CHAPTER 1

INTRODUCTION

1.1 Background

This study addresses important issues on infant and childhood mortality in Zimbabwe. This country provides an interesting context within which to study child health because of the substantial improvements in indicators of living conditions for a decade after political independence (attained April 18, 1980) and the reversal of socio-economic gains since the early 1990s due to the worsening recession and political instability. Broadly, this study is expected to contribute to the understanding of the levels, trends, differentials and determinants of infant and child mortality in Zimbabwe and other African countries as well. The study offers an in-depth analysis of the 2005-06 ZDHS survey and should assist in the understanding of the mortality situation among children in Zimbabwe. The study provides appropriate conclusions and recommendations to facilitate the formulation of maternal and child health policies and the design of relevant child health programming in Zimbabwe.

Childhood mortality is one of the important indicators of a country's general medical and public health conditions, and consequently, the country's level of socioeconomic development. Its increase is therefore not only undesirable but also indicative of a decline in general living standards. Data indicate that some eleven million children under the age of five years die annually in the world as a whole, of whom over ten million are in the developing world.[1] It is not surprising that infant and child mortality measures are of key relevance in assessing progress in overall national development as well as progress for children. It is for this reason that this thesis focuses on the relative importance of

maternal, socioeconomic and environmental factors on infant and child mortality.

The International Conference on Primary Health Care held in Alma Ata in 1978 was the first to consider how child mortality could be reduced world-wide by systematic development of a primary health care system. Since then, the United Nations has been actively involved in reducing infant and under-five mortality in developing countries. To this end, the Plan of Action adopted at the World Summit for Children, held in New York in September 1990, incorporates specific targets for the reduction of infant and under-five mortality. In order to monitor progress towards the Plan of Action goals, the estimation of under-five mortality rates in the developing world has become increasingly important.[1]

Reducing mortality and improving the health of young children has long been a concern of the international community. One of the eight Millennium Development Goals (MDGs) adopted after the Millennium Summit in 2000 is to reduce child mortality (MDG4). Donors and development agencies, the United Nations and national governments around the world committed themselves to the goal of reducing the under-five mortality rate by two-thirds between 1990 and 2015. Two of the key indicators for monitoring progress towards this goal are the under-five mortality rate and the infant mortality rate.[2] MDG4 is deemed unachievable for Zimbabwe under the present circumstances where under-5 mortality, poverty and HIV/AIDS remain high. Poverty, hunger, and the HIV/AIDS situation must improve first before the MDG4 can be achieved. [2]

Country estimates of the level and trends in childhood mortality are needed to help set priorities, shape policies, design programmes and monitor progress towards the MDGs at the national level. These

estimates are needed at the international level to inform funding decisions for activities directed towards reducing child mortality. To be useful for the latter purpose, the country estimates must be internationally comparable. Yet developing accurate and timely estimates of childhood mortality poses a considerable challenge.

There are limited data in many developing countries and a lack of agreement on how best to generate estimates from what data are available. Mortality of children under the age of five remains unacceptably high in many developing countries. Under-five mortality needs to remain the focus of public health policy to protect the gains in child survival from new threats such as HIV and AIDS. A special edition of the Bulletin of the World Health Organization stressed this point and noted that 10.5 million children still die each year.[3]

Evidence has been found that under-five mortality has increased due primarily to the increasing prevalence of AIDS in the population.[4,5] Numerous causes have been cited for the reversal or stagnation of child survival. Adetunji concludes that not all of the stagnation in child mortality levels can be directly attributed to the prevalence of HIV and AIDS.[6] The resurgence of malaria and lower levels of vaccination coverage and health care utilization have also contributed to the reversal of child survival trends.[6]

Deteriorating health systems have resulted in fewer children being vaccinated against childhood diseases, and thus increases or stagnation in mortality levels have occurred. Recent data from two states in India (Rajastan and Arunachal Pradesh) show stagnation of child mortality coinciding with lower vaccination coverage between 1992 and 1998.[6,7,8] Changes in socioeconomic conditions such as women's level of education and investment in the health sector have affected child

survival. It is against this background that the relative importance of maternal, socioeconomic, environmental contamination and personal illness control determinants to infant and child mortality is the major focus of this study.

An assessment of the determinants of childhood mortality focusing on under-five mortality as a broad category would not capture the differential impact of maternal and socioeconomic factors on mortality among children. It is for this reason that this study focuses on infant and child mortality as separate components of under-5 mortality. Previous studies have further shown that maternal determinants are more important during the infant age (0-11 months) than the child (12-59 months) age. In turn, socioeconomic and environmental factors are more important during the childhood than the infancy phase. Hence, in order to show the differential impact of endogenous (maternal) factors and exogenous (socioeconomic and environmental factors) on under-5 mortality this study will analyse mortality within the following age classifications:

Infant mortality ($_1q_0$): the probability of dying between birth and exact age one year;

Child mortality ($_4q_1$): the probability of dying between exact ages one and five years.

Studying the determinants of childhood mortality within these childhood age segments is appropriate and meaningful in that it facilitates the design of relevant public health interventions and programmes aimed at improving child health and child survival in Zimbabwe. Research has further shown that the HIV and AIDS epidemic threatens to reverse 30 years of childhood mortality reductions in sub-Saharan Africa.[5,9]

However; Africa also faces a number of other economic and social problems, which may also be threatening child survival improvements. In order to be able to determine appropriate health policy for under-five children, it is necessary to have a better understanding of how important these different factors are[5].

Despite the broad approach towards child health, the decline in childhood mortality in Africa has been slower since 1980 than in the 1960s and 1970s. Of the thirty countries with the world's highest child mortality rates, twenty-seven are in sub-Saharan Africa.[10] The region's under-five mortality rate was 173 per 1,000 live births in 1998 compared to the minimum goal of 70 per 1,000 internationally adopted in the 1990 World Summit for Children.[10]

It is not known why the infant and child mortality rates are staying higher or even increasing in many sub-Saharan African countries despite action plans and interventions made. Mortality rates among children under the age of five remain strikingly high throughout the majority of sub-Saharan Africa. While other areas of the world have experienced declining rates of childhood mortality over the last 30 years, this area, for the most part, still maintains relatively high rates.[10]

It has been recently noted that 18 of the 20 countries across the world with the highest childhood mortality rates were in sub-Saharan Africa.[11] As the world enters into the 21st century, childhood mortality remains a big issue for these developing countries, especially as researchers attempt to distinguish what factors contribute to the high levels.

1.2 Study Purpose

The overall purpose of this thesis is to establish the levels and trends of under-five mortality and the differentials thereof and to determine the relative importance of various maternal, socioeconomic, environmental contamination and personal illness control determinants of infant and child mortality in Zimbabwe. The study will focus on the relationships between infant and child mortality and birth order and birth interval, maternal age, type of birth, sex of child, birth size, antenatal visits, place of delivery, province, rural-urban residence, maternal education, paternal education, wealth status, piped water and flush toilet.

1.3 Population, Social Development and Political Economy of Zimbabwe

1.3.1 Population

Population estimates vary widely owing to the impact of AIDS. The last census in Zimbabwe in 2002 reported a population of 11.6 million persons and an inter–censal population growth rate 1.1 percent.[12] The majority of Zimbabweans are Shona, a broad ethno-linguistic group who are concentrated mainly in the north and eastern regions. They outnumber the Ndebele who live mainly in the south and western regions, by four to one. The total population of Zimbabwe in 2009 is an estimated 12.5 million people.

1.3.2 Political Economy

For much of its existence as an independent nation, Zimbabwe has been widely viewed as a “success story” in terms of its socioeconomic development and political stability. In the 5 to 10 year period following independence, economic growth was strong and operated to mitigate the potentially harmful influence of very high fertility and rapid population growth on living standards. After this period of growing prosperity, a number of internal and external factors including political instability,

sharp increases in government expenditures and an adverse movement in terms of trade started to reverse the trend from one of improving to one of declining living standards that continued at least into 2008.

Over the last 15 years, Zimbabwe has been going through socio-political and economic challenges that have seen most of the human development indicators decline. A politically and economically polarised environment resulting from lack of consensus on policy issues, capacity erosion in all sectors of the society and a diminished domestic resource base for development activities are undermining social development in Zimbabwe. Poverty has become a perennial problem in Zimbabwe underlying the current food crisis, the HIV and AIDS epidemic and the deteriorating social and economic conditions.[12]

Poor households are characterised by high dependency ratios. While the mean household size for the nation was estimated at around 4.6 in 1998, it is currently 5.5 and 6.1 for the poor and very poor households, respectively. This compares to a household size of 3.1 for the non-poor households. And rural households are also more likely to be poorer than urban households.[12,13]

1.3.3 Social Setting

Accelerated social and economic development in Zimbabwe in the first decade after independence was followed by accelerated declining social and economic conditions, from the early 1990s to the present. There were also a number of potentially adverse developments that coincided with the upturn in mortality in Zimbabwe. After a decade of growth, per capita income stagnated in the early 1990s. Impressive gains in levels of education were not sustained. Improvements in public health measures, particularly immunisation levels, also leveled out or were reversed. The

late 1980s and early 1990s also saw the emergence of HIV and AIDS as major public health factors in Zimbabwe.[13,14]

Presently, Zimbabwe is completely cut off from international aid support after defaulting on its loans. It no longer has a working relationship with the International Monetary Fund or the World Bank, and most western donors have frozen all aid. However, Zimbabwe has bilateral relationships with a few countries, for example, China and Iran and the countries in the SADC region.

The unemployment rate presently stands at 80 percent and inflation at nearly 14 million percent, by far the highest in the world. Eight percent of the people are living in poverty and Gross Domestic Product (GDP) is projected to shrink annually by 10 to 15 percent. Real income dropped by 75 percent in 10 years after 1995. Coupled with the current economic melt-down in the country is the havoc caused by the HIV and AIDS epidemic. The HIV and AIDS prevalence rate is presently estimated at 15.6 percent, one of the highest in sub-Saharan Africa and in the world.[15]

1.4 Rationale of Study

Data indicate that some eleven million children under the age of five die annually in the world as a whole, of whom over ten million are in the developing world. Nearly three quarters of the child deaths in the developing world are caused by diseases for which practical, low cost interventions exist. A large majority of these lives being lost could be saved. Moreover, these deaths represent nearly 700 million years of future potential life lost annually (assuming a life expectancy at birth in the absence of under-five mortality of about 70 years).[16]

1.5 Objectives of the Study

The broad objective of the study is to establish levels and trends of under-5 mortality and to determine the impact of maternal, socioeconomic and environmental contamination variables on infant and child mortality in Zimbabwe.

The specific objectives guiding this research are to:

1. Present and analyse levels and trends of under-5 mortality in Zimbabwe,
2. Analyse selected demographic and socioeconomic under-5 mortality differentials in Zimbabwe and determine the trends in under-5 mortality between 1950 and 2006.
3. Identify the relative impact of maternal, socioeconomic, environmental contamination (sanitation) and personal illness control determinants on infant and child mortality,
4. Estimate the effect of unmeasured and immeasurable factors on the risk of infant and child death,
5. Provide recommendations for health policy formulation, planning and action towards improving child survival prospects in Zimbabwe.

1.6 Organisation of the Thesis

Chapter 1 provided Zimbabwe's background pertaining to population, social development and political economy. The chapter further provided details on the rationale of the study and its objectives. Chapter 2 discusses the conceptual framework and review of previous studies on levels, trends and determinants of childhood mortality. Chapter 3 presents the methodology of the study. The results of the study are presented in Chapters 4 to 7 as follows:

- Trends in various types of childhood mortality are presented in Chapter 4.
- Results of bivariate relationships of the independent variables with infant and child mortality are presented in Chapter 5.
- Results of multivariate relationships with infant and child mortality (relationships after controlling for the impact of other variables) are presented in Chapter 6.
- Results for the analysis of the determinants of infant and child mortality controlling for frailty effects are presented in Chapter 7.

Finally, Chapter 8 presents the discussion of findings, conclusions and recommendations emanating from the research.

The list of references is shown after Chapter 8. Appendix 1 shows the 2005-06 Zimbabwe Demographic and Health Survey woman's questionnaire. The letters of approval for the thesis project are shown in Appendix 2. Appendix 3 shows proof of acceptance of an article drawn from chapter 6 of this thesis for publication in *Demographic Research* journal. The article is entitled *"Determinants of infant and child mortality in Zimbabwe: results of multivariate hazard analysis"*. Finally, Appendix 4 shows the curriculum vitae of the author of the thesis and a summary of the purpose and contents of the thesis project.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter presents the review of literature and the theoretical framework guiding this study. The review of literature has three parts. The first part deals with results of research and observations on trends in infant and child mortality in Africa and Zimbabwe, the second part deals with determinants of under-5 mortality while the third part presents the theoretical perspectives of frailty. The second part of the chapter presents the Mosley and Chen framework, which is the theoretical framework underpinning this study. This classical proximate determinants framework is in this study extended to include HIV/AIDS.

2.2 Review of Literature

2.2.1 Trends in Under-5 Mortality including the role of HIV/AIDS

Mortality rates among children under the age of five remain strikingly high throughout the majority of sub-Saharan Africa. While other areas of the world have experienced declining rates of childhood mortality over the last 30 years, this region, for the most part, still maintains relatively high rates. As the world enters into the 21st century, childhood mortality remains a big issue for these developing countries, especially as researchers attempt to distinguish what factors contribute to the high levels.[17]

Hill, Bicego and Mahy examined trends and determinants of childhood mortality in Kenya in the late 1980's to mid 1990's.[5] Their analysis focused on merged data from the 1993 Demographic and Health Survey

and 1998 Demographic Health Survey in Kenya. Multivariate analysis was used to examine the factors associated with mortality risks in childhood. The independent variables used in the proportional hazard models included mother's education, wealth status, residence, maternal age, birth order, sex and preceding birth interval.

In addition, an indicator of the HIV epidemic, the prevalence of HIV in the district of birth of the child, was applied. With no controls, the models confirmed an increase in mortality of about 25 percent between 1984-1986 and 1996-1998. Including socioeconomic and biodemographic controls tended to strengthen the upward trend in mortality; in other words, had there been no changes in these factors, child mortality would have been expected to decline.

Introducing controls for health variables such as immunisation, pregnancy and delivery care, prevalence of childhood diseases and maternal and child malnutrition - also did not alter the underlying trends substantially. Thus the authors concluded that rising child mortality could not be explained by socioeconomic, biodemographic or health status factors. The authors concluded that the HIV epidemic appeared to be the most probable cause of the observed recent increase in child mortality in Kenya. Of the health variables, the only one found to be significantly protective was immunisation.[5]

Although accurate information on cause of death is lacking, the cause of death structure of under-5 mortality in Zimbabwe is probably similar to most countries in sub-Saharan Africa and dominated by pneumonia, malaria, measles and diarrhoeal diseases. It is estimated that these diseases have been responsible for some 60 percent of the disease burden in the region around 1990.[18]

Due to the inadequacies of the registration of deaths in Malawi, Baker[19] uses indirect methods to estimate levels and trends in mortality. She employs a widely used technique developed by Brass, which is based upon retrospective reports of children ever born and children surviving. This technique involves taking the proportion of the children dead to those ever born to women categorized by age group. The proportions are converted into probabilities by multiplying the proportion of children dead among children ever born to women of a certain age group by an adjustment factor based on comparisons of cumulative parities of women of different age groups. The results indicate that owning a pit latrine does not have a significant effect on child mortality.

This is contrary to her original hypothesis and she concludes that this variable is not a good measure of environmental contamination and has many limitations. Just because a household has sanitation facilities (such as a pit latrine) does not mean that it will be used hygienically or by all members of the household. To buttress this point, she notes that in a study on child mortality in relation to water supply and nutritional status in Malawi, it was found that the young children often did not use the pit latrines, and consequently there was much faecal contamination around the homes (ibid).

In their study of trends and differentials in child mortality in Zimbabwe from 1970 to 1994, Marindo and Hill observed that after Independence in the early 1980's, child mortality in Zimbabwe fell rapidly.[20] They further noted that the pace of child mortality decline in Zimbabwe since 1970 has not been uniform. The period 1970-1979 was associated with a slower pace of mortality decline whereas the period 1980-1987 witnessed a faster pace of mortality decline. In this study the authors also observed regional differences in under-5 mortality in Zimbabwe. Their findings indicated that the Eastern region (Masvingo and

Manicaland) had the highest under-5 mortality (100 deaths per 1,000 live births) followed by the Northern region which consisted of Mashonaland East, Mashonaland West and Mashonaland Central (80 deaths per 1,000 live births) and the Southwestern region consisting of Matabeleland North, Matabeleland South and Midlands (63 deaths per 1,000 live deaths). The Metropolitan region which combined the two major cities of Harare and Bulawayo had the least mortality levels (39 deaths per 1,000 live births). The relatively low under-5 mortality prevalent in the South-western region of Zimbabwe has been confirmed by other surveys in Zimbabwe.[12,13,14,21]

The provincial variations in under-5 mortality in Zimbabwe have also been noted by Bah in his study of recent trends in infant and child mortality and possible explanations in Zimbabwe.[22] Bah observed that the lowest under-five mortality rates were in the Matabeleland North and Matabeleland South provinces. He also observed that the period 1986-1988 saw the reversal of the gains in mortality decline in Zimbabwe. Bah argued that after the period 1986-1988 some provinces in Zimbabwe experienced a slow-down in mortality decline while for some of the provinces there were reversals in mortality decline. Bah states that "the figures also show that 1986 to 1988 was the turning point after which the decline became much slower and even reversed in some areas" (ibid) (p. 37). Bah further added that the slowing down of mortality decline, which happened after the period 1986-1988 in Zimbabwe is not an uncommon event in developing countries (ibid). Citing Palloni[23] Bah stated that the reasons for the slow-down in mortality in Zimbabwe after the period 1986-1988 could be due to constrained social and economic development as well as poor health care infrastructure (ibid).

The study by Bah also used correlation analysis to determine whether the factors affecting infant mortality were the same as those affecting

child mortality. The high correlations of 0.9 pointed to the fact that the factors affecting infant and child mortality rates were indeed probably similar. Bah provides two sets of hypotheses as explanations for the slow-down in mortality after the period 1986-1988. The first was that it could have been possible that child mortality had been significantly reduced due to immunization and therefore children were dying of other diseases in the mid 1980s. The second hypothesis provided by Bah was the epidemiologic polarization, that is, the possible widening of socioeconomic differentials in Zimbabwe (ibid).

According to Bah epidemiologic polarization "... describes how different population subgroups experience contrastingly different epidemiologic profiles and these profiles diverge further instead of converging to a common profile. The concept has been found to occur in Latin America where there has been a long history of oppression and exploitation" (ibid) (p 39). Bah further argued that while there was no available data to support the case for epidemiologic polarization it could still have been possible that epidemiologic polarization could have contributed to the slow-down in child mortality in Zimbabwe after the period 1986-1988 (ibid).

The observation of the provincial variations that existed in child mortality in Zimbabwe made by Bah[22] and Marindo and Hill[20] is supported by Root[24] who also observed that Matabeleland North and South provinces had lower levels of under-5 mortality when compared to Mashonaland East, West and Central provinces in Zimbabwe.

Marindo and Hill[20] also observed mortality differentials by residence in Zimbabwe. This differential has been observed in other demographic studies conducted in the country. Rural areas generally have higher childhood mortality than urban areas.[12,13,14,21] Marindo and Hill observed

that from the period 1983-1988 to the period 1990-1994 the rural-urban mortality differentials narrowed largely due to the increase in childhood mortality for urban mothers and the falling mortality for rural mothers.[20]

An interesting aspect noted by Marindo and Hill is the relatively higher under-5 mortality experienced in the other urban areas compared to the larger metropolitan areas such as Bulawayo and Harare.[20] The authors postulate that the acceleration in the increase in under-5 mortality in the other urban areas apart from Harare and Bulawayo could be due to the impact of HIV/AIDS (ibid). When persons fall ill they generally migrate from the rural and major urban areas to the smaller towns. However, Marindo and Hill also noted that it is difficult to draw a correlation between under-5 mortality and HIV/AIDS particularly in situations where the mortality estimates are computed from data on reports by the mothers in the survey (ibid). In the first instance, these mothers are not there to report these deaths in the survey because they would have died. This phenomenon, which tends to depress under-5 mortality estimates, forms part of the hypotheses that will further be explored in chapters 4, 5 and 8 of this thesis (ibid).

The recent evidence from the Zimbabwe Demographic and Health Survey of 2005-06 indicates a reversal of the increase in infant and under-5 mortality that prevailed from 1988 to 1999[21]. It is difficult to accept that there has been a decline in under-five mortality in Zimbabwe. We expected an increase in under-five mortality due to the direct and indirect impact of HIV and AIDS and the negative impact caused by the economic and political downturn prevailing in the country.

2.2.2 Determinants of Childhood Mortality

2.2.2.1. Introduction

This section contains three parts. The first part deals with studies that focus on mortality as the outcome. The second part reviews studies that focus on morbidity and the third part reviews studies that focus on health practices as explanatory factors.

2.2.2.2 Mortality

Cleland and van Ginneken[24] using the results of multivariate analysis of data from 16 countries presented by Hobcraft et al.[25] demonstrate that shifts in the reproductive pattern (as measured by birth interval, birth order and maternal age) cannot explain the education/ child mortality relationship. However, Behrman[26] using data that permits control for the education of a woman's siblings, finds the education effect had nearly disappeared. One interpretation of this finding is that the previously reported effects of maternal education may simply be the effect of unobserved familial abilities and motivation passed on to the daughter by mother.[27]

Zerai[28] examined socioeconomic and demographic variables in a multi-level framework to determine conditions influencing infant survival in Zimbabwe. She employed Cox regression analysis to study the socioeconomic determinants of infant mortality, based on data from the Zimbabwe Demographic and Health Survey conducted in 1988. The most unique finding was that women's average educational levels in their community exert a greater effect on infant survival than the individual mother's educational level. This result supports assertions that child survival is strongly impacted by mass education.[24]

Root[29] further examined population density and spatial differentials in child mortality in Zimbabwe using data from the 1988 Zimbabwe

Demographic and Health Survey and the 1992 census. Root focused his study on the possible explanation of population density as an explanatory factor for the provincial variations in under-5 mortality in Zimbabwe. In his study, Root classified the eight rural provinces in Zimbabwe into “Ndebele provinces” and “Shona provinces”. The former comprised of Matabeleland South and Matabeleland North while the later constituted Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Midlands and Masvingo provinces. The findings from the study by Root[29] confirmed the observations made by Bah[22] and Marindo and Hill[20] that Matabeleland South and Matabeleland North provinces experienced lower under-5 mortality than the other provinces in Zimbabwe. Using the Cox regression method to control for the effects of socioeconomic, demographic and environmental factors, Root concluded that children aged between 1 to 4 years residing in “Ndebele provinces” experienced 45 percent lower mortality than their counterparts living in the “Shona provinces”.[29]

Furthermore, Root rejected the hypothesis that health care provision and/or cultural factors were responsible for the provincial under-5 mortality differentials in Zimbabwe.[24] Rather, he asserted that it was the lower population densities prevailing in the “Ndebele provinces” as compared to the “Shona provinces” that were responsible for the lower under-5 mortality rates experienced in the “Ndebele provinces”. He argued that “The hypothesis that low population densities in the Ndebele provinces have contributed to their lower child mortality is plausible” (ibid, p. 419).

Root recommended additional research to determine the specific routes through which population density affects the disease - transmission processes. He added that “… as population densities also vary within provinces, it would be worthwhile examining the relationship between

inter-provincial variation in child mortality and population density" (ibid, p. 420).

Jhamba used data from the 1984 Zimbabwe Reproductive Survey (ZRHS) and the 1988 Zimbabwe Demographic and Health Survey (ZDHS) to study child mortality differentials in Zimbabwe.[30] He used the multiple linear regression method to explore the relationship between the independent variables and childhood mortality. The variables studied in that study included region of residence, place of residence, maternal education, age at first marriage, ever-use of modern contraception and use of health services for prenatal care. The findings from Jhamba's study confirmed that higher maternal education levels lead to lower child mortality, as do postponement of marriage.[30] The findings also showed that use of modern contraception led to a reduction in childhood mortality of at least 20 percent. Living in urban areas was associated with a reduction in child mortality of the same magnitude as use of modern contraception. According to Jhamba "As levels of education among women rise, this should lead to an increase in age at marriage, greater use of modern contraception as well as increasing use of modern health services" (ibid, p. 170). Consistent with other research findings, for example, Bah[22] Marindo and Hill[20] and Root[24], the results from Jhamba's study showed that Manicaland, Mashonaland Central and Mashonaland provinces exhibited higher child mortality levels than Matabeleland South and North provinces in Zimbabwe (ibid).

Jhamba added that "Because the geographical differentials remained significant after controlling for the other factors, the high mortality provinces may also be disadvantaged in other socioeconomic indicators not considered in this study, such as physical characteristics, transport facilities, health infrastructure and other social developments" (ibid, p. 170). Jhamba also maintained that it was the individual characteristics

of parents and their households that largely determined child survival (ibid).

Woelk et al.[31] used the preceding births technique developed by Brass and Macrae[32] to estimate child mortality rates in Zimbabwe. The study by Woelk et al. involved interviews with 2,229 mothers attending four antenatal care centres at two polyclinics in Harare, at a provincial hospital in Marondera and at a district hospital in Mutoko. The results from this study indicated that there were minor differences between under-2 mortality and under-5 mortality. Woelk et al explained the lack of a notable difference between under-2 mortality and under-5 mortality to "some degree of urbanization being experienced at two of the centres, and to a systematic selection bias of the method" (ibid, p. 63). This study further confirmed that younger (below 20 years) and older (above 40 years) maternal age increased the risk of child mortality compared to maternal age in the age group 20-40 years. The authors also observed that longer birth intervals, that is, of 3 years and above, elevated child survival.

Bicego[27] applied a three-step procedure using proportional hazards regression to estimate trends and determinants of childhood mortality in Haiti. He used the data from the 1987 EMMUS in Haiti. Maternal education and young age at birth were found to have marked effects on neonatal survivorship but little effect thereafter. Indices that reflect community-level access to child health services were shown to be important, especially in childhood ($_4q_1$).

Manda[33] used data from the 1992 Demographic and Health Survey in Malawi to study the relationship between infant and child mortality and birth interval, maternal age at birth and birth order with and without controlling for other relevant explanatory variables. He also investigated

the direct and indirect (through its relationship with birth intervals) effects of breastfeeding on childhood mortality. The study employed proportional hazards models. The results show that substantial birth interval and maternal age effects are largely limited to the infant period. The influence of social and economic variables on the mortality risk and on the relationship between biodemographic variables and mortality risk is much enhanced with increasing age of the child. The study further shows that consideration of breastfeeding status of the child does not significantly alter interpretation of effects of preceding birth interval length on mortality risk, but does partially diminish the succeeding birth interval effect.

Abou-Ali[34] assesses socio-demographic and household environmental impacts on child mortality in Egypt. He estimates a duration model for the entire sample together with a three-part model. Neonatal mortality is first modelled by using a discrete dependent variable model and the mortality risk in the infant - up to his first birthday - and childhood –from the first birthday to under 5 years stages is modelled using non-parametric, semi-parametric and parametric duration models. In this particular application, this three-part model predicts mortality better than a duration model for the under five child mortality in general since it uncovers some interesting differences between the impacts of household environmental and socio-demographic determinants on the neonatal, infant and subsequent mortality risk. Results show that access to municipal water decreases the risk and sanitation is found to have a more pronounced impact on mortality than water.

Jacoby and Wang[35] examine the determinants of child mortality and morbidity in rural and urban China using a competing risks approach. The data source is the 1992 China National Survey for Children, which resemble the Demographic and Health Surveys. The key findings

include (1) higher maternal education levels reduce child mortality which means that - controlling for other factors - a child living in a neighbourhood with more educated mothers has about 50 percent lower mortality risk; (2) access to safe water/ sanitation, and immunization reduces diarrhoea incidence in rural areas, while access to modern sanitation facilities (flush toilets) reduces diarrhoea prevalence in urban areas; (3) significant linkages between Acute Respiratory Infections (ARI) incidence and use of unclean cooking fuels (firewood and coal) are found using the city level data constructed from the survey.

This study indicates that effective policy interventions for improving health outcomes often lie both within and outside the health sector. Cross-sectoral approaches can potentially produce large health benefits. Based on the data, Jacoby and Wang[35] projected that mother's education plays a role in the survival rate for children aged below five years of age. Results in urban areas found male children had higher mortality rates than female children; a result Jacoby and Wang (ibid) said is inconsistent with data from other countries. It was also found that access to flush toilets significantly lowered mortality rates.

In a related study Wang[36], using the data from the 2000 Ethiopia Demographic and Health Survey examines the socioeconomic and environmental determinants of child mortality. She ran three hazard models, the Weibull, the Piece-wise Weibull and the Cox model to examine the impact of location (rural-urban), female education attainment, religion affiliation, income quintile, and access to basic environmental services (water, sanitation and electricity) on neonatal, infant and under-five mortality. The results show that children born in rural areas face much higher mortality risk compared with those born in urban areas. A strong statistical association is found between poor environmental conditions and child mortality rates. Safe water, sanitation

and electricity are mainly accessible to households living in urban areas (accounting for less than 20 percent of the total population).

In Ridder and Tunali[37] the aim is to assess whether empirical evidence supports the presence of family specific frailty components. Although child mortality differentials with respect to water supply and sanitation in many developing countries suggests that access to piped water and toilet facility may improve survival chances of children, Ridder and Tunali[37] could not find any evidence supporting this relation. Guilkey and Riphahn[38] estimate a structural discrete time hazard model of the determinants of infant and child mortality in the Philippines in order to evaluate the effect of biological variables on mortality. They find that controlling for biological mechanisms; birth order and parity no longer have a direct effect on mortality. However, breastfeeding is found to be one of the most important determinants of child survival. Trussell and Hammerslough[39] provide a complete self-contained exposition of estimating a life table with covariates through the use of hazard models applied to child mortality in Sri Lanka. Their results show that the type of toilet facility, mother's and father's education, urban/rural estate residence, ethnicity, birth order, age of mother at birth and gender are strongly related factors with child mortality.

2.2.2.3 Morbidity

Woldemicael[40] examines the effect of socioeconomic factors that determine childhood diarrhea in Eritrea. He uses data from the 1995 Eritrea Demographic and Health Survey. The method employed is logistic regression. The results show that household economic status and place of residence are significant predictors of diarrhea.

The study also discovers an important relationship between diarrhoeal morbidity and age of child and number of children living in the house

with particularly high prevalence of diarrhoea at the age of weaning and in households with a large number of living children. However, the effects of toilet facility and maternal education are not found to be statistically significant when other factors are held constant.

A comparative study of urban areas of Ghana, Egypt, Brazil and Thailand by Timaeus and Lush[41] clearly indicates that children's health is affected by the economic status of the household. According to these authors, children from better-off households have lower diarrhoeal morbidity and mortality in Egypt, Thailand, and Brazil. Such differentials in diarrhoeal diseases by household economic status are probably due to differences in childcare practices, for instance preparation of weaning foods and personal hygiene.[41]

2.2.2.4 Health Care Seeking Practices

Lavy[42] analyses the effects of quality and accessibility of health services and other public infrastructure on the health of children in Ghana. Incorporating some community characteristics the author constructed an indicator of poor water quality and sanitation. Focusing on child survival, height and weight, the results suggest an important role for public health policy in eliminating the rural-urban disparities, particularly in improving health status of rural children as well as reducing their mortality rates.

While the higher socioeconomic status of better-educated women explains about half of the magnitude of the relationship between maternal education and child survival[24], the domestic health practice of individual women is probably the new most salient mechanism in the maternal education - child mortality relationship. The fact that mother's education is a more important determinant of child survival than father's education is probably due to greater maternal involvement in child-health related care.[43]

Mother's education influences her choices and skills in health care practices.[43,41] According to Caldwell[43] both educated and illiterate mothers recognize when their child is sick but the educated mother more frequently will take action "without waiting for (her) husband or mother-in-law to notice the child's condition too." This is partly because illiterate women do feel a lack of capability when dealing with the modern world." [43]

Caldwell found that the educated mother is "more likely to report back to the health center if the treatment does not seem to be effecting a cure. Educated women see the health process as experimental... (and do not feel it is an attack on the health care practitioner to give this important feedback)." (p.106)[43]

Joshi[44] has postulated that it is through the acquisition of skills and identity that education impacts the health behaviour of women, but says, "While these findings are interesting, they are still incomplete. More studies, especially longitudinal ones, are needed before these findings can be woven into a meaningful theory." [44]

2.2.3 Theoretical Perspectives of Frailty

This section presents theoretical perspectives around the concept of frailty or unobserved heterogeneity. Results on the impact of maternal, socioeconomic and environmental contamination variables on infant and child mortality taking account of frailty are presented in Chapter 7.

According to Sastry, frailty, also referred to as unobserved heterogeneity, represents an individual's susceptibility to the risk of death[45]. Sastry further argues that frailty includes those factors that allow the risk to death of children belonging to one mother or in one family or living in one community to be different from another mother or

community. On the other hand, Omariba argues that the basis of frailty is that children belonging to one mother or one family or one community have certain shared characteristics that predispose them to common risk[46]. It is these shared characteristics that would make them different from the other children. Omariba further states that frailty effects can broadly be classified as genetic, behavioural and environmental factors that occur at various levels that include the child, the family and the community.[46]

The presence of frailty indicates the amount of variation across families and communities in the risk of dying due to unobserved factors and suggests that deaths are likely to be clustered in certain families and communities[46]. The term death clustering has also been used to determine whether families or communities continue to differ after known determinants of mortality have been accounted for.[45,46,47]

Frailty, which arises from death clustering, encompasses factors that are not included in the baseline hazard but that have a bearing on the individual's risk of death. In other words, the frailty effect represents the unmeasured effects in the standard models frequently used.[45,46] Hence, the frailty effect in the models presented in Chapter 7 captures the unobserved familial characteristics that include for instance, mother's attitude towards health care-seeking behaviour and forms part of the unobserved factors at the family and community levels. Frailty models also assume that the mortality risks of children are correlated.[45,46] Therefore, the presence of frailty is an indication of the difference between and among families and communities. Frailty therefore indicates that deaths are likely to be clustered in families and communities.[45,46] On the basis of the aforementioned literature it is therefore important to study to what extent children in Zimbabwe are different from one family to another and from one community to another,

having controlled for maternal, socioeconomic and environmental factors considered in this study. The study of frailty is made possible by the fact that the sampling design of the 2005-06 Zimbabwe Demographic and Health Survey utilised a multi-stage design which allows researchers to estimate the magnitude of the frailty effect at household and community levels. This is because the sample in the 2005-06 Zimbabwe Demographic and Health Survey is stratified by province, ward, enumeration area, cluster and household. In this study, frailty will be studied at family level (using 'MOTHERID' as the grouping variable) and community (using 'CLUSTER' as the grouping variable). The estimates of the magnitude of the frailty effect at family and community level based on data from the 2005-06 Zimbabwe Demographic and Health Survey will be presented, analysed and interpreted in Chapter 7.

2.2.4 Concluding Remarks

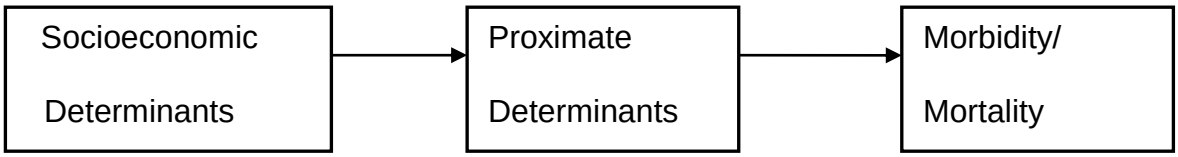
This section presented an overview of literature on maternal, socioeconomic and environmental determinants of childhood mortality. It also presented the theoretical concepts around the concept of frailty in this section. The determinants of childhood mortality have been extensively researched in most parts of the world as evidenced by numerous published articles. However, little research has been conducted in Zimbabwe in spite of the fact that it has one of the highest infant and child mortality rates in the world.

2.3 Theoretical Framework

This section discusses the analytic framework guiding this study. An analytic framework developed by Mosley and Chen in 1984 is applied in this study to explaining the mechanisms through which various determinants operate to affect infant and child mortality.[48] The framework categorises the determinants into two groups: indirect

determinants (for example, education and availability of sanitation facilities); and direct or proximate determinants (for example, immunisation and child-feeding practices). Proximate determinants have the closest or most direct effect on mortality. Indirect factors, on the other hand, are the most "distant" from mortality, and they operate through one or more proximate factors to affect mortality (see Figures 2.1 and 2.2). The Mosley and Chen framework was developed before HIV/AIDS had reached pandemic stages. HIV/AIDS, in particular among mothers, is, therefore, a maternal factor that should be added to the Mosley and Chen framework. A covariate for HIV prevalence in the Cox proportional hazard models will therefore be included in order to determine the impact (direct and/ or indirect) of HIV/AIDS on infant and child mortality. The methods used to compute the impact of the HIV prevalence rates in this study will be explained in detail in Chapter 3.

Figure 2.1: Summarised Mosley and Chen Framework

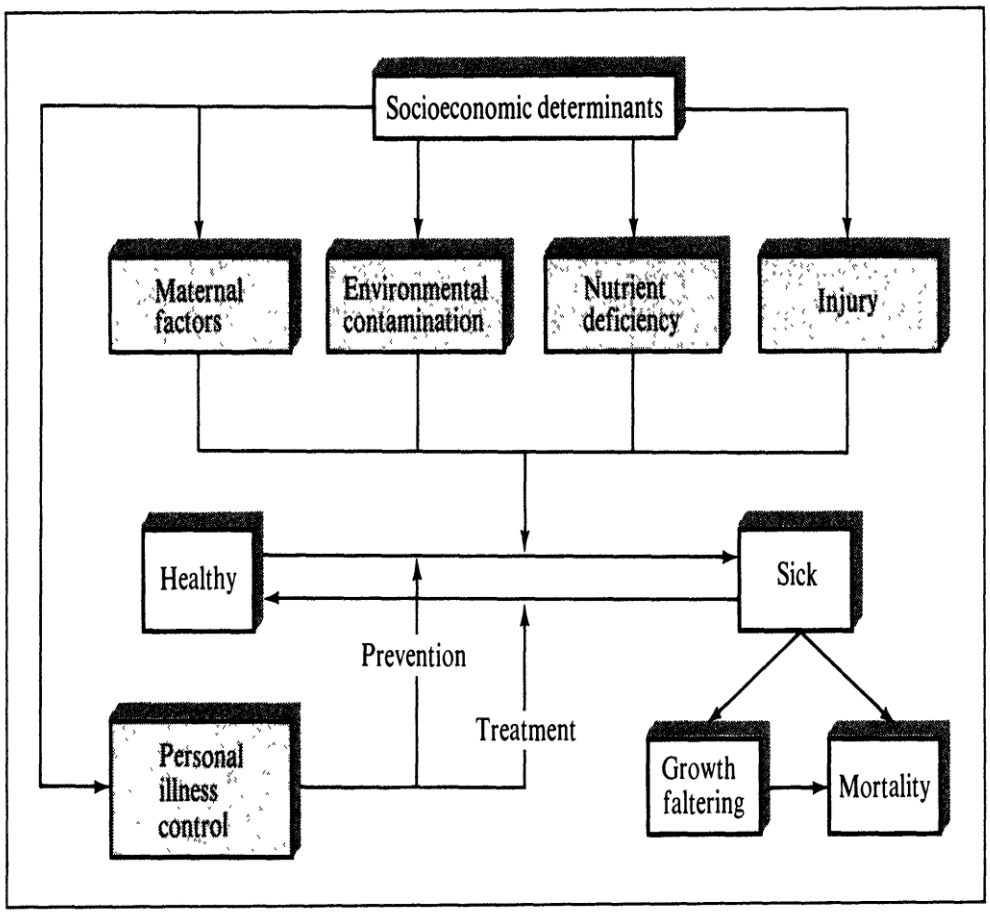


Source: Extracted from Mosley and Chen[48]

The summarized conceptual framework (*Figure 2.1*) shows how socioeconomic determinants operate through proximate determinants that in turn influence the risk of diseases and the outcome of disease process.[48]

An extended version of this model is found in Figure 2.2.

Figure 2.2: The Mosley and Chen (1984) Proximate Determinants Framework



Source: Mosley and Chen.[48]

The theoretical framework of child health in Zimbabwe here begins with some of the individual-level variables in the classical proximate determinants framework.[48] Other crucial variables are added that operate through the proximate determinants, such as maternal and paternal education, wealth status and place of residence (see Figure 2.2). Proximate determinants operate through specific mechanisms to determine child health outcomes. Socioeconomic variables operate through the proximate determinants of child health.[48] Although we

acknowledge that community conditions also exert an impact on socioeconomic conditions to influence proximate determinants of child health indirectly, these will not be looked at in this study.

Presently, maternal fertility variables are typified by later marriage and childbearing, lower parities, and longer birth intervals than in preceding periods in Zimbabwe. Operating through the biological mechanism of improved production of breast milk and through the social mechanism of less competition with siblings for mother's attention and household resources, children get better nutrition and better care, thus improving their survival chances.[49]

In Zimbabwe, household contamination is still a big problem. Piped water is provided to a minority of households. Only 36 percent of households have water piped into the dwelling, yard or plot, while 5 percent of households use a public tap or standpipe.[21] In rural areas, boreholes are the main source of drinking water (38 percent), followed by unprotected and protected dug wells (18 percent and 17 percent, respectively).[21] Most households (87 percent) do not treat their water. Of the selected urban households in the 2005-06 ZDHS survey, 78 percent do not treat their water, compared with 91 percent in rural areas.[21]

Sanitation measures are still not adequate in Zimbabwe. Improvements in hygienic sanitation facilities work through the mechanism of less exposure of children to contamination to make them less susceptible to disease and eventually lower mortality. Forty percent of households in Zimbabwe have access to improved toilet facilities that are not shared with other households, of which 19 percent flush to a piped sewer system, 2 percent flush to a septic tank, and less than 1 percent flush to a pit latrine. More than 4 in 10 households in rural areas have no toilet facility.[21]

Nutrient availability has worsened in Zimbabwe due to deteriorating economic conditions. Operating through the mechanism of decreased susceptibility to illness, improved nutrient availability leads to improvements in child health.[50,51] The current socio-economic meltdown in the country coupled with decreased agricultural production and persistent droughts are constraining nutrient availability to infants and children. Comparison of results from the 1988, 1994, 1999 and 2005-6 ZDHS surveys indicate that in Zimbabwe nutritional status of young children has worsened. [13,14,21]

The prevalence of stunting has risen steadily from 21 percent in 1994 to 28 percent during 2001-2005. Wasting remained at a comparatively high level (7 percent) throughout the period. The proportion underweight decreased between 1994 and 1999 and then rose to 17 percent during 2001-2005. Malnutrition as measured by the three indices namely; height-for-age, weight-for-height and weight-for-age also worsened between 1994 and 2005-06 and is higher in rural areas than urban areas.[21]

Personal disease control is typified by a sharp decline in immunisation coverage and access to treatment. Comparison of the 2005-06 ZDHS results with those of the earlier surveys shows that there has been a decline in vaccination coverage in Zimbabwe, from 80 percent in 1994 to 75 percent in 1999 to the current rate of 53 percent. This is not surprising given the worsening social and economic conditions in the country since the late 1990s. Various studies have shown that timely personal disease control is critical for improving child survival chances.

Mother's higher levels of education and increased professional and blue collar employment of the household head lead to low child-health-risk

fertility, timely immunization of children, adequate nutritional intake by children, and household environments with lessened contaminants. Children whose mothers have more than secondary education have somewhat lower mortality than children whose mothers have less education. These socioeconomic variables operate through the proximate determinants to influence child health.[48]

Amongst the numerous factors that have been found to be associated with childhood mortality, maternal education has been shown to have the greatest impact on children's survival chances. Education is highly and negatively correlated with childhood mortality even when other factors correlated with education have been controlled.[25,29,49]

Although there is general consensus about the importance of maternal education, there is little agreement on the mechanisms through which education operates to affect mortality. Nayar contends that educated people are more aware of the location of health care facilities and are more likely to utilize them.[52] At home, they may take better care of their children by providing more nutritious food and practicing hygienic habits (for example, washing hands before handling food). Jain on the other hand, contends that increased levels of education result in better utilization of available health facilities.[53] A more economically oriented argument by Schultz states that better educated mothers earn more in the labour market and consequently their household incomes are elevated, thus enabling them to purchase goods and services to improve child health.[54]

Women's educational attainment has improved significantly in Zimbabwe. The proportion of women aged 15-49 years with secondary education and above (that is, 10 or more years of schooling) increased from 16 percent in 1980 to 31 and 40 percent in 1986 and 1992

respectively and to 43 percent by 2002.[12] Though education levels have improved vastly at the national level, rural as compared to urban areas still lag behind. Consequently, we expect areas with relatively high educational attainment to have lower levels of childhood mortality. Distinct childhood mortality differentials by place of residence (rural-urban) and by province of residence have been observed in Zimbabwe. Apart from the data from the technical reports from the Zimbabwe Central Statistical Office[13,14,21] these variations and their possible explanations have also been observed by various authors, notable among them are Bah[22], Jhamba[30], Marindo and Hill[20] and Root[29]. Their works will be discussed in detail in the literature review section of this thesis.

In their study in Kenya, Anker and Knowles found that malarial endemicity in different regions had a strong effect on childhood mortality levels.[55,56] Place of delivery is also an important determinant of mortality, particularly neonatal mortality. Children delivered in modern health facilities usually exhibit lower rates of mortality. However, in some cases, mortality among children delivered in modern facilities is observed to be higher because mothers use these facilities mostly when they have pregnancy complications.[53]

The level of utilisation of modern health delivery services is quite high in Zimbabwe. For example, 68 percent of the women delivered their children in modern health facilities (that is, hospitals or health centers) in 2005-6.[21] The remainder delivered in their homes or in the homes of traditional birth attendants. The figure for 2005-06 (68 percent) is slightly lower than that recorded in the 1999 ZDHS (72 percent) and the 1994 ZDHS (69 percent).[21]

Almost all women who had a live birth in the five years before the 2005-06 ZDHS survey received antenatal care from health professionals (94

percent). Only 5 percent of mothers did not receive any antenatal care.[21] Due to differential levels of utilisation of delivery health facilities per area, areas with higher levels of utilisation are expected to have lower levels of childhood mortality.

When universal education is encouraged and high percentages of women complete schooling, women have a more egalitarian role in society that allows them to delay childbearing and encourages lower parities that are conducive to improved child health.[43,49] When men and women exercise their right to choose their education and employment, living standards rise as a result of increased household economic resources. This produces living environments with reduced contamination that promote child health. Development resources such as piped water and adequate sanitation promote health because they also reduce contamination. Finally, when child health is a high priority in the public sector, as reflected in the building of hospitals and health centers that include prenatal care, immunisation, and growth-monitoring programs, children's survival chances improve.[43]

The principal hypotheses to be tested in this thesis are that infant and childhood mortality are lowest in households and areas:

- that have a high proportion of educated women;
- that have access to antenatal care;
- that are located in the urban areas;
- that have a high level of utilisation of modern delivery health facilities, and
- that have low HIV rates among mothers.

2.4: Concluding Remarks

This chapter discussed the literature review and the conceptual framework. It was noted that the Mosley and Chen framework is a relevant framework for this study. However since the Mosley and Chen framework was developed before HIV/AIDS had reached epidemic stages, HIV prevalence will have to be included in the Cox proportional hazard models in order to study its impact on infant and child mortality.

The discussion on the literature review included evidence on the interplay between various relevant demographic and socioeconomic variables. It is clear from the review of the literature that the Cox proportional hazards model was little used in the study of the determinants of infant and child mortality in Zimbabwe. The rationale for the study is to fill this gap in the literature, firstly, by describing in detail the childhood mortality levels and trends in Zimbabwe; and secondly, by employing survival analysis (Cox proportional hazard models) to examine the determinants of infant and child mortality in Zimbabwe from 1996 to 2005.