higher risk of dying than single births meaning that birth type had a direct influence on neonatal mortality. These results are in line with the findings for Kombo and Ginneken (2009) using the 2005-6 Zimbabwe Demographic and Health Survey where they found an increased neonatal mortality for multiple than single births. Despite neonatal deaths of multiple births being higher in Zambia, it experienced the highest reduction of 31 per cent from 205 deaths per 1000 live births in 1992 to 142 deaths per 1000 live births in 2007 as compared to deaths of single births which reduced by 25 per cent from 36 deaths per 1000 live births in 1992 to 27 deaths per 1000 live births in 2007.

The data revealed a balanced sex ratio at birth for all the years from 1992 to 2007. The sex ratio was about 100, meaning that there was no much difference in the number of male and female births in the period under study. However, neonatal mortality rate was higher among male than female births for all the years under investigation. Neonatal mortality rate for males averaged at 40 deaths per 1000 live births while that of female births was at 32 deaths per 1000 births. This clearly shows that neonatal mortality rate was higher among males than females. This is in line with the findings of the Demographic and Health Survey (1992) which clearly revealed a higher death rate for male neonates as compared to the females. This is the case with the 1996 Demographic and Health Survey report which records a higher death rate for male neonates than the female neonates.

Results of logistic regression further revealed a significant influence of the sex of a neonate on neonatal mortality in 1992 and 1996. Male neonates were associated with a higher risk of dying than females and the difference in the number of male and female neonates dying was statistically significant. This again is in line with the findings for Nsemukila (1996) where he used the 1992 DHS data to study the determinants of child mortality. His findings also revealed a higher risk of neonatal mortality being associated with male than female births. For the two years (2001-2 and 2007), sex of a neonate was found not to have significantly influenced neonatal mortality. In addition, despite the neonatal mortality rates among male and female births five years preceding the 2001-2 and 2007 surveys being different, the differences were statistically insignificant. This clearly shows that there were major efforts to enhance the survivorship of male neonates. In fact, this can also be seen from the steady and sharp decline of male neonatal mortality rate by 33% from 51 deaths per 1000 live births in 1992 to 34 deaths per 1000 live births in 2007 as compared to the 11% decline in the neonatal mortality rate of female neonates. In addition, there was a general decline in neonatal mortality for both sexes, signifying improvements in health for both male and female neonates.

The relationship between parity of a mother and neonatal mortality is also very important in the analysis of child survival studies. In this study, it was established that neonatal mortality for all the years under investigation was highest among births from women with a parity of at least 7 averaging at 37 deaths per 1000 live births as compared to the groups which had an average of 36 deaths per 1000 live births. This clearly shows that neonatal mortality was highest among births from women with a higher parity. Results of logistic regression reveal that parity of a mother did not significantly influence neonatal mortality but its influence was enhanced by the number of living children of a mother. In addition, the neonatal mortality rates according to parity reduced significantly from higher levels in 1992 to lower levels in 2007. The highest reduction was recorded among births from women with 1-3 parity by 35 per cent from 45 deaths per 1000 live births in 1992 to 29 deaths per 1000 live births in 2007. This reduction could be attributed to a substantial reduction in fertility which could be seen from a reduction in the proportion of at least 10 children ever born from 7 per cent in 1992 to 1 per cent in 2007. This can also be confirmed by the increased proportion of women who desired to limit the number of children from 1992 to 2007. For example, the proportion of married women who desired to limit their births increased by about 12 per cent from 24.1 per cent in 1992 to 35.9 per cent in 2007 (ZDHS 1992, 1996, 2001-2, 2007). This directly reduced the number of children ever born among women of the reproductive age hence reducing the proportion of neonatal deaths among births from women with higher numbers of parity.

The contribution of the number of living children of a mother to neonatal mortality was investigated in this study. The number of living children of a mother was classified into three categories namely small (1-3), medium (4-6) and large (7+). Neonatal mortality rate was constantly higher among births from women with 1-3 living children. This reduced with an increase in the number of living children with the neonatal mortality rate among births from women with a medium number of living children averaging at 22 and large with 21 neonatal deaths per 1000 live births respectively. This clearly shows that neonatal mortality was highly associated with births among women with 1-3 living children. The possible reason to explain this is that women with more children are more experienced in taking care of the new born babies unlike those with few numbers of living children. The general observation also was that neonatal mortality according to the specific categories of living children of a mother declined from higher levels in 1992 to lower levels in 2007. In addition, results of logistic regression revealed a significant contribution of this variable to neonatal mortality for all the years under investigation. This influence was direct and neither enhanced nor explained by any other independent variable. This clearly indicates a direct contribution of the number of living children of a mother to neonatal mortality.

Birth weight is an important factor in child survival studies. The size of a child at birth was classified into three distinct categories namely large, average and small. As expected, neonatal mortality for babies who were small in size at birth was highest across all the years under investigation with an average of 94 deaths per 1000 live births. This was followed by deaths among neonates who were average in size at birth which recorded an average of 28 deaths per 1000 live births over the period 1992-2007. The lowest mortality rates were recorded for neonates whose birth size was large with an average of 26 neonatal deaths per 1000 live births. These findings support Nsemukila's study (1996) which revealed that small births were more likely to die during neonatal period than average sized. This is also confirmed by the Zambia Demographic and Health Survey reports which reveal that neonatal mortality was constantly higher among births which were small in size at birth for all the years from 1992 to 2007.

Results further revealed that birth size had directly significantly contributed to neonatal mortality during the period of study. This is with particular reference to the neonates who were classified as small in terms of the size at birth. The trend in the neonatal mortality rates show a decline for the small birth weights from 147 deaths per 1000 live births in 1992 to 75 deaths per 1000 live births in 2007 indicating a 49 per cent decline. This was the case for the average birth weights whose mortality also declined from 29 deaths per 1000 live births in 1992 to 23 deaths per 1000 live births in 2007 indicating a 21 per cent decline, clearly showing that neonatal mortality for small births had the highest decline. However, neonatal mortality increased for large births from 23 to 29 deaths per 1000 live births in 1992 and 2007 respectively.

Preceding birth interval is another factor which is highly considered in neonatal mortality studies. In this study, neonatal mortality was highest among births with the preceding birth interval of less than 24 months for all years averaging 50 deaths per 1000 live births. This reduced with an increase in the preceding birth interval. Analysis revealed that neonatal reduced among births with a preceding interval of 24-35 months to an average of 28 deaths per 1000 live births and was lowest among births with more than 35 months preceding interval with an average of 26 deaths per 1000 live births during the period 1992-2007.

Results also reveal that shorter preceding birth intervals (less than 24 months) were significantly associated with a higher risk of neonatal mortality. This can be confirmed by the Zambia Demographic and Health Survey reports for all the years under investigation that neonatal mortality was highest among births with shorter intervals (ZDHS, 1992-2007). Gandotra (1992) in his study in Gujarat and its neighbouring state of Maharashtra also established that shorter birth intervals were significantly associated with a higher risk of neonatal mortality. Ezra and Gurum (2002) also in his study of infant and child mortality in Ethiopia established that shorter intervals were associated with a higher risk of neonatal mortality. Neonatal mortality rate for births with less than 24 months preceding interval declined significantly by 32 per cent while that of births with interval of 24-35 months also reduced by 36 per cent from 1992 to 2007. However, neonatal mortality among births with a preceding interval of more than 35 months increased by 13 per cent.

The contribution of the Mosley and Chen Child Survival framework in understanding the bio-demographic determinants of neonatal mortality cannot be underestimated. As discussed within the framework, most of these determinants are intermediate variables through which other factors (e.g social-economic) operate to influence neonatal mortality. What has been observed is that there are several bio-demographic factors whose influence on neonatal mortality had remained significant over the long period of study (1992-2007). These include the type of birth, number of living children of mother, preceding birth interval and size of child at birth. Perhaps, their contribution to neonatal mortality could also be explained or is enhanced by other socio-economic factors which have not been investigated in this study. This, therefore, implies that there is need for more research in order to fully establish other factors which might be influencing neonatal mortality through these bio-demographic variables. Although Nsemukila (1996) attempted to do this for neonatal mortality using 1992 ZDHS data, there has never been an attempt in Zambian to assess changes over time through a trend analysis like has done in this study. In addition, despite the major efforts which were put in place to enhance child survival in Zambia, much still needs to be done in terms of health policy and programmes implementation, and general improvements in the economy of the country. These may consequently have significant influences in the reduction of neonatal mortality in Zambia.

6.1: CONCLUSION

The study aimed at investigating trends in bio-demographic determinants of neonatal mortality in Zambia from 1992 to 2007. In line with the objectives of the study, it is clear that in 1992, preceding birth interval, size of child at birth, number of living children of a mother, sex of a child and birth type significantly contributed to neonatal mortality. Birth order and age of a mother had no significant influence on neonatal mortality while the contribution of the number of children ever born was enhanced by the number of living children a mother had. The pattern was similar in 2007 though the contribution of sex of a child was minimal. In addition, the significance levels of some of the variables reduced and the odds ratios reduced from high figures in 1992 to lower ones in 2007. This could be an indication that the health status of neonates in Zambia has generally improved over the period of study. Findings of this study are in line with most of the earlier studies of similar nature which have been conducted in Zambia and the other parts of the world. The study has, however, demonstrated the changes in the factors influencing neonatal mortality over a period of 15 years and gave insight to interventions that could have been key to influencing changes in neonatal mortality in Zambia. The study further demonstrates the usefulness of the Mosley-Chen framework in explaining the pathways through which a number of bio-demographic factors influence neonatal mortality in Zambia.

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APPENDIX: TABLES OF LOGISTIC REGRESSION

TABLE A.1: 1992 RESULTS OF UNIVARIATE LOGISTIC REGRESSION

INDEPENDENT VARIABLE ᵛ	B	ODDS RATIOS [Exp(B)]
Age of Mother		
15-19	0.048	1.049
20-24	0.024	1.024
25-29	-0.284	0.754
30-34	-0.368	0.692
35-39	-0.717	0.488
40-44	-0.199	0.819
45-49 RC	0.000	1.000
Birth Order		
Lower (1-3)	0.094	1.099
Middle (4-6)	-0.247	0.781
Higher (7+) RC	0.000	1.000
Birth Type		
Single	0.000	1.000
Multiple	1.921	6.826***
Sex of a Child		
Male	0.410	1.507***
Female RC	0.000	1.000
Parity		
1-3 RC	0.000	1.000
4-6	-0.130	0.878
7+	-0.055	0.947
Number of Living Children		
1-3	0.377	1.459*
4-6	-0.365	0.694
7+ RC	0.000	1.000
Size of Child at Birth		
Large RC	0.000	1.000
Average	0.263	1.300
Small	1.994	7.345***
Preceding Birth Interval		
< 24 months	1.176	3.241***
24-35 months	0.423	1.526**
> 35 months RC	0.000	1.000

*Significance values: * = p<0.1, ** = p<0.05, *** = p<0.01 RC = Reference Category*

TABLE A.2: 1996 RESULTS OF UNIVARIATE LOGISTIC REGRESSION

INDEPENDENT VARIABLE ˅	B	ODDS RATIOS [Exp(B)]
Age of Mother		
15-19	0.620	1.860
20-24	0.133	1.143
25-29	-0.032	0.969
30-34	-0.612	0.542
35-39	0.005	1.005
40-44	0.128	1.136
45-49 RC	0.000	1.000
Birth Order		
Lower (1-3)	0.285	1.330
Middle (4-6)	0.039	1.040
Higher (7+) RC	0.000	1.000
Birth Type		
Single RC	0.000	1.000
Multiple	2.051	7.777***
Sex of a Child		
Male	0.432	1.541***
Female RC	0.000	1.000
Parity		
1-3 RC	0.000	1.000
4-6	-0.019	0.981
7+	-0.006	0.994
Number of Living Children		
1-3	0.792	2.207***
4-6	0.549	1.732*
7+ RC	0.000	1.000
Size of Child at Birth		
Large RC	0.000	1.000
Average	0.078	1.082
Small	1.022	2.778***
Preceding Birth Interval		
< 24 months	0.616	1.852***
24-35 months	0.167	1.182
> 35 months RC	0.000	1.000

*Significance values: * = p<0.1, ** = p<0.05, *** = p<0.01   RC = Reference Category*

TABLE A.3: 2001-2 RESULTS OF UNIVARIATE LOGISTIC REGRESSION (ODDS RATIOS)

INDEPENDENT VARIABLE ^V^	B	ODDS RATIOS [Exp(B)]
Age of Mother		
15-19	0.620	2.004
20-24	0.133	1.664
25-29	-0.032	1.381
30-34	-0.612	1.492
35-39	0.005	1.107
40-44	0.128	1.984
45-49 RC	0.000	1.000
Birth Order		
Lower (1-3)	0.285	1.268
Middle (4-6)	0.039	1.210
Higher (7+) RC	0.000	1.000
Birth Type		
Single RC	0.000	1.000
Multiple	2.051	6.964***
Sex of a Child		
Male	0.432	1.138
Female RC	0.000	1.000
Parity		
1-3 RC	0.000	1.000
4-6	-0.019	0.950
7+	-0.006	1.010
Number of Living Children		
1-3	0.552	1.737*
4-6	0.097	1.102
7+ RC	0.000	1.000
Size of Child at Birth		
Large RC	0.000	1.000
Average	0.078	1.363*
Small	1.022	3.768***
Preceding Birth Interval		
< 24 months	0.616	2.699***
24-35 months	0.167	0.941
> 35 months RC	0.000	1.000

*Significance values: * = p<0.1, ** = p<0.05, *** = p<0.01   RC = Reference Category*

TABLE A.4: 2007 RESULTS OF UNIVARIATE LOGISTIC REGRESSION

INDEPENDENT VARIABLE ᐯ	B	ODDS RATIOS [Exp(B)]
Age of Mother		
15-19	0.263	1.301
20-24	-0.086	0.918
25-29	-0.304	0.738
30-34	-0.393	0.675
35-39	0.035	1.036
40-44	-0.090	0.914
45-49 RC	0.000	1.000
Birth Order		
Lower (1-3)	0.058	1.059
Middle (4-6)	0.133	1.142
Higher (7+) RC	0.000	1.000
Birth Type		
Single RC	0.000	1.000
Multiple	1.774	5.893***
Sex of a Child		
Male	0.093	1.097
Female RC	0.000	1.000
Parity		
1-3 RC	0.000	1.000
4-6	0.191	1.211
7+	0.163	1.177
Number of Living Children		
1-3	0.564	1.758*
4-6	-0.146	0.864
7+ RC	0.000	1.000
Size of Child at Birth		
Large RC	0.000	1.000
Average	-0.214	0.808
Small	1.005	2.732***
Preceding Birth Interval		
< 24 months	0.616	1.852***
24-35 months	-0.164	0.849
> 35 months RC	0.000	1.000

*Significance values: * =p< 0.1, ** = p<0.05, *** = p<0.01 RC = Reference Category*

TABLE A.5: RESULTS OF MULTIVARIATE LOGISTIC REGRESSION [EXP(B)]: 1992

VARIABLE ˅	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size of Child at Birth								
Large RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Average	1.300	1.239	1.160	1.066	1.092	1.122	1.146	1.169
Small	7.345***	5.775***	6.237***	5.299***	5.741***	5.909***	6.063***	6.276***
Type of Birth								
Single RC		1.000	1.000	1.000	1.000	1.000	1.000	1.000
Multiple		4.050***	4.413***	4.858***	4.855***	4.932***	4.340***	3.739***
Preceding Birth Interval								
< 24 months			3.118***	2.670***	2.621***	3.117***	2.690***	2.357***
24-35 months			1.555**	1.579**	1.533**	1.842***	1.746***	1.683**
> 35 months RC			1.000	1.000	1.000	1.000	1.000	1.000
Number of living Children								
Lower (1-3)				1.858***	1.820**	5.044***	11.829***	13.189***
Middle (4-6)				0.787	0.768	1.331	1.965**	1.968**
Higher (7+) RC				1000	1.000	1.000	1.000	1.000
Sex of Child								
Male					1.809***	1.789***	1.746***	1.774***
Female RC					1.000	1.000	1.000	1.000
Age of Mother								
15-19						0.132**	0.340	0.521
20-24						0.192**	0.459	0.577
25-29						0.246**	0.471	0.506
30-34						0.387	0.534	0.544
35-39						0.517	0.562	0.572
40-44						1.026	0.973	0.969
45-49 RC						1.000	1.000	1.000
Birth Order								
Small (1-3)							0.172***	0.546
Medium (4-6)							0.370***	0.583
Large (7+) RC							1.000	1.000
Parity								
1-3 RC								1.000
4-6								2.822***
7+								5.302***

*Significance values: * = p<0.1, ** = p<0.05, *** = p<0.01   RC = Reference Category*

TABLE A.6: RESULTS OF MULTIVARIATE LOGISTIC REGRESSION [EXP(B)]: 1996

VARIABLE ˅	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size of Child at Birth								
Large RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Average	1.082	1.021	0.900	0.854	0.879	0.857	0.879	0.888
Small	2.778***	1.972***	1.735**	1.613**	1.660**	1.672**	1.706**	1.703**
Type of Birth								
Single RC		1.000	1.000	1.000	1.000	1.000	1.000	1.000
Multiple		6.473***	7.040***	8.319***	8.244***	9.049***	8.599***	7.114***
Preceding Birth Interval								
< 24 months			1.824***	1.614**	1.622**	2.013***	1.879***	1.683**
24-35 months			1.167	1.107	1.105	1.382	1.333	1.216
> 35 months RC			1.000	1.000	1.000	1.000	1.000	1.000
Number of living Children								
Lower (1-3)				3.084***	2.984***	10.934***	17.312***	24.095***
Middle (4-6)				1.822*	1.774*	4.118***	5.127***	5.248***
Higher (7+) RC				1.000	1.000	1.000	1.000	1.000
Sex of Child								
Male					1.513**	1.478**	1.484**	1.534**
Female RC					1.000	1.000	1.00	1.000
Age of Mother								
15-19						0.078***	0.131**	0.216
20-24						0.118***	0.189**	0.244**
25-29						0.161***	0.233**	0.244**
30-34						0.133***	0.164***	0.147***
35-39						0.439	0.485	0.486
40-44						0.799	0.808	0.770
45-49 RC						1.000	1.000	1.000
Birth Order								
Small (1-3)							0.394**	2.904**
Medium (4-6)							0.598*	1.830
Large (7+) RC							1.000	1.000
Parity								
1-3 RC								1.000
4-6								4.012***
7+								17.334***

*Significance values: * = p<0.1, ** = p<0.05, *** = p<0.01 RC = Reference Category*

TABLE A.7: RESULTS OF MULTIVARIATE LOGISTIC REGRESSION [EXP(B)]: 2001-2

VARIABLE	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size of Child at Birth								
Large RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Average	1.363*	1.286	1.925***	1.848**	1.895**	1.907**	1.899***	1.912***
Small	3.768***	2.984***	4.264***	4.291***	4.471***	4.439***	4.433***	4.423***
Type of Birth								
Single RC		1.000	1.000	1.000	1.000	1.000	1.000	1.000
Multiple		5.472***	7.079***	8.416***	8.286***	8.045***	7.395***	6.197***
Preceding Birth Interval								
< 24 months			3.033***	2.879***	2.852***	3.402***	3.161***	2.991***
24-35 months			0.971	0.893	0.884	1.048	0.990	0.992
> 35 months RC			1.000	1.000	1.000	1.000	1.000	1.000
Number of living Children								
Lower (1-3)				2.305***	2.282***	6.689***	10.365***	12.789***
Middle (4-6)				1.255	1.252	2.130**	2.372**	2.428**
Higher (7+) RC				1.000	1.000	1.000	1.000	1.000
Sex of Child								
Male					1.305	1.287	1.288	1.311
Female RC					1.000	1.000	1.000	1.000
Age of Mother								
15-19						0.070**	0.127*	0.184
20-24						0.262**	0.438	0.553
25-29						0.390	0.535	0.628
30-34						0.610	0.728	0.769
35-39						0.683	0.751	0.779
40-44						1.735	1.719	1.646
45-49 RC						1.000	1.000	1.000
Birth Order								
Small (1-3)							0.369**	1.388
Medium (4-6)							0.715	1.605
Large (7+) RC							1.000	1.000
Parity								
1-3 RC								1.000
4-6								2.060**
7+								6.697***

*Significance values: * = p<0.1, ** = p<0.05, *** = p<0.01 RC = Reference Category*

TABLE A.8: RESULTS OF MULTIVARIATE LOGISTIC REGRESSION [EXP(B)]: 2007

VARIABLE ᵛ	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size of Child at Birth								
Large RC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Average	0.808	0.756	0.708*	0.712	0.710	0.711	0.692	0.664
Small	2.732***	2.098***	1.931***	1.968***	1.953***	2.136***	2.062***	1.991**
Type of Birth								
Single RC		1.000	1.000	1.000	1.000	1.000	1.000	1.000
Multiple		4.780***	5.249***	6.739***	6.750***	7.602***	6.784***	5.330***
Preceding Birth Interval								
< 24 months			1.932***	1.642**	1.639***	2.319***	1.921***	1.730**
24-35 months			0.842	0.860	0.859	1.124	1.010	0.941
> 35 months RC			1.000	1.000	1.000	1.000	1.000	1.000
Number of living Children								
Lower (1-3)				2.521***	2.510***	11.573***	26.568***	34.990***
Middle (4-6)				0.812	0.812	1.719	2.306**	2.478**
Higher (7+) RC				1.000	1.000	1.000	1.000	1.000
Sex of Child								
Male					0.907	0.885	0.894	0.885
Female RC					1.000	1.000	1.000	1.000
Age of Mother								
15-19						0.124**	0.368	0.562
20-24						0.074***	0.194**	0.261*
25-29						0.133***	0.275*	0.310*
30-34						0.262**	0.417	0.435
35-39						0.556	0.739	0.774
40-44						0.798	0.905	0.973
45-49 RC						1.000	1.000	1.000
Birth Order								
Small (1-3)							0.173***	0.829
Medium (4-6)							0.488**	0.987
Large (7+) RC							1.000	1.000
Parity								
1-3 RC								1.000
4-6								3.252***
7+								8.676***

*Significance values: * = p<0.1, ** =p<0.05, *** = p<0.01   RC = Reference Category*