THE INFLUENCE OF INFANT FEEDING PRACTICES ON INFANT MORTALITY IN SOUTHERN AFRICA

A RESEARCH REPORT SUBMITTED TO THE FACULTY OF HUMANITIES, SCHOOL OF SOCIAL SCIENCES, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN THE FIELD OF DEMOGRAPHY AND POPULATION STUDIES

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JULY 2014

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DECLARATION

I, **Lungile F. Motsa** hereby declare that this research report is my own work. It is being submitted to the Faculty of Humanities, School of Social Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the Master of Arts degree in Demography and Population Studies. I declare that this report has not been submitted previously, in part or in full, for any other degree or examination in this or any other university.

……. [Signature of candidate]

……..day of…….20……

ACKNOWLEDGEMENTS

With a joyful heart, I would like to give thanks, glory and honour to the Almighty God who has remained faithful throughout the course of my studies by always surrounding me with His favour, providing every solution, resources and making successful this research report.

My special and sincere gratitude goes to the Swaziland King's Office, University of the Witwatersrand and also the William and Flora Hewlett Foundation, USA, through support to the interdisciplinary Demography and Population Studies Programme run through the Schools of Social Sciences and Public Health, University of the Witwatersrand, Johannesburg, South Africa, for the financial support they provided me to complete my studies.

I would also like to extend my deepest gratitude to Dr Latifat Ibisomi for the invaluable contribution she had as my supervisor to make my research report a success. This work would have not been possible without her limitless support and great mentorship. I also appreciate the guidance, support and mentorship of Professor Clifford Odimegwu which have undoubtedly shaped and prepared me for the outside world.

My warmest gratitude also goes to my family, including Phiwokwakhe Ndabandaba, and my friends for their endless love and making all good things possible in my life including this research report. I also appreciate the support and invaluable contributions of Mr Sidumo Masango to my academic achievements. My heartfelt gratitude is also extended to the awesome and God sent "Witsies", especially Lihle Mabuza, Lindelwa Masuku, Eveline Shinana, Sbonginkosi Moyo, Daisy Chimanga and Lebo Thwala who were constant pillars of strength, more than friends to me but also a family away from home. To my shell, Cassandra Nyathi, I give many thanks for all the love and support you never ceased to give me. Special thanks are also extended to the academic staff of the Demography and Population Studies department, especially Dr Sunday Adedini, Dr Nicole de Wet and Mr Jeremy Gumbo for the priceless contribution and guidance they gave me throughout the course of my studies.

The success of this research report would have not been possible without the light that each one of you shed in my life.

DEDICATION

This research report is dedicated to the Almighty God and my family.

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LIST OF ACRONYMS

AIDS - Acquired Immunodeficiency Syndrome

ARI - Acute Respiratory Infections

ARV - Antiretroviral

CI - Confidence Interval

CSO - Central Statistical Office

DHS - Demographic and Health Survey

EPI - Expanded Program of Immunization

GDP - Gross Domestic Product

HIV- Human Immunodeficiency Virus

IBFAN - International Baby Food Action Network

IMR - Infant mortality rate

IYCF - Infant and Young Children Feeding

LDHS - Lesotho Demographic and Health Survey

MDG - Millennium Development Goal

MOHSW - Ministry of Health and Social Welfare

ORT - Oral Rehydration Therapy

SDHS - Swaziland Demographic and Health Survey

SPSS - Statistical Package for Social Science

TDRC - Tropical Diseases Control Centre

UNICEF - United Nation's Children and Emergency Fund

WHO - World Health Organization

ZDHS - Zambia Demographic and Health Survey

ZDHS - Zimbabwe Demographic and Health Survey

ZIMSTAT - Zimbabwe National Statistics Agency

ABSTRACT

Context: Despite the many initiatives implemented over the past decades as part of the global priority on child survival, there still exists high infant mortality in Southern Africa. Although studies have examined factors contributing to poor child health outcomes including the effect of the HIV/AIDS pandemic, there is paucity of studies on the possible effect of infant feeding practices on infant mortality in the region. This study examines the association between infant feeding practices and infant mortality in Southern Africa. The need to reduce infant mortality is a global health concern hence the United Nations through the Millennium Development Goals (MDGs) declared the reduction of infant and child mortality as one of its major targets by the year 2015.

Methods: A merged dataset from the most recent Demographic and Health Surveys for Lesotho, Swaziland, Zambia and Zimbabwe was analysed in this study. A total number of 13, 218 infants born in the last five years preceding the surveys whose information on infant feeding practices was available formed the analysis sample. The outcome variable was infant mortality and infant feeding practices which had the categories, no breastfeeding, partial breastfeeding and exclusive breastfeeding was the main explanatory variable of the study. Other explanatory variables used in the study pertained to maternal demographic and socio-economic characteristics as well as the infants' bio-demographic characteristics. The Cox Hazard Regression Model was employed to examine both the unadjusted and adjusted effect of infant feeding practices on infant mortality in Southern Africa.

Results: Although, exclusive breastfeeding was quite low (12%), its mortality reduction effect was significant, and infants who were exclusively breastfed exhibited a 97% lower risk of dying during infancy compared to no breastfeeding in the region. Further, variations exist by country in the levels and patterns of both infant mortality and infant feeding practices. Country, highest educational level, marital status, sex of child, preceding birth interval and birth weight were the significant predictors of infant mortality in Southern Africa.

Conclusions: Overall, the study found that any form of breastfeeding whether exclusive or partial breastfeeding greatly reduces the risk of infant mortality, with the mortality reduction effect being higher among exclusively breastfed infants in the Southern African region. Thus,

in order to reduce the upsurge of infant mortality, there is need to step up the effectiveness of child nutrition programmes that promote breastfeeding and put emphasis on exclusive breastfeeding of infants in the region.

Keywords: Infant feeding practices, infant mortality, Southern Africa.

CHAPTER 1: INTRODUCTION

1.0 Introduction

This chapter begins with the background of the study which highlights the problem of infant mortality, its causal factors and how infant feeding practices can lead to this societal problem. The problem statement, objectives of the study as well as the justification for the study are also presented.

1.1 Background

It is undisputable that much still remains to be done in order to improve child survival especially in some parts of the developing world. According to the World Health Organization (WHO), approximately 21 000 children under-five die every day mainly from preventable causes worldwide, with an estimated 99% of the deaths occurring in the developing regions (WHO, 2013). The attributed preventable causes of death among children in their five years of life include diarrhoea, neonatal conditions, pneumonia, malaria and measles whereas, an overwhelming 71% of these deaths were observed among infants in 2010, that is, children in their first year of life (WHO, 2013). Further, Amouzou and Hill (2004) assert that of all the child deaths experienced in developing countries, an estimated three-quarters of the deaths were predominantly caused by diseases that can be averted by affordable and practical interventions such as immunization, antibiotics and oral rehydration therapy (ORT) use.

The pervasive high number of deaths among children under-five is contrary to many initiatives implemented as part of global priority on child survival and other development programmes of the WHO and United Nations Children Emergency Fund (UNICEF) in the developing world. These programmes include the Expanded Program of Immunization (EPI) and Optimal Infant and Young Children Feeding (IYCF) aimed at improving child health over the past decades (UNICEF, 2011). Despite child mortality declines observed in the developing world in the twentieth century, the early 1990s were coupled with a reversal of this pattern in many countries in sub-Saharan Africa (Rutstein, 2000). Some countries in sub-Saharan Africa including those of Southern Africa are still characterised by persistently high infant mortality rates, while others experience either slowed or stalled declines of infant mortality rates compared to other regions in the developing world such as Oceania, Caucasus, Central and Southern Asia (WHO, 2012; Sartorius et al., 2011; Edmond, 2007; Fotso, 2007;

Garenne and Gakusi, 2006). According to Buwembo (2010), the highest infant and child mortality rates in sub-Saharan Africa than all the regions in the developing world are particularly resulting from underdevelopment, armed conflicts and the spread of HIV/AIDS hence gravely undermining the efforts that have been made so far to improve infant and child mortality .

Empirical evidence traditionally attributed increased infant mortality rates to the impact of a wide range of biological as well as socio-economic factors as aforementioned by Buwembo (2010) in sub-Saharan Africa. However, the emergence of the HIV/AIDS epidemic is asserted to have spurred the overall mortality rates in recent decades, particularly in Southern Africa (Sartorius et al., 2011). With documented evidence still showing high infant and child mortality and notably reversal patterns in child health gains in many parts of the developing world, there is no doubt about the existence of many causal factors. The WHO in collaboration with UNICEF (2003) emphasized and renewed the world's attention to the impact of feeding practices on nutritional status, growth, development, health and the overall survival of infants and young children. As such both international bodies recommend that infants be exclusively breastfed for the first six months of life, with adequate and safe complementary foods from six months up to two years of age and beyond in order to ensure optimal health and development. According to the WHO (2012), any breastfeeding, whether exclusive or partial compared to lack of breastfeeding protects children by significantly reducing the risk of malnutrition and serious infectious diseases that are more prominent in the first year of life. For instance, diarrhoea is stated to be preventable by exclusive breastfeeding in addition to good sanitary and hygienic practices (WHO, 2013).

Despite the global recommendation for infant and young child feeding, around 35% of children under-five still die of causes related to malnutrition as a result of poor infant and young children feeding practices in most low and middle income countries (WHO, 2012). It was also reported that only less than half (39 %) of the world's infants aged 0-5 months were exclusively breastfed in the period between 2007 and 2011 hence the remainder experienced inappropriate and unsafe complementary feeding practices (UNICEF, 2013). The rate of exclusive breastfeeding at six months has been found to differ in disparate parts of the world and remains low in some places. In the developing country of Nigeria, exclusive breastfeeding rates in the first six months of life ranged from 21.4 % in a semi-urban population in Ilesa (Ogunlesi, 2009) to 78.7% in a rural population in Sokoto (Oche and

Umar, 2008). However, in some developed countries like Canada, exclusive breastfeeding rate in the first four months of life was estimated at 4 % and at 0% in the first six months of life (Leger-LeBlanc and Rioux, 2008). In addition, an estimated 5% of infants in their first six months of life or younger had never been breastfed in developing countries (Shankar, 2009). Thus, apart from the sizeable number of infants and young children deaths due to malnutrition which is a consequent factor of inappropriate feeding practices, the life-long impact emanating from poor feeding practices among children includes poor school performance, reduced productivity, and impaired social and intellectual development (WHO, 2003).

Even in the face of the controversy surrounding the issue of breastfeeding in the context of the HIV/AIDS pandemic in recent years, especially in Southern Africa, the recommendation on infant and young children feeding is still much the same. However, after undergoing several reviews and revisions over the past years, the recommendation has factored in the most current research on the relationship between feeding practices and the HIV/AIDS pandemic while taking into account potential risks and benefits as well as feasibility and cost implications (World Vision, 2011). According to the WHO (2007), the general range of transmitting HIV through any form of breastfeeding in the absence of any interventions has been found to be from 5 to 20 %. Several studies have been done to assess the effects of breastfeeding infants in the context of the HIV/AIDS pandemic in Southern Africa. In South Africa and Zimbabwe, studies have found the risk of HIV transmission through exclusive breastfeeding from about six weeks to six months to be 4 % and 1.3 %, respectively (Coovadia et al., 2007 ; Iliff et al., 2005).

Therefore, taking into account the wider use of antiretroviral drugs (ARVs) in all affected countries, the WHO (2012) recommends that women who breastfeed and also receive ARVs or whose infants are receiving ARVs, should exclusively breastfeed their infants for 6 months and continue breastfeeding up to 12 months of age and only then consider stopping. Previously, mothers were recommended to exclusively breastfeed only up to six months and thereafter stop breastfeeding completely as soon as they were able to adequately provide a safe diet to their infants without breast milk (WHO, 2012). Additionally, in the updated HIV and Infant Feeding Framework for 2013, the WHO explicitly emphasized that health authorities should endorse either breastfeeding for the infant when the mother or infant is

receiving ARVs, or completely avoid all forms of breastfeeding if the risk of HIV transmission to the infant is likely to be high. Even though the avoidance of breastfeeding is supported as it eliminates the risk HIV transmission, however, one study showed that non breastfed infants were exposed to an increased risk of morbidity and mortality associated with replacement feeds (Coovadia et al., 2007). Furthermore, empirical evidence has also shown improved HIV-free survival among HIV-exposed infants who were exclusively breastfed as they were substantially protected from infectious diseases compared to mixed or replacement feeding (WHO, 2002; 2012).

As such, even in the high HIV prevalence region of Southern Africa, the deaths of millions of infants can be avoided through the benefits of both exclusive breastfeed in the first six months of their lifetime and continued appropriate infant feeding practices beyond that age. Moreover, reinforcing exclusive breastfeeding among children in the first six months of their lives is stated to be one affordable and low technology strategy to prevent infants' death among other interventions such as provision of antenatal care, expert care during child delivery, immunization, correct administration of antibiotics, oral rehydration therapy and anti-malarial drugs (WHO, 2013). The health benefits of breastfeeding would undoubtedly play a major role in improving child survival, especially in high infant mortality countries of the developing world.

1.2 Problem Statement

Infant mortality continues to be high in many countries in sub-Saharan Africa including Lesotho, Swaziland, Zambia and Zimbabwe. In these countries, infant mortality rates remain strikingly high and also fluctuate despite the efforts to improve child survival in Southern Africa. These efforts include compulsory immunization, antenatal care, postnatal care and overall improvement in the prevention and treatment of previously deadly infectious diseases such as cholera, diarrhoea and malaria. The lack of progress on child survival is marked in Southern Africa as a 17% increase between 1990 and 2006 was reported with deaths rising from 125 to 146 deaths per 1000 live births (UNICEF, 2008). Consequently, the region requires a 13.9% average annual rate of reduction (AARR) in under-five mortality rate between 2007 and 2015 for the achievement of Millennium Development Goal (MDG) number four (UNICEF, 2008).

In Swaziland, infant mortality rose from 78 to 107 deaths per 1000 live births between 1997 and 2007 (Central Statistical Office, CSO, and Macro International Inc., 2008). In Lesotho it increased from 72 to 91 deaths per 1000 live births between 2004 and 2009 (Ministry of Health and Social Welfare, MOHSW, Lesotho, and ICF Macro, 2010). However, Zambia and Zimbabwe are the only exceptional countries among the four selected countries of Southern Africa where infant mortality indicated slight decreases in recent periods even though apparent increases were observed in these countries in the mid 1990s as indicated in the individual country's DHS reports. Thus, Zambia's infant mortality decreased from 95 in 2002 to 70 deaths per 1000 live births in 2007 whereas in Zimbabwe it also slightly decreased from 60 in 2002 to 57 deaths per 1000 live births in 2011 (Central Statistical Office (CSO), Ministry of Health (MOH), Tropical Diseases Research Centre (TDRC), University of Zambia, and Macro International Inc., 2009; Zimbabwe National Statistics Agency (ZIMSTAT) and ICF International, 2012).

The devastating consequences of high infant mortality are felt both at societal and familial levels. At the societal level, high infant mortality is indicative of poor and inadequate basic health infrastructure to fight poor sanitation, environmental hazards and living conditions to the extent that infectious and parasitic diseases will be prevalent (Kyei, 2011). High infant mortality also has negative consequences on the potential socioeconomic growth of populations as it diminishes the age group that is expected to participate in the labour force, other areas of development and also help in driving countries' economies to the right direction in prospective years. A study in the Arab World also confirmed the existence of an inverse correlation between Gross Domestic Product (GDP) per capita and infant mortality as low socioeconomic status was found to have an association with high infant mortality rate in the region (Abuqamar et al., 2011). However, at the family level, Kyei (2011) points out that the loss of many children brings pain, sorrow and possible despise and lack of respect to the affected couples, families and even the community at large. Therefore, in sum, high infant mortality deprives affected nations, communities and families of future socioeconomic development.

Whilst a large body of existing literature has been associating the high infant mortality to the high HIV/AIDS pandemic in Southern Africa (Sartorius et al. 2011; Buwembo, 2010), little attention has been given to other reasons for poor child survival in the region since the emergence of the HIV/AIDS epidemic. These reasons include acute respiratory illnesses,

diarrhoea, malaria and malnutrition, in addition to HIV/AIDS as the major causes of deaths among neonates and under-five children worldwide (WHO, 2013). According to the same report by the WHO, about 20 million children were severely malnourished in 2010, which left them susceptible to illness as well as early death. However, of particular note, is the paucity of studies on the possible effect of infant feeding practices on infant mortality in Southern Africa.

Although both the WHO and UNICEF recommend that children must be exclusively breastfed in the first six months of their lives and be given solid or semi-solid complementary foods in addition to continued breastfeeding from age 6 to 24 months or even beyond that period (WHO and UNICEF, 2003). However, a notable feature of the selected four countries in Southern Africa for this study is that they all hardly fulfil the global recommendation by the WHO and UNICEF for infant and young children feeding to ensure optimal health and development. Thus, despite the relatively high prevalence of breastfeeding of over 90% observed in the four countries as evidenced in the individual countries' DHS reports, there exist low prevalence of exclusive breastfeeding among children. Additionally, it is also stated in the reports that a considerable number of children receive complementary foods too early or too late than it is recommended. Among the countries, Zimbabwe has the lowest prevalence (31%) of exclusively breastfed children, Swaziland (32%), Lesotho (54%) and Zambia has the highest prevalence (61%) (Zimbabwe National Statistics Agency (ZIMSTAT) and ICF International, 2012; Central Statistical Office, CSO, and Macro International Inc., 2008; Ministry of Health and Social Welfare, MOHSW, Lesotho, and ICF Macro, 2010; Central Statistical Office (CSO), Ministry of Health (MOH), Tropical Diseases Research Centre (TDRC),University of Zambia, and Macro International Inc., 2009).

Therefore, both the upsurge and stalling of infant mortality experienced in Southern Africa could likely be attributable to the observed poor infant feeding practices that are non-compliant with the global health recommendation on infant and young children feeding practices. Many studies on infant feeding practices have mainly focused on its relationship with infant mortality from various diseases at infancy or in early childhood including diarrhoeal disease, acute respiratory infections and HIV/AIDS (Roosenkhan et al, 2012; Mihrshahi et al., 2008; Betran et al., 2001). However, the association between infant feeding practices and infant mortality without taking into account the main or specific causes of mortality among infants has not been explored in the region and elsewhere, especially using

secondary data. Therefore, understanding how infant feeding practices influence infant mortality is vital for improving child health indicators in the region.

1.3 Research Question

What is the association of infant feeding practices with infant mortality in Southern Africa?

1.3.1 General Objective

To examine the relationship between infant feeding practices and infant mortality in Southern Africa.

1.3.2 Specific Objectives

- To estimate the levels and examine the pattern of infant feeding practices and infant mortality in Southern Africa.

- To examine the unadjusted and adjusted association of infant feeding practices on infant mortality in Southern Africa.

1.4 Justification

The low level of the recommended exclusive breastfeeding in Lesotho, Swaziland, Zambia and Zimbabwe pose a major challenge to child survival and may have contributed to the observed high infant mortality rates in the Southern African region. The study is important because in recent years, both global and local organisations as well as health research and interventions have been focusing and associating the high infant and child mortality with the HIV/AIDS pandemic in these highly affected countries. Some socio-economic factors including the education of mother, type of residence, labour market status and biological and maternal determinants also do receive attention in the research of infant and child mortality. However, studies on the possible impact of infant feeding practices on infant mortality are lacking in the region.

Although the pattern of feeding was defined as a significant predictor of child morbidity and mortality by the WHO (Goga et al., 2012;WHO, 2000), very little is known about the relationship between infant feeding practices and infant mortality in Southern Africa, especially in the context of the high HIV prevalence in the region. As such this study will shed light into this relationship which is expected to aid or improve the implementation of timely and relevant intervention programmes for improved child health outcomes. It has also been brought forth that compliance with the recommended infant and young children's

feeding practices could prevent an estimated 1, 301, 000 deaths or 13 % of the total deaths among children under-five in a theoretical year (Beasley and Amir, 2007). Further, inappropriate feeding practices and their consequences are stated by the WHO (2003) as the major obstacles to sustainable socio-economic development and poverty reduction. Therefore, the study will undoubtedly provide invaluable information to inform policies and intervention programmes aimed at improving both child health outcomes and overall socioeconomic development in the region.

CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.0 Introduction

This chapter presents the relevant literature review on infant mortality and its relationship with infant feeding practices, HIV/AIDS, maternal demographic and socio-economic characteristics as well as the infants' bio-demographic characteristics. This chapter also comprises of the Conceptual and Theoretical Framework employed in this study and concludes with the study hypothesis.

2.1 Literature review

2.1.1 Infant mortality

The developed countries experience only 8 deaths per 1000 live births on average whilst 61 deaths per 1000 live births are observed for their developing counterparts, with the rate even higher than the average for some developing countries in Sub Saharan Africa (Bankole and Singh, 2002). Infant mortality continues to devastate families and communities in many countries of the developing world including Southern Africa. Since the emergence of the HIV/AIDS pandemic in the early 1980s along with its rapid spread among various subgroups of the population, the overall increases in mortality have been alarming in the region. Similarly, recent studies have predominantly linked the currently high infant mortality to the HIV/AIDS pandemic in Southern Africa (Sartorius et al. 2011; Buwembo, 2010). Empirical evidence indicates that with 42% of child deaths occurring in Sub Saharan Africa, AIDS is responsible for more than half of child deaths experienced in Southern African countries such as Botswana and Zimbabwe (Black et al., 2008).

Apart from the HIV/AIDS pandemic, studies have also demonstrated other causes of infant mortality worldwide and also in Southern Africa. In a study by Black et al. (2008), under nutrition is cited as an underlying cause for a substantial proportion of all child deaths. According to UNICEF (2011), out of all the 29 000 of children under-five who die every day, mainly from preventable causes such as measles, malaria, tetanus, conflicts, marginalization and HIV/AIDS, about half of all these children's deaths are due to malnutrition and lack of safe water and sanitation. Most of the deaths are stated to occur in the developing countries (UNICEF, 2011).

2.1.2 Infant mortality and feeding practices

In order to improve child survival in developing countries, especially in Southern Africa, there is need to also focus on infant feeding practices even in the backdrop of high HIV prevalence. As part of its mission to improve child survival and also eliminate deaths due to preventable causes such as malnutrition, both WHO and UNICEF encourage exclusive breastfeeding for infants in the first few six of life and thereafter continued breastfeeding combined with nutritive complementary foods well into two years age or more (WHO, 2003). However, even though appropriate infant feeding practices are vital for the survival of children, malnutrition continues to play a lead role as a contributory factor for high infant and child mortality in countries where the global recommendation for infant and young child feeding is not satisfied. For instance, in a study by Awumbila (2003), infant feeding practices were found to be the largest contributor to the high rates of malnutrition which consequently accounted for the majority of infant and child mortality in Ghana.

Adequate infant feeding practices especially breastfeeding has been known and proven by many studies to have more benefits for improving the health status of infant and children under-five year (Fowler, 2008; Edmond et al., 2006). In general, the practice of breastfeeding has nutritional, physiological, immunological and psychological benefits (Lobola, 2000). According to Burns (2001), the specific benefits of breast milk as opposed to artificial products are that it has sufficient calorie content, digestible proteins, fat and carbohydrates, low load of electrolyte, sufficient vitamins, easily absorbable iron and other micronutrients that promote child health. The nutrient content of breast milk is described as the best remedy to fight diarrhoea and dehydration which is the major cause of infant mortality in many sub-Saharan African countries (Coutsoudis et al., 1999).

Breastfeeding, especially exclusive breastfeeding coupled with its early initiation offers a great protection against diseases while no breastfeeding is associated with a six-fold increase in mortality due to infectious diseases particularly in resource poor countries (WHO, 2012). According to the International Baby Food Action Network (IBFAN) (1999), infants who are not breastfeeding have a 14 times higher risk of dying from diarrhoea and 3 times higher risk of dying from respiratory infection (ARI). The negative effect of no breastfeeding are detrimental to child's health as a three-year cohort study of children less than 4 years in Guinea Bissau also found that no breastfeeding was a risk factor for continued diarrhoea in

early childhood (Molbalk et al., 1997). Another study in Chittagong, Bangladesh (2008) also found that infants who experienced exclusive breastfeeding for six months exhibited a significantly lower prevalence of both acute respiratory infection and diarrhoea as opposed to infants who were not exclusively breasted (Mihrshahi et al., 2008). In addition, a study by Mihrshahi et al. (2008) found no differences in the prevalence of morbidity between infants experiencing exclusive breastfeeding and predominantly breastfed infants hence suggestive of the morbidity reduction effect of both exclusive and predominant breastfeeding in the Bangladesh rural area.

Humphrey (2010) further describes breastfeeding as both a cornerstone and a critical factor for child survival as compared to formula feeding which is often inaccessible, unfeasible, unaffordable, unsustainable and unsafe for most families in developing countries. Breast milk is stated by UNICEF (2000) to be more superior to bottle feeding as infants who are fed breast milk experience minimal illnesses and experience less malnutrition than infants that are bottle fed. In Botswana, for instance, exclusive breastfeeding was associated with a reduced risk of late vertical transmission of HIV among infants when compared to infants who were having a combination of breast milk and other supplementary foods or liquids (Roosenkhan et al., 2012). In a study in Uganda (1999), it was also reported that 85% of infants who were given formula died as a result of contaminated dilution water that was used as opposed to 27% deaths of infants infected with HIV.

According to Sika-Bright (2010), infant feeding practices have undergone many changes and many debates to the extent that infants across the globe are either fed exclusive breast milk , exclusive complementary food or a combination of the two. Infant feeding behaviour, especially breastfeeding tends to vary by different regions, countries and communities. In a study in Northern Ghana by Awubila (2003), it is stated that less success in increasing the percentage of exclusively breastfed infants was due to the difficulty in changing infant feeding practices as they are linked directly to various economic, socio-cultural and religious factors at the community level as well as other several dynamics that are prevalent at the household level. In other countries, such as rural India, there is late initiation of breastfeeding and colostrum is usually discarded despite the overall universal breastfeeding among Indian mothers (Mahmood et al., 2012). As such, the impact that infant feeding practices has on

infant mortality is confounded by other socio-economic, cultural, religious and individual factors.

2.1.3 Infant mortality, feeding practices and HIV/AIDS

The issue of infant feeding, especially breastfeeding in the context of HIV/AIDS has been contentious in recent years, with some studies linking breastfeeding with increased infant HIV infections. Alban and Andersen (2007) found that children born in areas with high as opposed to low HIV prevalence face a significantly increased risk of dying before the age of five, both as a direct and indirect consequence of HIV/AIDS. Whilst breastfeeding is viewed as a key component for promoting child survival, Humphrey (2010) asserts that breastfeeding account for one-third of all infant HIV infections. It is such controversies that have also led to the several reviews of the global recommendation of infant and young children feeding over the past years. Even though the global recommendation for infant and young child feeding has undergone several revisions up-to-date in the light of the HIV/AIDS pandemic, not much has been altered from the initial recommendation. In 2010, the WHO reviewed and modified the recommendations for feeding an infant whose mother is HIV positive to also reflect new evidence and knowledge regarding ARVs and breastfeeding , and to further harmonize the reviewed recommendations with HIV treatment and prevention of mother-to-child transmission of HIV (PMTCT), (WHO,2012).

Thus, studies in South Africa and Zimbabwe have found the risk of HIV transmission through exclusive breastfeeding from about six weeks to six months to be very low, 4 % and 1.3 %, respectively (Coovadia et al. 2007 ; Iliff et al., 2005). On the other hand, non-breastfed infants of HIV positive women were found to be exposed to an increased risk of morbidity and mortality associated with replacement feeds (Coovadia et al., 2007). Additionally, empirical evidence has also shown improved HIV-free survival among HIV-exposed infants who were exclusively breastfed as they were substantially protected from infectious diseases as compared to mixed feeding or replacement (WHO, 2002; 2012). Therefore, such evidence suggests that infant and child mortality rates can still be improved even in countries that are experiencing higher HIV prevalence like those in Southern Africa as long as the infant and young children feeding recommendation is complied with. On the other hand, high infant and child mortality can be expected among infants and children born to women who are HIV positive as opposed to infants and children of HIV negative women. This is because health

personnel can advise HIV positive women to completely avoid breastfeeding as this is embedded in the recommendations for infant feeding in the HIV setting (WHO, 2013). Additionally, when taking into account the benefits of breastfeeding, in particular, exclusive breastfeeding, infants who are breastfed can be expected to have lower chances of both morbidity and mortality than not breastfeeding infants.

2.1.4 Infant mortality and maternal characteristics

There also exists a large body of literature on the determinants of infant mortality in both developed and developing countries. Many studies done in disparate settings have found significant relationships between mothers' demographic, environmental and socio-economic characteristics and infant and child mortality. The characteristics include mother's age, education, type of place of residence, marital status, occupation, and level of income or wealth status.

Mothers' age

The age of the mother is one of the important causal factors of infant and child mortality. Similarly to the common bath tub or U-shape relationship between age and mortality, the same pattern is observed for the age of mother and child mortality. A study done in Uganda by Ssewanyana and Younger (2007) revealed a lower probability of mortality among infants born to older women compared to infants born to younger women. Apart from exhibiting a 50-100% risk of death in less than a month after birth, children born to younger mothers, in particular, adolescents are likely to experience preterm birth, low birth weight and asphyxia which potentially upsurge the risk of death and development of unfavourable future health conditions for the children than children born to older women (WHO, 2006, 2013; Patton et al., 2009). However, despite the steady decline in the risk of infant and child mortality with age, it tends to also increase again with age. According to Sullivan (1994), older women who have had repeated births are likely to experience pregnancy complications due to the deterioration of the reproductive system. Charmabagwala et al. (2004) also found that older mothers were likely to experience child death than young mothers. Thus, in sum, the evidence underscores the fact that both young and old women can be expected to have high risk of infant and child mortality than women in the middle of the reproductive years.

Mother's education

Among the socioeconomic characteristics, various studies (Buwembo, 2010; Mustafa and Odimegwu, 2008; Walufa et al., 2012; Uddin et al., 2009) have consistently found that the education of parents, especially maternal education has substantial influence on both child mortality and child survival. According to Charmabagwala et al. (2004) and as also embedded in the Mosley and Chen Framework (1984), the mother's education determines children's' health and nutritional status in two folds. First, better education often translates into higher income hence increased expenditure on food and access to health care services. Secondly, better educated mothers are also likely to make better use of available information about child nutrition and health such as the knowledge to boil water when that is the only source as well as even adhering to recommended infant and child feeding practices. As such a study in Bangladesh found an increase in infant mortality of 1. 64% for children born to illiterate mothers as compared to only 0.54% for children born to mothers with an educational level of secondary and above (Uddin et al., 2009).

Type of place of residence

A large body of literature have demonstrated the relationship between mothers' type of place of residence and child mortality. Buwembo (2010) asserts that in most developing countries, the mother's type of place of residence influences children's survival and nutritional status. This relationship has been demonstrated in several studies; Zhang and Kanbor (2005), Bbaale, 2011. In a study that explored infant mortality in relation to social inequalities in the provision of health care between rural and urban areas in China found wide gaps in infant mortality rate between rural and urban residents and also among different provinces or regions (Zhang and Kanbor, 2005). Similarly, in a study in Uganda, Bbaale (2011) also found an association between rural residents and lower child survival rate compared to their urban counterparts. According to Zwane (2007), the differentials in infant mortality between rural and urban areas can be expected to exist due to inherent regional differences in the provision of health infrastructure and prevalence of disease. Thus, taking into account the wide socio-economic disparities between rural and urban areas in most African countries, children born in rural areas are likely to have high child mortality compared to children in adequately resourced urban areas.

However, despite the consistent relationship that has been observed between the type of place of residence and child mortality from several studies, it could also be expected that children from urban areas with disadvantaged backgrounds can experience high mortality and be more prone to infectious diseases due to increased urban poverty brought about by the week effect of urbanization (Amouzou and Hill, 2004; Buwembo, 2010). This is further supported by a study done by Sastry (2004) in Sao Paulo in Brazil where there was a relatively narrow gap between rural-urban differentials and intra-urban differentials. According to Sastry (2004), rapid urbanization which contributed to poor living conditions in metro Sao Paulo, particularly, its periphery accounted for most of the under-five mortality rate even though disadvantaged rural children continued to also exhibit higher mortality than urban children.

Mothers' Marital Status

There are very few studies that have ivestigated the association between marital status and child mortality. However, in a study by Wright (1997) which examined the aforementioned relationship in Jamaica, marital status especially the type of unions were found to be a good explanatory factor for the variations in infant mortality. After holding other factors constant, this study revealed that infant mortality was higher in common-law as well as visiting unions than in marriage, with the risk of dying at infancy being lower when the child is born within marriage. Kyei (2011), in study done in South Africa also found a significant relationship between marital status and under-five mortality. Other studies on child mortality have focused on studying the effect of the age at marriage and marriage duration. Quamrul et al. (2010) in Bangladesh found that both the age at marriage and marriage duration had a significant influence on child mortality. The results from the study found that, despite being married, child mortality was higher among mothers who married before the age of 15 and those who had a longer duration in marriage of over four years as compared to mothers who got married above age 15 years and who had short marriage duration of 0-4 years. As such, these findings are indicative of a variation of child mortality even among the married women. Thus the variations in the age at marriage in most African countries make exploring the type of relationship that marital status has with infant mortality worthwhile in the study.

Mothers' Work Status and Occupation

Participation in the labour market by mothers has an influence on the survival of under-five children as captured in vast amount of literature. Studies have found the influence of

mother's labour market participation on child survival to be in two directions. According to Kyei (2011), the necessity to work, mainly outside the home is usually matched with both modernity and better family income which are subsequently expected to increase the survival chances of children. However, at the same time, working outside the home is also linked to low survival chances of children as it directly prevents the mother from caring for infants hence lack of proper feeding, particularly breastfeeding early at infancy can have considerable negative effects (Hobcraft et al., 1984; Buwembo;, 2010).

Whilst employed parents are likely to improve the quality of lives of their children, Kyei (2011) in a study in South Africa pointed out that some children born to unemployed parents with no financial means to support them would find themselves without parental care, proper food and in the worst situation they are even abandoned and left to fend for themselves in the streets. Several studies have indeed found differing relationship between the mothers' work status and infant and child mortality (Buwembo, 2010; Kyei, 2011). In a study in South Africa by Buwembo (2010), children born to unemployed mothers' exhibited a 1.4 times likelihood of dying than those of employed mothers. Thus it was concluded that the employment of women has an empowering effect that helps improve the survival status of their children. However, the study by Kyei (2011) in South Africa found that under-five mortality was higher among working women. In this study it is also brought forth that most women in South Africa are domestic workers, who often do not stay with their children, do not have sufficient incomes or wages that can compensate for their absence from home hence this tend to have negative impact on their young children's health. Furthermore, a study in Kenya by Mustafa and Odimegwu (2008) also found that nonworking women exhibited lower infant mortality in comparison to working women. The difference in post neonatal mortality rate is assumed to be due to nonworking women having all the time to take care of their infants hence working mothers only have limited maternal leave and time from work to care for their young ones.

Mothers' Wealth Status

Many studies have examined the impact of wealth or income on infant mortality. Studies have found differing infant mortality rates by levels of income, fluctuations in income and income inequality within both advanced industrialized and less developed countries (Abouharb and Kimball, 2002). According to Sultan (1995), people in lower income brackets,

and also experiencing fluctuations in income and uneven distributions of income even in advanced industrialized democracies, have been associated with a higher infant mortality rate. In a study on child health and nutrition outcome, increased wealth or income increased the availability of resources to a household translating into higher expenditures on food and health, thus implying reduced risk of infant and child mortality (Charmabagwala et al., 2004).

The level of socioeconomic status has for a long time been associated with health outcomes, hence infant and child mortality. At the national level, a study by Abuqamar et al. (2010) which was done in the Arab World for the period 1990-2009 found an inverse relationship, that is, low socioeconomic status was related to increased risk of infant mortality. Thus, whilst high socioeconomic status has been linked with low infant mortality as also found by Abuqamar et al. (2010), this pattern has also been observed in Uganda. Uganda is one country that experiences high infant mortality despite improvements on national income (Ssewanyana and Younger, 2007). The inconsistency in the relationship between socioeconomic status and child survival was also observed in Kenya. In relation to socioeconomic status which was measured by wealth index, as could be expected the poorest households experienced the highest infant mortality rate, however, the richest households exhibited higher levels of infant mortality than the richer households (Mustafa and Odimegwu, 2008). The high number of AIDS related deaths in rich households was stated by Doctor (2004) in his study on adult mortality in Malawi to be the predominant cause of the high infant mortality experienced in rich households. Therefore, given the high prevalence of HIV/AIDS in Southern Africa, the direction of the relationship between socioeconomic status and infant mortality becomes difficult to predict.

2.1.5 Infant mortality and infant's biological and demographic characteristics

Many studies have investigated the relationship between infants' biological and demographic variables such as sex of child, preceding birth interval, birth order and birth weight.

Sex of child

While it is documented in demographic literature that a decline in childhood mortality is normally observed with an increase in age (McFalls, 2007), however, males have been found to be biologically more susceptible to mortality than females in virtually all the age groups throughout life. Boys typically have higher probabilities of both infant and child mortality (Ssewanyana and Younger, 2007). Charmabagwala et al. (2004) also brought forth that

mortality is higher among male infants compared to female infants with approximately half of nutrition studies having found that male children were the less well malnourished than their female counterparts and this was mostly dominant in East and Southern Africa. Additionally, Mustafa and Odimegwu (2008) also found that there was a significantly higher risk for infants not surviving if they were male , born in the fifth or more birth order, those who had less than two years birth interval and also never breastfed at all. Thus, the relationship between sex of the child and infant and child mortality has tended to be consistent in most studies in the large body of literature and in different settings.

Birth Order

With regards to the birth order of children, studies have shown contradictory relationships with infant mortality. According to Kamal (2012), while some studies indicated increased risk of neonatal mortality among higher-ranked births, other studies have found the risk increased for the first or lower-ranked births. The relationship between birth order and infant and child mortality is illustrated as taking the form of a U-shape. Generally, the risk of dying at infancy and childhood is described as higher among first birth order born by very young mothers , it steadily declines with subsequent birth orders and mother's age and then starts increasing again (Mekonnen, 2011). According to Mekonnen (2011), social, physiological coupled with reproduction immaturity among young mothers, especially adolescents are attributable to the high infant and child deaths of their first born child. Conversely, the high risk of infant and child deaths among older women is caused by repeated child birth and pregnancy complications that come with deterioration of the reproductive system (Sullivan, 1994). Therefore, the evidence suggests that infant mortality can be expected to be higher both among infants in the first birth order and those in higher birth order.

Preceding birth interval

The preceding birth interval is no doubt an important bio-demographic indicator that impacts on infant and child mortality. Several studies on mortality have demonstrated a high risk of infancy and childhood deaths for short birth intervals whereas long birth intervals are related with reduced risk of infancy and childhood deaths (Mustafa and Odimegwu, 2008; Rutstein, 2000). In a study to investigate determinants of infant and child mortality in developing countries during the 1990s using the Demographic and Health Surveys, Rutstein (2000) found that short birth interval, especially an interval of less than 24 months reduced

significantly both post-neonatal and infant mortality. Additionally, two other a studies, one done in Ethiopia by Mekonnen (2011) and the other done in South Africa by Buwembo (2010) concluded that prolonged birth intervals reduce the incidents of infant and child mortality. Therefore, based on the various research findings, longer birth intervals are associated with higher chances of infants' survival and shorter ones are associated with lower chances of infants' survival.

Birth weight

A considerable body of literature has documented the relationship between the birth weight and infant mortality. In a study by Wafula et al. (2012) done in Kenya, a smaller birth weight of an infant was found to be significantly associated with an increased risk of infant mortality compared to infants with average and large birth weight. The above mentioned findings were also consistent with a study done in Dallas (Mcltire et al., 1999) which found increased morbidity and mortality among preterm infants (born between 24 and 36 weeks of pregnancy), with birth weights at or below the third percentile for their gestational age. Additionally, Fanaroff et al. (2007) found progressive rises in infant survival with increasing birth weight among all infants who were born between 1997 and 2002 at the Neonatal Research Network centres in the United States.

2.2 Conceptual and Theoretical Framework

The study made use of the Mosley and Chen Framework of 1984, a proposed analytical framework for studying the determinants of child survival in developing countries. This framework was particularly relevant for the study since it postulates that "all social and economic determinants of child mortality necessarily operate through a common set of biological mechanisms, or proximate determinants, to exert an impact on mortality" (Mosley & Chen, 1984:25). As identified in the Mosley and Chen Framework (1984), the set of proximate determinants which have a direct influence on the risk of morbidity and mortality are grouped into five categories, which are; maternal factors (age, parity and birth interval), environmental factors (land, air, water and food contamination), nutrient deficiency (calories, proteins and micronutrients) injury (accidental and intentional) and personal illness control (personal preventive measures and medical treatment).

Apart from the proximate determinants, the Mosley and Chen Framework (1984) also brought forth and examined a range of socio-economic determinants (independent variables) which must operate through the proximate determinants to influence child morbidity and mortality. These are namely; individual-level variables (fathers and mothers' educational level, health status and time they have available to bear and rear a healthy surviving child as well as societal traditions/norms/attitudes), household-level variables (income and wealth) and also community level variables (ecological setting, health system and political economy).

Thus, this study adapted the Mosley and Chen Framework (1984) to examine the association of infant feeding practices on infant mortality in Southern Africa. From the five categories of proximate determinants in the original framework, this study operationalized only three. These were the maternal factors, environmental factors and nutrient deficiency. The remaining two of the five proximate determinants including injury and personal illness control were not operationalized in this study. In addition, infant's bio-demographic variables were also investigated and included in the adapted framework as factors that also influence child survival.

As such, the main explanatory variable of the study, infant feeding practices, was hypothesized to fall under the nutrient deficiency proximate determinant as embedded in the Mosley and Chen Framework (1984). According to Mosley and Chen (1984), nutrient deficiency relates to the influence of the intake and availability of nutrients to both the mother and child. The intake of calories, proteins and micronutrients are listed as important classes of nutrients for child survival. For instance, the importance of nutrition during pregnancy and lactation is stated to have an impact on the weight of new born children as well as the quality of breast milk (Mekonnen, 2011). The maternal factors adopted in this study included maternal age, highest educational level, marital status, HIV status, occupation and wealth index whereas type of place of residence was the only environmental factor. Infants' bio-demographic variables included sex of child, preceding birth interval, birth order and birth weight. Therefore, in line with the purpose of the study, it was assumed that infant feeding practices coupled with the maternal socio-economic determinants, infant's bio-demographic characteristics and environmental factors had a direct impact on infant survival in Southern Africa.

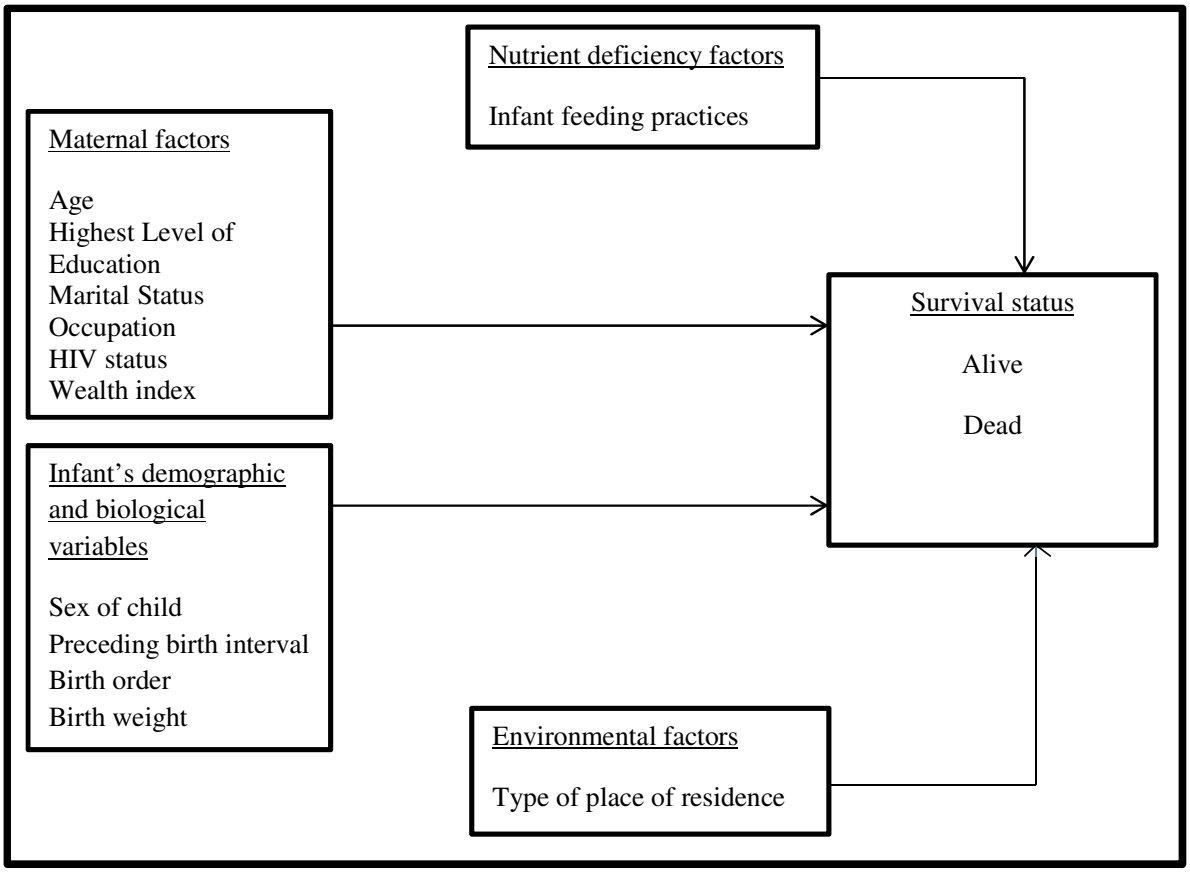

Figure 1: Framework for the study of infant feeding practices and infant mortality: Adapted from Mosley & Chen 1984

In view of the literature review and the conceptual framework by Mosley and Chen (1984), there is a well-established relationship between socio-economic and demographic factors, environmental factors, nutritional factors and infant and child mortality (Mosley & Chen, 1984; Kamal, 2012). The adapted Mosley and Chen (1984) framework in this study made use of nutrient deficiency (infant feeding practices), maternal factors (age, highest educational level, marital status, occupation, HIV status and wealth index), infants' bio-demographic variables (sex of child, preceding birth interval, birth order and birth weight) as well as environmental factor (type of place of residence) as explanatory variables that might influence infant survival in the Southern African region.

2.3 Research Hypothesis

This study hypothesize that exclusively breastfed infants compared to infants with other feeding practices have a lower risk of mortality.

This is on the premise that even though breastfeeding is widely practiced in Southern Africa, there exist low levels of exclusive breastfeeding among infants in their first six months of life despite the many benefits for their health and development. Empirical evidence has shown that breastfeeding especially exclusive breastfeeding offers great protection against infectious diseases to children in the first year of life (WHO, 2003; 2012 and 2013; Hobcraft et al, 1984; Betran et al., 2001; Edmond et al., 2006; Humphrey, 2010; Coovadia et al., 2007), thus significantly reducing both the risk of infant morbidity and mortality.

CHAPTER 3: METHODOLOGY

3.0 Introduction

This chapter focuses on the methodology, which provides detailed information about how the objectives of the study were achieved. Details on the study design, study population, sample size as well as study variables and their definitions are presented. The data methods which include statistical techniques, procedures of data management and data analysis used are also outlined. Lastly, the chapter highlighted the study limitations and ethical issues pertaining to the study.

3.1 Study Design

The study used the 2009/2010 Lesotho Demographic and Health Survey (LDHS), 2006/07 Swaziland Demographic and Health Survey (SDHS), 2007 Zambia Demographic and Health Survey (ZDHS) and 2010/11 Zimbabwe Demographic and Health Survey (ZDHS) datasets. All the surveys were conducted within a five year period. The datasets utilized were the Children's and HIV recodes for each of the four countries. A recode is a standardised DHS dataset for each country, which contains both standard and country specific variables (Measure DHS, 2013). The Children recode had all the information on children and their mothers. The same CASEID (which refers to a unique identification of each respondent), was used for the mother and children plus a consecutive number to differentiate among children of the same mother born in the last five years (Measure DHS, 2008). On the other hand, the HIV recode had information on both men and women's HIV testing results. It was after the merging procedure of both the Children's and HIV recodes that only women whose HIV testing results were known, had children in the last five years and whose CASEIDs were matching those in the Children recode were obtained. Women who did not have HIV testing results despite having had children in the last five years and also men were removed during the merging. Therefore, both the Children and HIV recodes were merged separately for each country, thereafter appended to have one dataset for analysis.

3.2 Study Population

The target population for this study were children born in the last five years preceding the surveys whose information on feeding practices was provided by their mothers in Lesotho, Swaziland, Zambia and Zimbabwe. The reasons for selecting the four countries was mainly because they all have high infant mortality, above 50 deaths per 1000 live births and are also highly affected by the HIV/AIDS pandemic. The HIV/AIDS pandemic has an effect on infant

feeding practices, in particular, contributing to the number of infants who may never breastfeed at all and is also one factor that contributes to the high infant mortality in Southern Africa as already mentioned in the reviewed literature. The four countries also have comparable recent data that are suitable for the examination of the association of infant feeding practices with infant mortality. Another important reason for selecting the four countries was also to obtain a larger sample size as death is a rare event hence a combination of four countries resulted in a substantial sample size.

3.3 Sample Size

The analysis sample size of the study was obtained from a total of 18, 773 children born in the last five years prior to the surveys by mothers aged 15-49 years of whom 13, 362 had their information on feeding practices provided by their mothers as indicated in Table 1. The remaining total number of 5, 411 children who did not have their information on feeding practices were removed from the study sample. Then from the total of 13, 362 children born in the last five years who had information on feeding practices, a total of 144 children who were aged 12-59 months were also removed in order to remain with infants, those 0-11 months who were 13, 218 as also shown in Table 1 by each country. Further, of the 13, 218 children aged 0 to 11 months (infants), 677 of them died before their first birthday as demonstrated in Figure 2.

Table 1: Sample Size by Country

Original Sample Size					
	Lesotho	**Swaziland**	**Zambia**	**Zimbabwe**	**Total**
Number of children born in the last five years.	3, 999	2, 812	6, 399	5, 563	18, 773
Number of children born in the last five years whose information on infant feeding practices was available.	2, 895	1, 801	5, 312	3, 354	13, 362
Study / Analysis Sample Size					
Number of children 0-11 months (infants) born in the last five years whose information on infant feeding practices was available.	2, 870	1,790	5, 238	3,320	13, 218

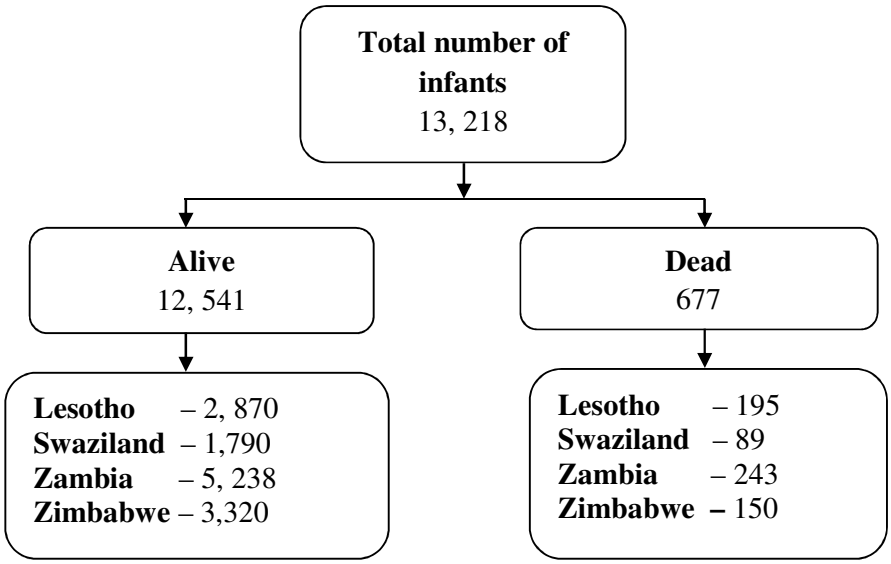

Figure 2: Study sample size, infants (dead and alive)

3.4 Variables used for the study and their definitions

3.4.1 Outcome variable

Infant mortality was the outcome variable of the study. It refers to death between 0 and 11 months of life. The children that died were regarded as having experienced the event while those that survived to the end of the observation period of 1 year were censored. Overall, the dependent variable took into account the infants' survival status and the month at which they died within the first year of their lives.

3.4.2 Explanatory variables

Main explanatory variable

Infant feeding practices was the main explanatory variable and had three categories which were:

Exclusive breastfeeding

Exclusive breastfeeding means that an infant received only breast milk from his or her mother or a wet nurse, or expressed breast milk and no other liquids or solids, not even water, with the exception of oral rehydration solution, drops or syrups consisting of vitamins, mineral supplements or medicines (WHO, 2012). This category takes into account infants who received exclusive breast milk in the first six months (0-5 months) as recommended by WHO and UNICEF.

Partial breastfeeding

Breastfeeding while also receiving water-based drinks, food-based fluid, semi-solid or solid food or non-human milk (also called complementary foods). All infants that did not receive exclusive breast milk but received some breast milk in addition to complementary foods are in this category.

No breastfeeding

This category comprised of infants that never received breast milk.

How infant feeding practices were derived and coded

The variable m4 on duration of breastfeeding was used. This variable gave the number of children who had ever breastfed (in months), never breastfed and those who were still breastfeeding reported for both surviving and dead children born in the last five years preceding each survey. For those children who ever breastfed, their mothers were then further asked about any other type of drinks or foods that were given to the child other than breast milk. The above question was asked to determine whether a child was exclusively or partially breastfed. Thus, the other types of drinks and foods that were given to children other than breast milk were obtained from variables V409 up to V414 in the DHS datasets. The category no breastfeeding, was derived directly from variable m4 which gave the number of infants that were never breastfed for a duration of 0 to 11 months, thus coded 0. Partial breastfeeding was derived from infants who had received other liquids or/and foods, combined with breast milk for a duration of 0 to 11 months and was coded 1. Lastly, exclusive breastfeeding was derived from infants who had not been given any other liquid or type of food but only breast milk from age 0 to 5 months and thus coded 2.

3.4.3 Other explanatory variables

The other explanatory variables that were examined in this study consisted of the mothers' demographic, environmental, socio-economic characteristics and the infants' bio-demographic characteristics as shown in Table 2.

The mothers' demographic, environmental and socio-economic characteristics included age, type of place of residence, highest educational level, marital status, occupation, HIV status and wealth index. The variable age referred to the mothers' current age in completed years,

grouped into seven groups in 5-year intervals for women in their reproductive age 15-49 years. This study categorised the mothers' age into four groups > 20 years, 20-29, 30-39 and 40-49 years. As found in literature, the risk of infant mortality is associated with the age of the mother and generally higher for both younger and older mothers.

Infant mortality differs by the mother's environment and socio-economic status. The type of place of residence referred to where the interview with the respondent took place, either urban or rural, which represents the kind of environment both the mother and infant come from. However, the variable country identifies the survey from which the data were gathered. The analyses in this study were controlled for country and the four countries of interest were, namely, Lesotho, Swaziland, Zimbabwe and Zambia. The highest level of education provided the level of the highest education attended by the respondent. In this study it was grouped into three categories, which were, mothers with no education, primary education as well as secondary and higher. In literature, high infant mortality is associated with lack of education whereas low infant mortality is associated with increased levels of parental education.

The marital status refers to the current marital status of the respondent. It was grouped into three categories in this study, mothers who were married at the time of the survey (which consisted of married women combined with those living with a partner), the formerly married (which consisted of the widowed, divorced and separated women) and also the never married. The variable occupation refers to mothers who currently work or have worked in the last 12 months. In the study the variable had four categories, consisting, not working, Professionals/clerical/services, domestic/sales, agriculture/skilled and unskilled manual labour. Infant mortality as well infant feeding practices differ by whether a mother is working or not and also by the type of occupation.

The HIV status gave the mother's HIV status as either negative or positive. This applied to respondents who did the HIV test during the surveys and whose HIV test results were known. The HIV status of the mother has been found to have an influence on both child survival and the infant feeding practices. The wealth index measures the cumulative living standard of the mothers' household. It was derived by collecting data on household's ownership of assets such as televisions, house construction materials, and water access and sanitation conditions. In this study, it was categorised into three groups, namely, poor, middle and rich. Infant mortality also varies by the wealth status of the mother.

The infants' bio-demographic variables comprised of sex of child, preceding birth interval, birth order and birth weight. Infant mortality varies by the bio-demographic characteristics of infants. The pattern of infant feeding practices can also be affected, especially by the preceding birth interval of the infant. The sex of child simply described the child as either male or female in this study. However, the preceding birth interval refers to the month/s difference between the current and the former birth. Twins are also counted as having experienced one birth. The preceding birth interval was measured as a continuous variable in the study. The birth order refers to the order in which the children were born and it was also measured as a continuous variable. Lastly, the birth weight of an infant which refers to child's weight at birth measured either in grams or kilograms and was categorised into three groups comprising, large, average and small birth weight.

Table 2: Definitions of explanatory variables used in the study

Variables			
Variable Code	Variable name	Original Codes	How coded in this study
Mothers' demographic, environmental and socio-economic variables			
V013	Age	15-19 (1) 20-24 (2) 25-29 (3) 30-34 (4) 35-39 (5) 40-44 (6) 45-49 (7)	< 20 (1) 20-29 (2) 30-39 (3) 40-49 (4)
V025	Type of place of residence	Urban (1) Rural (2)	Urban (1) Rural (2)
V000	Country	Lesotho (LS5) Swaziland (SZ5) Zambia (ZM5) Zimbabwe (ZW6)	Lesotho (1) Swaziland (2) Zambia (3) Zimbabwe (4)
V106	Highest educational level	None (0) Primary (1) Secondary (2) Tertiary/Higher (3)	None (0) Primary (1) Secondary and Higher (2)
V 502	Marital status	Never married (0) Currently married (1) Formerly married (2)	Never married (0) Currently married (1) Formerly married (2)

Variables			
Variable Code	Variable name	Original Codes	How coded in this study
V716	Occupation	Not working (0) Professional/technical /manager (1) Clerical (2) Sales/service (3) Skilled manual labour (4) Unskilled manual labour(5) Domestic (6) Agriculture (7)	Not Working (0) Professionals+clerical+services (1) Domestic+sales (2) Agriculture + skilled and unskilled manual labour (3)
Hiv03	HIV status	HIV negative (0) HIV positive (1)	HIV negative (0) HIV positive (1)
V190	Wealth status	Poorest(1) Poorer (2) Middle(3) Richer (4) Richest (5)	Poorest + Poorer=Poor (1) Middle(2) Richer + Richest=Rich(3)
Infants' bio-demographic variables			
b4	Sex of child	Male (1) Female (2)	Male (1) Female (2)
b11	Preceding birth interval	Continuous variable	Continuous variable
bord	Birth order	Continuous variable	Continuous variable
M18	Birth weight	Very large (1) Larger than average (2) Average (3) Smaller than average (4) Very small (5)	Large (1) Average (2) Small (3)

3.5 Data Management

In achieving the objectives of the study, the data management was done using Stata version 12 and SPSS version 20. SPSS are acronyms for Statistical Package for Social Science. Both SPSS and Stata are popular programmes for statistical analysis that are used by researchers in social sciences and other disciplines. They are very powerful tools for managing data and computing a wide range of statistics through the implementation of various statistical techniques (Social Science Computing Cooperative, 2011).

The first step to the data management process was to download the 2006/07 Swaziland Demographic and Health Survey (SDHS), 2009/2010 Lesotho Demographic and Health Survey (LDHS), 2007 Zambia Demographic and Health Survey (ZDHS) and 2010/11 Zimbabwe Demographic and Health Survey (ZDHS), Children and HIV datasets from the Measure DHS website. The next step was to merge both the Children and HIV recodes separately for each country and then all the four to each other to have one dataset comprising all the four countries' data.

All the variables were generated in the format indicated in Table 2 to produce more meaningful interpretation and analysis. There were 13, 218 infants aged 0-11 months that were observed in this research, whether the infant was alive or dead. To obtain the number of infants by whether they were alive or dead in this study, the variable b5 from the DHS was used. This variable (b5) gave the information on the child's survival status; either the child was alive or dead when the interview was conducted. Therefore, 677 of the infants were dead and 12, 541 were alive. The variable Death was then created based on b5, hence infants that died were regarded as having experienced the event and coded 1 while those that survived up to the end of the observation period of 1 year were censored and were coded 0. The variable Death represented the dependent variable of this research and took into account the infants' survival status and the month at which they died within the first year of their lives (less than 12 months). The Time variable was also created and made equivalent to b7, a variable in the DHS dataset that gives the age at death of the child in completed months.

The total number of 13,218 infants was observed for most variables of the study, namely, infant feeding practices, maternal age, type of place of residence, highest educational level, marital status, wealth index as well as sex of child and birth order. However, the observations were incomplete for some variables. These variables and their level of completeness were occupation (99.6%), HIV status (93.5%), preceding birth interval (99.7%) and birth weight (98.4%). With regards to occupation, the missing data was caused by some mothers who did not give the information or stated that they did not know the response pertaining to their occupation whereas for HIV status, some mothers' HIV status results were missing even though all mothers in the study had done the HIV test. Moreover, some infants' information on the preceding birth interval and birth weight was also not provided.

3.6 Data Analysis

Stata version 12.0 was employed to analyse the data with the Cox proportional hazard regression model. The Cox proportional hazard regression model is a statistical technique used to analyse survival data, especially for studies where the outcome or dependent variable is the measurement of time taken to experience a definite end-point event, usually death (Bewick et. al, 2004). The model is similar to the multiple regression model as it allows for the investigation of the survival time of particular groups while simultaneously adjusting for other covariates (Bewick et. al, 2004; Walters, 2009). Walters (2009) succinctly describes the proportional hazard regression model as a method that regresses or models the hazard function (survival time) on the predictor variables. In this study, for instance, infant mortality which is the dependent variable is the hazard and it indicates the probability of dying given that infants have survived up to 11 months.

The first step of data analysis began with declaring the data to be survival-time data (Stata Corporation, 2011), as per the requirement of the Cox proportional hazard regression model. Thus given the time and Death variables which were already created, the Stata command *stset time, failure (Death)* was set. All the children that did not die (experience the event) within the infancy period were right censored at 11 months.

The analysis was conducted at three levels. The first level was the descriptive analyses of infant mortality, infant feeding practices, maternal demographic, environmental and socio-economic variables as well as the infant's bio-demographic variables. These were done using frequency distribution, cross-tabulations, graphs and Kaplan-Meier curves, specifically, for the dependent variable (infant mortality) and main independent variable (infant feeding practices). The Kaplan-Meier's curves were done to show the pattern of infant mortality and infant feeding practices in Southern Africa. The generation of all the Kaplan-Meier's curves were for the Hazard function which only took into account dead infants. To estimate the levels of infant mortality, the study employed the direct demographic technique for measuring infant mortality.

Formula;

$$\textbf{Infant mortality rate (IMR)} = \frac{\text{Number of} < 1 \text{ year deaths given a period}}{\text{Number of live births in the same period}} * 1000$$

Source: Preston et al. (2001)

The second level of analysis was the Cox's hazard modelling of the independent effect of infant feeding practices and other covariates (maternal demographic, environmental and socio-economic variables as well as the infant's bio-demographic variables) on the probability of infant death before age 1. Lastly, multivariate Cox's hazard modelling of infant feeding practices variable together with all the other variables was done to assess the net impact of infant feeding practices on the probability of death before age 1.

3.7 Study Limitations

The number of infants who died before celebrating their first year of life includes those who died from endogenous, congenital factors and not necessarily the direct impact of infant feeding practices. Factors including low birth weight, prematurity and congenital malformations are stated by (Betran et al., 2001) as also having the potential to reduce the likelihood of breastfeeding among infants and further increasing the risk of death. This can be most expected for infants who died within 28 days after birth who also formed part of the study population size and this might have had an effect on the study findings.

The explanatory variable, infant feeding practices had a 28% missing data because some infants' information on infant feeding practices was not provided by their mothers. Due to this large percentage of missing data which could not be ignored, a comparison of the distribution of infants with the information on feeding practices and those with missing information was done (see Appendix 1). The results showed comparability and consistency in the distribution of the population by the various characteristics in this study. Therefore, the missing data on infant feeding practices was unlikely to have much effect (if any) on the results of the study. Moreover, the study sample size ended up being restricted to only infants whose information on feeding practices was available.

3.8 Ethical Issues

Since the study was an analysis of secondary data, the respondents' identifier information was removed as per the protocols of the all Demographic Health Surveys. Moreover, all respondents' gave informed consent before participation and all information was treated with confidentiality. Therefore, the participants' rights were not infringed when the information was collected. Additionally, data collection methods for all the surveys were revised and authorized by the Ethics Committee in the Ministries of Health and Institutional Review Boards (IRB) at the Human Sciences Research Council and Macro International.

CHAPTER 4: RESULTS

4.0 Introduction

This chapter presents the results obtained in the study. First to be presented are the results relating to the univariate analysis. These include the estimated levels and patterns of infant mortality and infant feeding practices in Southern Africa. It is also at the univariate level that the patterns of infant mortality rate by infant feeding practices and other explanatory variables while controlling for country are presented. The second presentation of results relates to the Cox's univariate and multivariate analyses aimed at examining the unadjusted and adjusted effect, respectively, of infant feeding practices and other covariates on infant mortality in the region.

4.1 Univariate Analysis

The first objective of the study was to estimate both the levels and patterns of infant mortality and infant feeding practices in the Southern African region as subsequently presented.

4.1.1 Estimation of the levels and pattern of infant mortality

It was found in the study that a total of 13, 218 infants born in the last five years prior to all the surveys in the four countries had their information on feeding practices available. Of the total number of infants, only 677 (5.5%) died before celebrating their first birthday. Between the countries, it is demonstrated in Figure 3 that infant mortality rate (IMR) was highest in Lesotho (68 deaths per 1000 live births), followed by Swaziland (50 deaths per 1000 live births, Zambia (46 deaths per 1000 live births) while Zimbabwe had the lowest IMR (45 deaths per 1000 live births). Overall, Southern Africa's infant mortality rate was 51 deaths per 1000 live births.

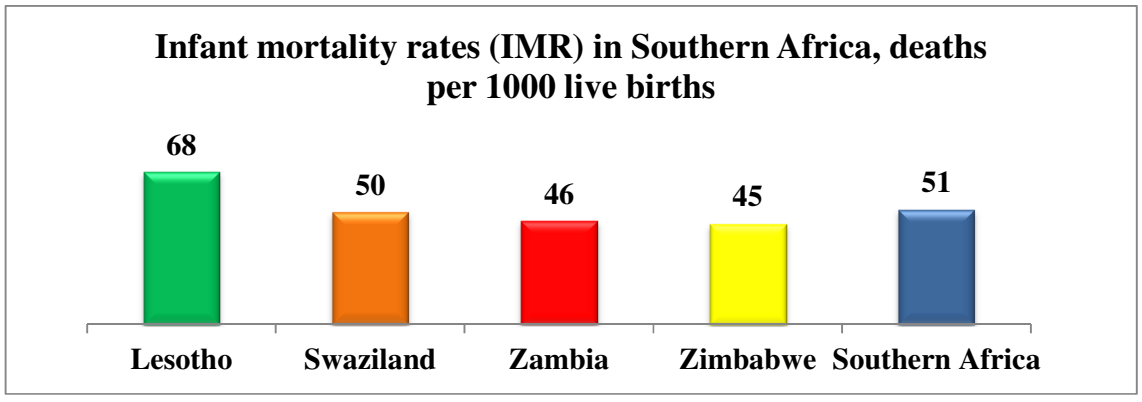

Figure 3: Levels of infant mortality rate (IMR) in Southern Africa

Overall, the probability of dying at infancy as demonstrated by the Kaplan-Meier's curve in Figure 4 indicated that the risk of infant death was over 50 % between ages 0 and 4 months. Thereafter, the risk of infant death was observed to decrease with an increase in the age of the infant. The pattern of the risk of infant mortality was also similar in the studied countries except in Swaziland, Appendix 2. The risk of death in the first month was shown to be certainly high, above 75 % for infants in their first month in Swaziland compared to about 50 % in the other three countries.

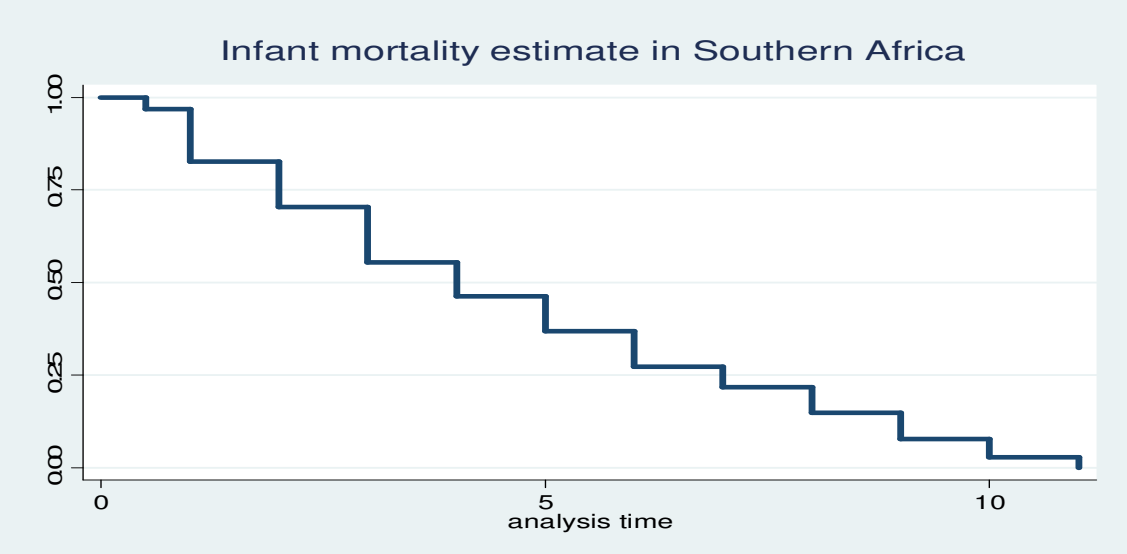

Figure 4 : Kaplan Meier's infant mortality curve (hazard function) in Southern Africa

4.1.2 Estimation of the levels and pattern of infant feeding practices

Another part of the first objective was to estimate the levels of infant feeding practices in Southern Africa. It is illustrated in Figure 5 that out of 13, 218 infants in this study, a sizeable proportion 10, 913 (82%) were partially breastfed, while 1, 544 (12%) were exclusively breastfed and the remaining 761 (6%) were never breastfed. Thus, the results indicated that partial breastfeeding was the predominant form of infant feeding in the region.

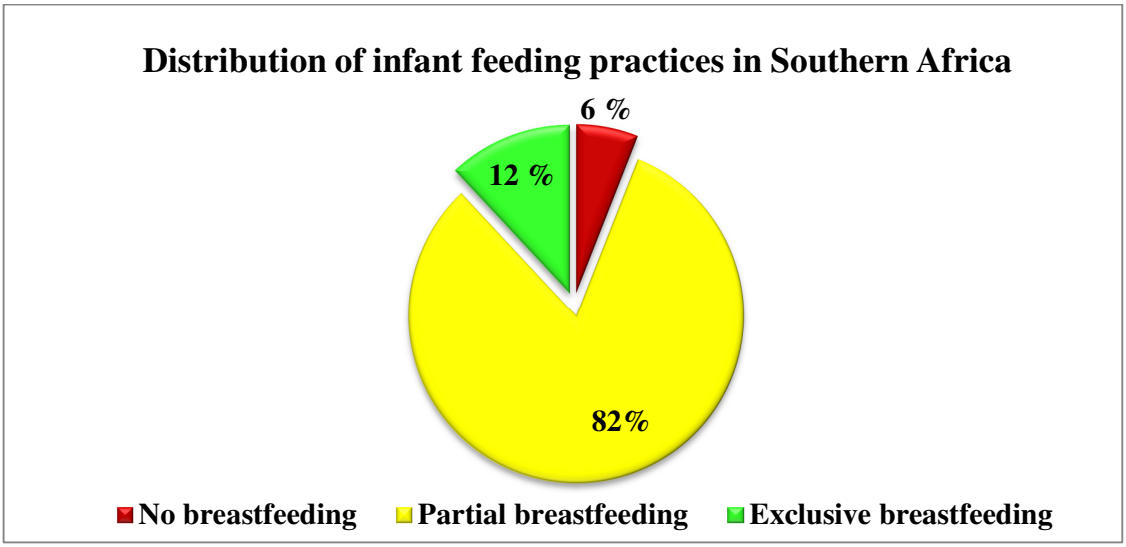

Figure 5: Percentage distribution of infant feeding practices in Southern Africa

It is shown in Figure 6 that within the countries, there were also variations in the proportions of infant feeding practices. The proportion of infants who were never breastfed was highest in Lesotho (11%) and lowest in Zambia (3%). Partial breastfeeding continued to predominate among the feeding practices even at country level and it was highest in Swaziland (85%) and lowest in Lesotho (75%). The proportion of exclusively breastfed infants was equally highest in both Lesotho and Zambia (14%) and lowest in Swaziland (7%).

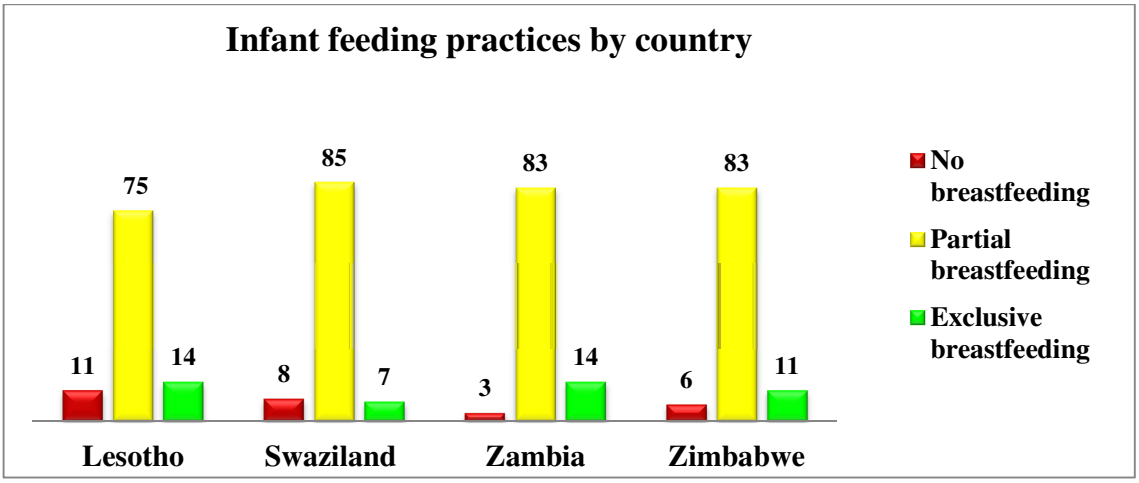

Figure 6: Percentage distribution of infant feeding practices by country

The Kaplan Meier's curves presented in Figure 7 revealed marked differences in the risk of dying at infancy by infant feeding practices in the Southern African region. For all the three infant feeding practices (no breastfeeding, partial breastfeeding and exclusive breastfeeding) the infant mortality risk was shown to be higher between ages 0 and 1 month even though it also tended to decrease with an increase in the age of the infant. Whilst the infant mortality risk remained high among the never breastfed infants, it was moderate for partially breastfed infants and even low among infants who were exclusively breastfed. A fairly similar pattern was also observed for each of the countries, Appendix 3.

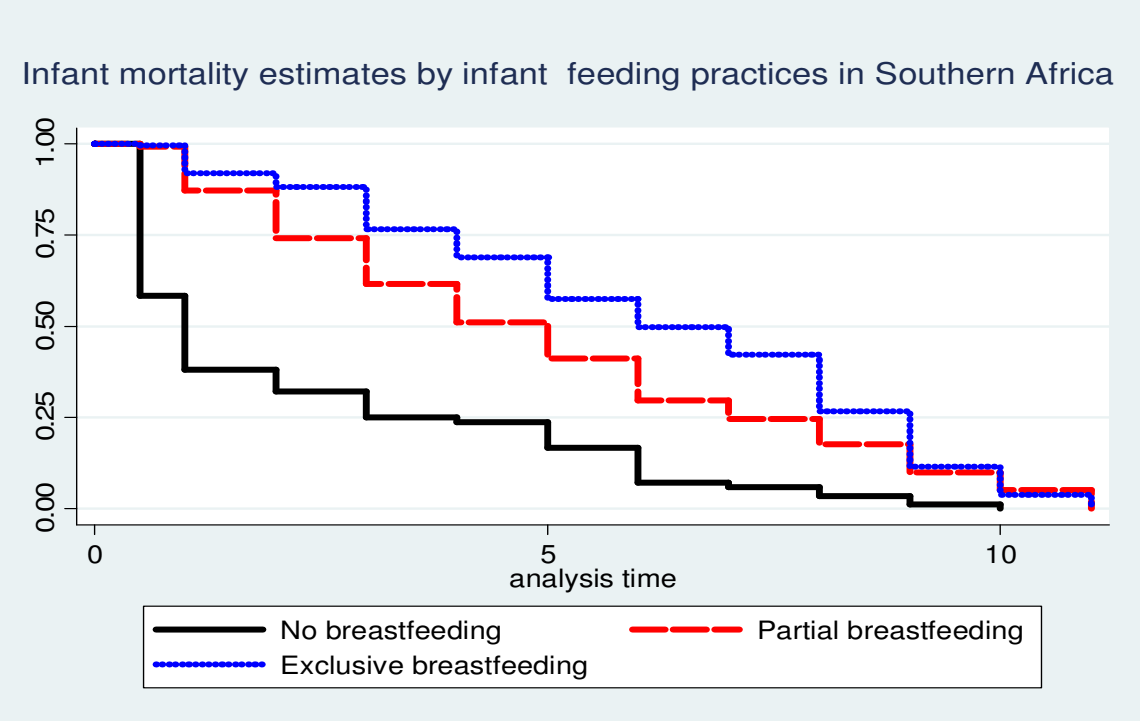

Figure 7: Kaplan Meier's infant mortality curves by infant feeding practices in Southern Africa

4.1.3 Pattern of infant mortality (IMR) by the selected characteristics

The results in Table 3 showed that in the four countries and Southern Africa, never breastfed infants had the highest infant mortality rates. In sum, by infant feeding practices, the results indicated that almost 500 deaths per 1000 live births were observed among never breastfed infants whilst less than 30 deaths per 1000 live births were represented among partially and

exclusively breastfed infants. The level of infant mortality was higher among infants who were partially breastfed and lower among exclusively breastfed infants for the different countries and in the region.

Country variations were observed in infant mortality rates by maternal age. In Lesotho, Swaziland and Zimbabwe, higher infant mortality rates (147, 85 and 60 deaths per 1000 live births), respectively, were observed among infants born to mothers in older ages, 40-49 years. Conversely, infants born to the age group that comprised of teenage mothers, < 20 years, exhibited higher infant mortality rate (58 deaths per 1000 live births) in Zambia. Overall, infants born to older mothers had higher infant mortality rate (78 deaths per 1000 live births) and the age group,< 20 years, demonstrated lower infant mortality rate (42 deaths per 1000 live births) in the region.

In relation to type of place of residence, the results showed that in three countries (Swaziland, Zambia and Zimbabwe), infant mortality was shown to be higher in urban areas as opposed to rural areas with the exception of Lesotho. Even in the region, infant mortality was found to be higher in urban areas (55 deaths per 1000 live births) as opposed to rural areas (50 deaths per 1000 live births). Country variations in infant mortality rates were also observed by highest educational level. Whilst in Lesotho and Zimbabwe, infants born to mothers who attained primary education had higher infant mortality rate (73 and 50 deaths per 1000 live births), respectively. However, in Swaziland and Zambia, higher infant mortality rate was observed among infants born to mothers with no education (62 and 51 deaths per 1000 live births), respectively. Overall, infant mortality rate was higher (56 deaths per 1000 live births) among infants born to mothers who attained primary education and lower (45 deaths per 1000 live births) among infants born to mothers who attained secondary and higher education in the region.

No much country variations were observed in infant mortality rates by marital status. For all the four countries including the regional total, infant mortality was observed to be higher among infants born to formerly married mothers. However, lower infant mortality rates by marital status were observed among infants born to never married mothers in three countries (Lesotho, Swaziland and Zimbabwe) with the exception of Zambia. In the three countries, infant mortality rates were 43, 42 and 6 deaths per 1000 live births, respectively. On the other hand, infant mortality rate in Zambia was lower among infants born to currently married

mothers (45 deaths per 1000 live births). Thus, overall, higher infant mortality rate was among infants born to mothers who were formerly married (77 deaths per 1000 live births) and lower among infants born to never married mothers (39 deaths per 1000 live births).

Infant mortality rate also varied by country in relation to mothers' occupation. In Lesotho and Zambia, infants born to mothers in professions exhibited higher infant mortality rates (106 and 63 deaths per 1000 live births), respectively. On the other hand, infants born to mothers in the agricultural and sales sector had higher infant mortality rate in Swaziland (87 deaths per 1000 live births) and Zimbabwe (67 deaths per 1000 live births). In the whole region, infants born to mothers in professions exhibited higher infant mortality rate (64 deaths per 1000 live births) while infants born to none working mothers had the lowest infant mortality rate (47 deaths per 1000 live births). The results also indicated country variations in infant mortality rates by mothers' HIV status. Both Lesotho and Zambia exhibited higher infant mortality rates among infants born to HIV positive mothers (71 and 51 deaths per 1000 live births), respectively, while Swaziland and Zimbabwe demonstrated higher infant mortality rate among infants born to mothers who were HIV negative (50 and 49 deaths per 1000 live births), respectively. Overall, infant mortality rate was higher among infants born to HIV positive mothers (53 deaths per 1000 live births) as opposed to those from HIV negative mothers (52 deaths per 1000 live births) in the region.

With regards to wealth status, the results showed fewer differences in infant mortality rates. In three countries (Lesotho, Swaziland and Zambia) infants born to mothers in the rich wealth status demonstrated higher infant mortality rates, (74, 65 and 50 deaths per 1000 live births) respectively, with the exception of Zimbabwe which exhibited higher infant mortality rate (46 deaths per 1000 live births) among infants born to poor mothers. In the region, the results further indicated that infants born to rich mothers had higher infant mortality rate (55 deaths per 1000 live births) and lower infant mortality rate (47 deaths per 1000 live births) was exhibited by infants born to mothers in the middle wealth status.

There were also fewer country variations in infant mortality by sex of child. With the exception of Swaziland, the other three countries (Lesotho, Zambia and Zimbabwe) indicated higher infant mortality rates among male infants as opposed to female infants. Overall, male infants exhibited higher infant mortality rate (58 deaths per 1000 live births) in Southern

Africa while female infants exhibited lower infant mortality rate (44 deaths per 1000 live births). The difference in infant mortality rates by sex of child was also sizeable.

Lastly, country variations were less in infant mortality rates by birth weight. In all the four countries (Swaziland, Lesotho, Zambia and Zimbabwe), infant mortality rates were higher among infants with small birth weight (129, 74, 90 and 90 deaths per 1000 live births), respectively. In the whole region, the results continued to indicate higher infant mortality rate (97 deaths per 1000 live births) among infants born with small birth weight and lower infant mortality rates (42 deaths per 1000 live births) observed among infants born with both average and large birth weight.

Table 3: Levels of infant mortality (IMRs) by infant feeding practices and other covariates in Southern Africa.

Characteristics	**Infant mortality rates (IMRs), per 1000 live births**				
	Lesotho	**Swaziland**	**Zambia**	**Zimbabwe**	**Southern Africa**
	68	50	46	45	51
Main Explanatory Variable					
Infant feeding practices					
No breastfeeding	**458**	**322**	**646**	**516**	**481**
Partial breastfeeding	24	26	30	19	26
Exclusive breastfeeding	27	16	25	9	21
Age					
< 20	44	35	**58**	28	42
20-29	67	57	53	42	54
30-39	63	36	31	57	44
40-49	**147**	**85**	50	**60**	**78**
Type of place of residence					
Urban	65	**76**	**48**	**54**	**55**
Rural	**68**	41	46	42	50
Highest educational level					
None	57	**62**	**51**	22	52
Primary	**73**	58	48	**50**	**56**
Secondary and Higher	59	42	39	43	45
Marital status					
Never married	43	42	46	6	39
Currently married	68	51	45	45	51
Formerly married	**101**	**95**	**61**	**76**	**77**

Characteristics	Infant mortality rates (IMRs), per 1000 live births				
	Lesotho	**Swaziland**	**Zambia**	**Zimbabwe**	**Southern Africa**
	68	50	46	45	51
Occupation					
Not Working	58	44	45	42	47
Prof., clerical & services	**106**	55	**63**	0	**64**
Domestic	44	**87**	39	**67**	52
Agriculture and manual labour	87	42	49	45	56
HIV status					
HIV negative	67	**50**	46	**49**	52
HIV positive	**71**	48	**51**	34	**53**
Wealth status					
Poor	68	40	45	**46**	51
Middle	59	43	45	43	47
Rich	**74**	**65**	**50**	45	**55**
Sex of child					
Male	**81**	40	**55**	**54**	**58**
Female	55	**59**	38	37	44
Preceding birth interval					
Continuous variable	68	49	45	44	50
Birth order					
Continuous variable	68	50	46	45	51
Birth weight					
Large	70	40	39	34	42
Average	50	45	40	33	42
Small	**129**	**74**	**90**	**90**	**97**

4.2 Cox Hazard Regression Model's Univariate and Multivariate Analyses

The second objective of the study was to determine both the unadjusted and adjusted effect of infant feeding practices on infant mortality in Southern Africa. The Cox hazard regression modelling was carried out for both the univariate (unadjusted) and multivariate (adjusted) analyses. The results are presented in Table 4.

4.2.1 Unadjusted Model

When unadjusted, the results presented in Panel 1 of Table 4 indicated that infant feeding practices, maternal characteristics including age, country, highest educational level and marital status as well as the infants' bio-demographic characteristics including sex of child,

preceding birth interval and birth weight had significant associations with infant mortality in Southern Africa. However, maternal characteristics including type of place of residence, HIV status, occupation and wealth index as well as infants' birth order did not have significant associations with infant mortality in the region.

The unadjusted results shown in Panel 1 of Table 4 indicated that infants who were partially and exclusively breastfed had a 96% and 97% lower risk of dying, respectively, compared to never breastfed infants. The results indicated that the risk of infant mortality was much lower among exclusively breastfed infants than those who were partially breastfed. These findings also suggest that any form of breastfeeding, whether exclusive or partial compared to no breastfeeding significantly reduces the risk of death during infancy.

The results also indicated a significant association between maternal age and infant mortality. Whilst the relationship was not significant for the age groups 20-29 years and 30-39 years, however, for infants born to mothers in the old age group 40-49 years, a significant 86% increased risk of infant mortality was observed compared to infants born to younger mothers, aged <20 years. With regards to country, all the countries (Swaziland, Zambia and Zimbabwe) demonstrated significant associations with infant mortality in the region. Whilst Swaziland infants exhibited a 28 % reduced risk of dying at infancy, Zambia had 33% and Zimbabwe had 35% compared to Lesotho. In relation to marital status, the results revealed that infants born to currently married and formerly married mothers had a 31% and a more than two times (2.02) higher infant death risk, respectively, compared to infants born to never married mothers.

The results further revealed that female infants exhibited a 25% lower risk of dying compared to male infants in the Southern Africa region. Additionally, both the infants' preceding birth interval and birth weight were also observed to be significantly associated with infant mortality in the region. With regards to the preceding birth interval, the results showed a 1% reduced risk of dying at infancy with each 1 month increase in the preceding birth interval of an infant. Lastly, infants who were born with a small birth weight exhibited a more than two times (2.38) risk of dying at infancy compared to infants born with a large birth weight.

Table 4: The unadjusted and adjusted hazard ratios (HR) of the association between infant feeding practices and other covariates on infant mortality in Southern Africa

Explanatory Variables	**Panel 1**		**Panel 2**	
	Unadjusted hazard ratio		**Adjusted hazard ratio**	
	Hazard Ratio	[95% CI]	Hazard Ratio	[95% CI]
Main Explanatory variable				
Infant feeding practices	***			
No breastfeeding (RC)	1.00		1.00	
Partial breastfeeding	0.04*	0.03 - 0.04	0.04*	0.03 - 0.04
Exclusive breastfeeding	0.03*	0.02 - 0.04	0.03*	0.02 - 0.04
Age	***			
< 20 (RC)	1.00		1.00	
20-29	1.28	0.96 - 1.71	1.19	0.86 - 1.66
30-39	1.04	0.76 - 1.42	0.97	0.64 - 1.46
40-49	1.86*	1.26 - 1.75	1.31	0.75 - 2.31
Type of place of residence				
Urban (RC)	1.00		1.00	
Rural	0.89	0.75 - 1.06	1.03	0.80 - 1.32
Country	***			
Lesotho (RC)	1.00			
Swaziland	0.72*	0.56 - 0.93	0.98	0.74 - 1.31
Zambia	0.67*	0.56 - 0.81	1.34*	1.07 - 1.68
Zimbabwe	0.65*	0.53 - 0.81	1.13	0.87 - 1.48
Highest educational level	***			
None (RC)	1.00		1.00	
Primary	1.08	0.80 - 1.44	1.05	0.76 - 1.44
Secondary and Higher	0.86	0.64 - 1.17	0.67*	0.47 - 0.97
Marital status	***			
Never married (RC)	1.00		1.00	
Currently married	1.31*	1.00 - 1.71	1.46*	1.08 - 1.97
Formerly married	2.02*	1.43 - 2.84	1.68*	1.15 - 2.44
Occupation				
Not Working (RC)	1.00		1.00	
Professionals , clerical and services	1.35	1.02 - 1.79	1.36	0.99 - 1. 87
Domestic and sales	1.09	0.86 - 1.39	1.15	0.87 - 1.51
Agriculture and Manual labour	1.17	0.98 - 1.40	1.15	0.94 - 1.39
HIV status				
HIV negative (RC)	1.00		1.00	
HIV positive	1.01	0.82 - 1.24	0.86	0.69 - 1.07

Explanatory Variables	**Panel 1**		**Panel 2**	
	Unadjusted hazard ratio		**Adjusted hazard ratio**	
	Hazard Ratio	[95% CI]	Hazard Ratio	[95% CI]
Wealth status				
Poor (RC)	1.00		1.00	
Middle	0.92	0.75 - 1.13	1.02	0.81 - 1.28
Rich	1.09	0.92 - 1.29	1.00	0.76 - 1.30
Sex	***			
Male (RC)	1.00		1.00	
Female	0.75*	0.64 - 0.87	0.77*	0.65 - 0.91
Preceding birth interval	***			
(RC)	1.00		1.00	
Continuous	0.99*	0.99 - 0.99	0.99*	0.99 - 0.99
Birth order				
(RC)	1.00		1.00	
Continuous	0.99	0.95 - 1.03	0.99	0.93 - 1.05
Birth weight	***			
Large (RC)	1.00		1.00	
Average	0.99	0.82 - 1.20	0.96	0.79 - 1.18
Small	2.38*	1.92 - 2.96	1.75*	1.39 - 2.21

RC = Reference category, ***p<0.05= Variable significance, *p<0.05= category significance

4.2.2 Adjusted Model

The multivariate results in Panel 2 of Table 4 indicated that infant feeding practices were significantly associated with infant mortality even after controlling for the effect of other covariates in the study. Exclusively breastfed infants continued to exhibit the lowest risk of mortality than infants with the other feeding practices. According to the results, exclusively breastfed infants maintained the 97% lower risk of dying compared to not breastfeeding infants which is similar to the unadjusted model. Similarly, partially breastfed infants exhibited a 96% lower risk of death compared to infants who never experienced any form of breastfeeding as it was obtained in the unadjusted model.

By country, the multivariate results indicated that Zambian infants had a 34% increased risk of infant mortality compared to infants from Lesotho whilst the associations with the rest of the countries were insignificant. Despite the adjusted results being contrary to the unadjusted results as Zambian infants together with Swaziland and Zimbabwe infants exhibited reduced risks of dying when unadjusted, however, the adjusted results suggest that the highest risk of dying at infancy is found in Zambia compared to the other countries in Southern Africa. The results also revealed that infants of mothers who attained secondary or higher education had a 33% lower risk of dying compared to infants born to mothers with no education. On the other

hand, infants born to currently married and formerly married mothers, had a 46% and 68% increased risk of dying, respectively, compared to infants born to never married mothers.

The sex of child maintained its significant association with infant mortality even after adjusting the effect of other factors. The multivariate results indicated that female infants had a 23% lower risk of dying before age 1 compared to male infants. Further, the multivariate results indicated a 1% reduced risk of dying with each 1 month increase in the preceding birth interval of infants studied in the region. Lastly, the results continued to indicate that infants' birth weight had a significant association with infant mortality in the adjusted model. The results indicated a 75% increased risk of infant death among infants with an inherent small birth weight compared to infants with an inherent large birth weight.

CHAPTER 5: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This last chapter presents the discussion of results based on the objectives of the study and also integrated with other studies' findings or body of existing literature. Its main purpose is to help with giving the meaning of the results and how the factors that were examined, namely, infant feeding practices, explain infant mortality in Southern Africa. The chapter concludes with the pertinent conclusions drawn from the study findings as well as some policy and research recommendations.

5.1 Discussion

The main aim of the study was to examine the association between infant feeding practices and infant mortality in the Southern African region, in particular, Lesotho, Swaziland, Zambia and Zimbabwe. In this study, the unadjusted and adjusted Cox's regression hazard models were employed to examine infant feeding practices in combination with other maternal demographic, environmental and socio-economic characteristics as well as the infants' bio-demographic characteristics in order to ascertain if and how it was associated with infant mortality in the region. The study's unit of analysis were children aged 0-11 months born in the last five years preceding all the surveys in the four countries combined, whose information on feeding practices was available. The hypothesis that was tested in the study stated that "exclusively breastfed infants compared to infants with other feeding practices have a lower risk of mortality". In addition, the Mosley and Chen Framework (1984), was adapted and employed to guide this study.

Of the two specific objectives of the study, the first objective was to estimate the levels and patterns of infant mortality and infant feeding practices in the Southern African region. Across the region, it was found that infant mortality rate was highest in Lesotho (68 deaths per 1000 live births), Swaziland (50 deaths per 1000 live births), Zambia (46 deaths per 1000 live births) while Zimbabwe had the lowest infant mortality rate (45 deaths per 1000 live births), for births in the last five years. The levels of infant mortality obtained in the study were not comparable to those reported in the individual country's DHS reports. In Lesotho, the DHS had reported infant mortality rate of (91 deaths per 1000 live births), Swaziland (85 deaths per 1000 live births), Zambia (70 deaths per 1000 live births) and Zimbabwe (57 deaths per 1000 live births). The considerable discrepancy in the infant mortality rates is likely to have been caused by the study's sample being limited to infants whose information

on feeding practices was provided by their mothers hence infants whose information was not available were excluded. Thus, the exclusion of some infants resulted in a reduced study sample size which consequently reduced the mortality estimates.

In addition, the general pattern of infant mortality showed that the risk of dying was over 50 % between ages 0 and 4 months and subsequently decreased with an increase in the age of the infant in the region. The pattern of mortality was also similar for Lesotho, Zambia and Zimbabwe with the exception of Swaziland. Whilst in the other three countries, the risk of dying in the first month was about 50%, however, the risk of dying in Swaziland was higher, above 70% for infants in the first month of life. Moreover, the decrease in infant mortality with an increase in the infant's age which was demonstrated in the region is similar to the general pattern of childhood mortality which tends to decline with age throughout childhood (McFalls, 2007). Overall, the study findings indicated infant mortality rates that are still high in the region (above 50 deaths per 1000 live births) which threatens the fulfilment of the MDGs targets expected in the year 2015.

The levels and patterns of infant feeding practices were also estimated as part of the first specific objective. The study findings indicated that partial breastfeeding was the predominant form of infant feeding (82%) and exclusive breastfeeding (12%) while not breastfeeding was less predominant (6%) in the region. These findings are disconcerting, in particular, the small proportion of exclusive breastfeeding in the region when exclusive breastfeeding is the recommended infant feeding form for infants in the first six months of life. Exclusive breastfeeding is commended because breast milk is not contaminated and comprises of all the necessary nutrients for infants in their formative first six months of age (WHO and UNICEF, 2003). However, these results are not surprising, given the fact that global exclusive breastfeeding prevalence is very low, around 35% (WHO, 2012). The same situation exist in Southern Africa as the prevalence of exclusive breastfeeding was reported to be also very low in the individual country's DHS reports, the highest was observed in Zambia (61%) and the lowest in Zimbabwe (31%). Moreover, among other reasons, the high HIV/AIDS prevalence in the region could also be attributable to the high number of infants (6%) who have never breastfed. This is because, the Updated HIV and Infant Feeding Framework for 2013 (WHO, 2013) also emphasized the endorsement of complete avoidance of all forms of breastfeeding in order to eliminate the risk of HIV transmission, if the risk is deemed to be high by health professionals.

Within each country, the study found variations in the proportions of infant feeding practices. Whilst the highest proportion of infants who never breastfed was found in Lesotho (11%), the lowest was found in Zambia (3%). The findings also revealed that partial breastfeeding continued to predominate in each country with the highest proportion observed in Swaziland (85%) while Lesotho had the lowest (75%). The proportion of exclusively breastfed infants was found to be similar as well as highest for both Lesotho and Zambia (14%) while Swaziland exhibited the lowest proportion (7%). Although, the levels of infant feeding practices differed by each country, however, they were comparable to the levels observed for Southern Africa and may have largely contributed to each country's infant mortality rate. As such, the highest proportion of never breastfed infants in Lesotho compared to the other countries might have led to the high infant mortality rate (68 deaths per 1000 live births) observed in the country despite the highest proportion of exclusively breasted infants also exhibited by the country. On the other hand, the lowest proportion of never breastfed infants coupled with the highest proportion of exclusively breastfed infants in Zambia might have led to the country's low infant mortality rate (46 deaths per 1000 live births).

The pattern of infant mortality rates by infant feeding practices, maternal and infant's characteristics were also observed for each country and the region as a whole. The study results found no much country variations in the pattern of infant mortality rate by infant feeding practices. Both at country and regional level, infants who were never breastfed exhibited higher infant mortality rates and lower infant mortality rates were observed among both partially and exclusively breastfed infants. However, exclusively breastfed infants demonstrated the lowest infant mortality rates. Thus, overall the findings demonstrated infant mortality rate of almost 500 deaths per 1000 live births among never breastfed infants and only less than 30 deaths per 1000 live births among infants who were partially and exclusively breastfed in the region. As such, these findings were consistent with the findings by the International Baby Food Network (IBFAN) in 1999, which noted that never breastfed infants had a 14 times increased risk of dying from diarrhoea and other infectious diseases compared to those who were breastfeeding.

Another interesting finding from the pattern of infant mortality rate was the slight variations in infant mortality rates by type of place of residence. With an exception of Lesotho, in all the other three countries (Swaziland, Zambia and Zimbabwe) as well as in the whole region, infant mortality rates were found to be higher in urban areas than in rural areas. Overall, there

were 55 deaths per 1000 live births in urban areas as opposed to 50 deaths per 1000 live births in rural areas. Whilst most studies including a study by Bbaale (2011) in Uganda normally found higher infant mortality rate in rural areas than in urban areas, however, this study findings were on the contrary. Thus, the study findings highlighted the existence of high child mortality in urban areas likely brought about by urban poverty due to the weak effect of urbanization in the region as noted by Amouzou and Hill (2004) and Buwembo (2010). Moreover, these study findings were consistent with Sastry's study (2004) in Sao Paulo in Brazil which also found a relatively narrow gap between rural-urban differentials and intra-urban differentials in under-five mortality rates.

The findings of the study also indicated slight country variations in infant mortality rates by mothers' wealth status. In three countries (Lesotho, Swaziland and Zambia) infants born to mothers in the rich wealth status demonstrated higher infant mortality rates, (74, 65 and 50 deaths per 1000 live births), respectively, with the exception of Zimbabwe which exhibited higher infant mortality rate (46 deaths per 1000 live births) among infants born to poor mothers. Similarly, higher infant mortality rate was observed among infants born to mothers in the rich wealth status (55 deaths per 1000 live births) and lower infant mortality rate (47 deaths per 1000 live births) observed among infants born to mothers in the middle wealth status in the Southern African region. Therefore, these findings are suggestive of greater risk of dying among infants born to rich mothers compared to poor mothers in the majority of countries in the region with the exception of Zimbabwe where infants born the poor had a higher risk of dying. These study findings are also contrary to a study conducted in the Arab World by Abuqamar et al. (2010) which found an inverse association between socioeconomic status of mother and infant mortality. However, the study findings conform to a study by Mustafa and Odimegwu (2008) in Kenya which found higher infant mortality rate being exhibited by infants born to the richest households compared to richer households.

The findings of the study further indicated no much country variations in the pattern of infant mortality rate by maternal age, marital status and child's birth weight whereas substantial differences were observed by highest educational level, HIV status, occupation and sex of child.

The second specific objective of the study was to investigate the association between infant feeding practices and infant mortality in the Southern African region. The study findings

confirmed that infant feeding practices had a significant association with infant mortality in the region. The study found a significant, and lowest mortality reduction effect among exclusively breastfed infants, [HR: 0.03, CI: 0.02-0.04, P<0.05], as opposed to partial and no breastfeeding. The results were consistent, both when unadjusted and also after controlling for the effect of other covariates. Therefore, the study findings were in conformity with several research findings which found that breastfeeding, especially exclusive breastfeeding offers great protection against infectious diseases to children in the first year of life (WHO, 2003, 2012 and 2013; Hobcraft et al., 1984; Molbak et al., 1997; Edmond et al., 2006 ; Humphrey, 2010 ; Coovadia et al., 2007; Mihrshahi et al., 2008) , thus significantly reducing both the risk of infant morbidity and mortality.

The findings of the study were also comparable and supported by existing literature on the relationship between infant feeding practices and infant mortality worldwide. For instance, in a study done in Botswana by Roosenkhan et al. (2012), exclusive breastfeeding was associated with a reduced risk of late vertical transmission of HIV among infants when compared to infants who were receiving a combination of breast milk and other complementary foods or liquids. Similarly, in Latin America, a study by Betran et.al (2001) which estimated the impact of both exclusive and partial breastfeeding on infants' mortality from diarrhoeal disease and acute respiratory infections obtained results that are consistent with the study findings. Thus, it was established in the study by Betran et al. (2001) that exclusive breastfeeding from 0-3 months and partial breastfeeding throughout the remaining months of infancy would have prevented an estimation of 52 000 annual deaths in the Latin American region.

Therefore, the findings of the study were consistent with findings done in other settings, even though, different methodological approaches were used. The findings of the study also have some policy implication. It is suggested that interventions that aim at reducing infant mortality should focus on promoting breastfeeding, in particular, exclusive breastfeeding for the first six months of a child's life as recommended by both WHO and UNICEF. However, the prevalence of the HIV/AIDS pandemic is expected to pose a threat on the proportion of infants whose mothers can be advised not to breastfeed by health authorities and also the death of their mothers. Thus, the HIV/AIDS pandemic is still a major challenge facing the health systems and population of highly affected regions like Southern Africa.

Country was also another significant explanatory variable of infant mortality in the region. When unadjusted, it was found that infants born in Swaziland, Zambia and Zimbabwe had significantly low risks of infant mortality compared to infants born in Lesotho. However, after controlling for the effect of other factors, Zambian infants were found to be having a significantly 34% greater risk of infant mortality compared to Lesotho whereas the relationship was insignificant for the other countries in the region. Therefore, the highest risk of infant mortality in Zambia might be attributable to the overall highest number of infant deaths that were observed in that country including its largest overall contribution to the study sample compared to the other three countries. On the contrary, the low risk of infant mortality that was observed in the unadjusted model could have been due to the absence of the effect of other covariates in the region. In addition, the increased risk of infant mortality in Zambia is contrary to the fact that, Zambia exhibited the highest proportions of exclusive breastfed infants and also the lowest proportion of never breastfed infants. Therefore, these results are suggestive of generally worse infant survival chances in Zambia which are probably attributable to other factors than feeding practices in the Southern African country.

The study also found that highest educational level was another significant explanatory variable of infant mortality in the Southern African region. Infants born to women who attained secondary and higher education were found to have a 33% reduced risk of mortality compared to infants born to women who had no education. The findings of this study were consistent with findings by Uddin et al. (2009) in Bangladesh which found an increase in infant mortality for children born to illiterate mothers than infants born to mothers with an educational level of secondary and above. The findings also conformed to the Mosley and Chen Framework (1984), which brings forth the importance of education as a factor that determines children's health and nutritional status. According to Charmabagwala et al. (2004) and as also embedded in the Mosley and Chen Framework (1984), better education of the mother often translates to higher income, hence an increase on food expenditure as well as access to health care services, thus substantially reducing infant mortality.

Marital status was also found to be another significant explanatory variable of infant mortality in the Southern African region. When unadjusted, the risk of infant mortality was 31 % and more than two times (2.02) increased risk of dying among infants born to currently married and formerly married mothers, respectively, as opposed to infants born to never married mothers. However, after adjusting the effects of other factors, the study found a 46%

and 68% increased risk of dying among infants born to currently married and formerly married mothers, respectively, compared to infants of never married mothers. As such, the findings of the study are suggestive of increased risk of dying among infants born to currently married mothers and a further increased risk of infant mortality among infants born to formerly married women in Southern Africa. The study findings are contrary to a study done in Jamaica (Wright, 1997) which found infant mortality to be lower when the child was born within marriage than in common-law or visiting unions.

Whilst, the dissolution of marriage which often comes with economic and social instabilities could be likely attributable to the increased risk of infant mortality among formerly married mothers in the region. However, there is a need for more investigations on the effect of age at marriage and length of marriage on infant mortality in the region as both factors are likely to have a significant role on the increased risk of dying observed among infants born to married mothers in the region. This is because a study by Quamrul et al. (2010) in Bangladesh found that both age at marriage and length of marriage had significant influence on child mortality, hence infant mortality was higher among mothers who married before age 15 years and those who had a longer duration of marriage of over four years as compared to those who got married at above age 15 years and who had short marriage duration of less than four years. Moreover, investigations also have to be done on the factors that are predisposing both married and formerly married mothers to exhibit increased risks of infant mortality in the Southern African region.

The sex of child is another factor that is commonly used in demographic studies to explain variations in infant mortality rate. This study found that sex of child was a significant predictor of infant mortality in Southern Africa, with female infants experiencing a 23% reduced risk of dying when compared to male infants. This finding conformed to the wide-ranging documented demographic literature that males are biologically more susceptible to mortality than females virtually in all ages throughout life (Ssewanyana and Younger, 2007; Charmarbagwala et al., 2004). Similarly to the findings of this study, Odimegwu and Mustafa (2008) also found a significantly higher risk of infant not surviving if they were male compared to females in Kenya. Thus, the results are indicative of a normal pattern of infant mortality by sex of child in Southern Africa, hence the absence of cultural sex selection practices such as the killing of female infants or abortion of female foetuses as it is a common

practice in Northern India, China and South Korea where the culture and family systems promote son preference over daughters (Gupta et. al, 2002).

The infant's birth weight was also found to be a significant explanatory variable of infant mortality in the Southern African region. The birth weight of the infant was significant both when unadjusted and adjusted. As such, at the multivariate level, infants with a small birth weight exhibited a 75% increased risk of dying compared to infants with a large birth weight. However, the relationship between infants with an average birth weight and infant mortality was insignificant at all levels of analysis. These study findings are consistent with a study in Kenya by Wafula et. al (2012) which found that a smaller birth weight of infants had a significant association with an increase in the risk of mortality as opposed to infants with average and large birth weight. Thus, the results suggest that infants with an inherent large birth weight have higher survival chances than infants with an inherent small birth weight in Southern Africa as also found by Fanaroff et al. (2007) in the United States.

As such, it can be concluded from the findings of the study that infant feeding practices play a significant role on infant mortality in the Southern African region. Other factors found to have a significant association with infant mortality in the region also include country, highest educational level, marital status, sex of child, preceding birth interval and birth weight.

5.2 Conclusions

Like all other studies, some limitations already outlined may have slightly compromised the validity of the study findings. However, based on the datasets from selected Southern African countries, Lesotho, Swaziland, Zambia and Zimbabwe, the study established that infant feeding practices determine infant mortality in the Southern African region. Precisely, exclusively breastfed infants had the lowest risk of mortality and the greatest risk was observed among not breastfeeding infants. Overall, the suggestion from the study findings was that any form of breastfeeding whether exclusive or partial breastfeeding greatly reduced the risk of infant mortality.

These study findings may draw interest with regards to relating them across the globe where the benefits from various infant feeding practices tends to vary by different regions, countries and communities. Infant feeding behaviour, especially breastfeeding has been found in literature to be directly linked to various economic, socio-cultural and religious factors and other dynamics prevailing at household level. Not breastfeeding may have proved

unfavourable in Southern Africa may be due to poverty which in turn affects the quality of complementary foods that are given to infants. Insufficient income to access nutritional food for infants combined with poor food hygiene and storage may be the contributory factors to the high infant mortality observed among not breastfeeding infants in the Southern African region. On the contrary, in developed countries like Canada where exclusive breastfeeding extends to about four months, the low prevalence of breastfeeding is not as equally detrimental to infants' survival compared to Southern Africa. The high standards of living in developed countries, coupled with high income of working mothers, better access to infants' nutritional food, good food hygiene and storage are favourable for the survival of infants in the developed world.

Overall, suggestions from the study are that breastfeeding should be beneficial to all infants across the globe. For it has proved to be advantageous for the survival of infants among such communities of low socio-economic and poor living conditions like Southern Africa. On the other hand, the finding that not breastfeeding reduced survival chances of infants in Southern Africa, may not be generalised across the globe as was the case in the other finding noted above. This is because infant mortality is expected to vary with different contexts across the globe. For example mortality among infants not breastfed may not be high among Western societies due to such factors like high incomes among mothers, high standards of hygiene and better medical facilities. Whereas in developing countries these advantages may be scarce, consequently leading to high infant mortality where there is no breastfeeding.

5.3 Recommendations

The following are possible recommendations based on the study's findings.

5.3.1 Policy Implications

1. In order to reduce the upsurge of infant mortality, there is a need to step up the effectiveness of child nutrition programmes that promote breastfeeding and put emphasis on exclusive breastfeeding of infants in the region. The undoubtedly high levels of infant mortality in the region can be drastically reduced by improving the currently poor and inappropriate infant feeding practices.

2. Greater effort and funding should be committed to intervention programmes that aim to reduce the upsurge of infant mortality. These programmes should target and reach out to the majority of mothers whose infants are more susceptible to death, in particular, those

born to older aged mothers (40-49 years), the rural and urban poor, less educated, formerly married, HIV positive, professionals, rich as well as infants born with small birth weight in the region. There should be adequate and easy access to children's health information including the promotion of good food hygiene and storage practices throughout the region.

3. The poor child health indicator demonstrated by the high infant mortality rates in the region also points to poorly performing health policies and other socio-economic development programmes leading to the overall deterioration of the quality of life in the region. Therefore, there is need to improve women's socio-economic status through education in order to help improve women's access to nutritional food for children and health care services.

4. There is also need for continued support and promotion of child spacing through family planning programmes, especially more than two years preceding birth interval in order to improve child survival in the region.

5.3.2 Research Implications

1. Further research is needed to investigate the factors that are predisposing both married and formerly married mothers as well as mothers with professions and having rich wealth status to experience high infant mortality in the region.
2. A follow up study to investigate the cultural and socio-economic factors influencing infant feeding practices is also needed in the region. A better understanding of infant feeding behaviours which takes into account the cultural and socio-economic factors that influence feeding practices, can undoubtedly lead to the development of intervention programmes and health policies that reinforce appropriate infant feeding practices throughout the region, hence significantly reducing infant mortality.

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APPENDICES

Appendix 1

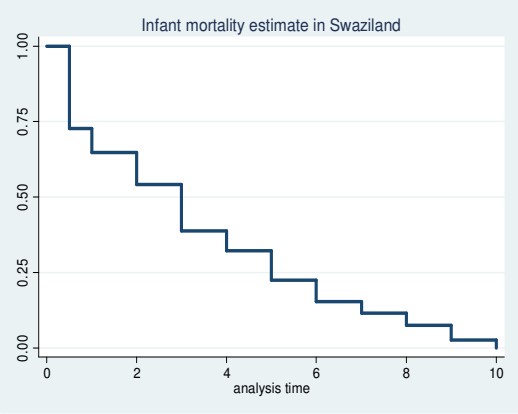
Summary of the percentage distribution of infants whose information on infant feeding practices were available and those whose information were missing by maternal demographic, socio-economic and infants' bio-demographic characteristics in Southern Africa.

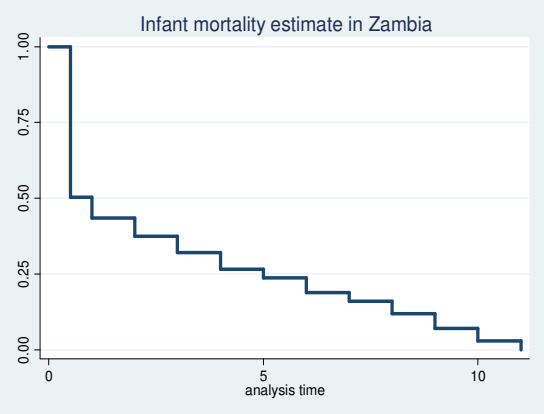
Characteristics	**Infant feeding practices** (%) N= 13, 218	**Missing** (%) N= 4, 647	**Total Number** N= 18, 432
Dependent Variable			
Infant mortality			
Alive	**94.88**	**89.13**	17, 188
Dead	5.12	10.87	1, 244
Total	100.00	100.00	18, 432
Age			
< 20	9.34	2.95	1, 388
20-29	**57.86**	**52.95**	10, 409
30-39	28.02	33.70	5, 461
40-49	4.78	10.40	1, 174
Total	100.00	100.00	18, 432
Type of place of residence			
Urban	24.98	32.18	4, 980
Rural	**75.02**	**67.82**	13, 452
Total	100.00	100.00	18, 432
Country			
Lesotho	21.71	20.41	3, 934
Swaziland	13.54	18.68	2, 764
Zambia	**39.63**	19.52	6, 256
Zimbabwe	25.12	**41.39**	5, 478
Total	100.00	100.00	18, 432
Highest educational level			
None	7.44	5. 47	1, 268
Primary	**51. 98**	41.87	9, 054
Secondary and Higher	40.58	**52.67**	8, 110
Total	100.00	100.00	18, 432
Marital status			
Never married	11.54	12.24	2, 163
Currently married	**81.12**	**74.55**	14, 609
Formerly married	7.35	13.21	1, 660
Total	100.00	100.00	18, 432
*HIV status**			
HIV negative	**82.60**	**80.78**	13, 983
HIV positive	17.40	19.22	3, 048
Total	100.00	100.00	17, 013

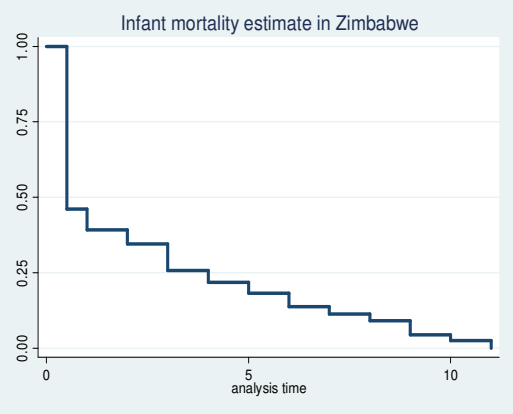
Characteristics	**Infant feeding practices** (%) N= 13, 218	**Missing** (%) N= 4, 647	**Total Number** N= 18, 432
Infants' bio-demographic characteristics			
Sex			
Male	49.57	**51.44**	9, 234
Female	**50.43**	48.56	9, 198
Total	100.00	100.00	18, 432
Preceding birth interval			
Continuous	71.71	28.29	18, 432
Birth order			
Continuous	71.71	28.29	18, 432
*Birth order**			
Large	30.10	32.22	5, 555
Average	**56.78**	**56.11**	10, 243
Small	13.12	11.67	2, 302
Total	100.00	100.00	18, 100

Appendix 2

Kaplan Meier's infant mortality estimates by country







Appendix 3

Kaplan Meier's infant mortality estimates by infant feeding practices