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FACTORS INFLUENCING INFANT AND CHILD MORTALITY IN ZIMBABWE

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ABSTRACT

According to a 2010 report by the United Nations, mortality rates among children under the age of five remain extremely high in most countries in sub-Saharan Africa in which Zimbabwe is one of them. Child mortality in Zimbabwe is found to be associated with the specific causes with differing factors. This thesis analyses main causes of child mortality in Zimbabwe with selected socioeconomic, bio-demographic, maternal fertility behaviour, sexual reproductive health and services delivery factors in the study area, and Zimbabwe's progress towards reaching MDG 4&5, which is to improve maternal health and reduce child mortality.

The study used secondary data from the Demographic and Health Survey Zimbabwe of 2010-11, which is a nationally representative sample of all deaths based on household interviews to assess the impact of socioeconomic factors, health care accessibility and HIV/AIDS on infant and child mortality. This is a theoretical and descriptive study which uses odds and hazard rates of analysis and also used bio-demographic variables to understand the problem by exploring the data to obtain the most plausible estimates of infant and child mortality in the past decades.

The findings, to a great extent showed that, socioeconomic factors have a huge contribution to infant and child mortality rates in Zimbabwe. Preceding birth interval, family size, birth type, breastfeeding status, source of drinking water, mother education, mother income, area of residence, and father education have significant effect at univariate level, whereas, area of residence, mother education and father education were not significant at multivariate level.

The finding from the study revealed that mother's educational level is not a determinant factor of infant and child mortality in Zimbabwe unlike other studies. However, awareness about the influencing factors of infant and child mortality is vital in order to control them, so also is enlightenment on the need of birth control and family size and benefit of breastfeeding. Improvement on the socioeconomic status and empowerment of citizens most especially women will help to reduce infant and child mortality.

Key words: *Infant and Child mortality, influencing factors, Zimbabwe.*

CHAPTER 1

INTRODUCTION

Statement of Research Problems

The issue of child and infant mortality has been a worrying factor especially in developing countries. According to a 2010 report by the United Nations, mortality rates among children under the age of five remain strikingly high throughout the majority of sub-Saharan Africa. Of the thirty countries with the world's highest child mortality rates in 2008, twenty-nine were in sub-Saharan Africa (United Nations, 2010). The Millennium Development Goals (MDGs) are the eight international development goals that were established following the Millennium Summit of the United Nations in 2000, following the adoption of the United Nations Millennium Declaration. All 189 United Nations member states at the time (193 currently), and at least 23 international organizations, committed to help achieve the Millennium Development Goals by 2015. One of the countries at that summit was Zimbabwe and part of the MDG goals was to reduce child mortality, to improve maternal health, to combat HIV/AIDS, malaria, and other diseases. Having mentioned the above, the problem of child mortality in Zimbabwe is highly correlated with the specific causes of the childhood mortality with differing factors, thus this thesis analyses key causes of child mortality in Zimbabwe with selected socioeconomic, bio-demographic, maternal fertility behaviour, sexual reproductive health and services delivery factors in the study area, while also analysing the extent of Zimbabwe's progress towards reaching MDG 4&5, which is to improve maternal health and reduce child mortality, looking at socioeconomic factors, access to health care and the impact of HIV/AIDS has on infant and child mortality.

Research Objectives

- Finding Key causes of infant and under-5 mortality in Zimbabwe
- Analysing the extent to which Zimbabwe has worked to achieve MDG 4 and 5
- To determine the level of infant and under-five mortality rates and to examine the effect of socioeconomic, demographic and environmental factors on the health status of the children under five years.

Research Question

- What are the key factors influencing infant and child mortality in Zimbabwe?

Significance of Study

This study is very significant as it will be a measure used to track, how far Zimbabwe as a country has come in combating infant and child mortality. This study will be used to influence policy making regarding the issues surrounding public health systems in Zimbabwe.

Global scenario

In 2013, 4.6 million (74% of all under-five deaths) occurred within the first year of life. The risk of a child dying before completing the first year of age was highest in the WHO African region (60 per 1000 live births), about five times higher than that in the WHO European region (11 per 1000 live births). Globally, the infant mortality rate has decreased from an estimated rate of 63 deaths per 1000 live births in 1990 to 34 deaths per 1000 live births in 2013. Annual infant deaths have declined from 8.9 million in 1990 to 4.6 million in 2013 (World Health Organisation 2013).

Since the beginning of the age of the Enlightenment and over the course of modernization, the mortality of children below 5 years of age has declined rapidly. Child mortality in rich countries today is much lower than 1%. This is a very recent development and was only reached after a hundredfold decline in child mortality in these countries. In early-modern times, child mortality was very high; in 18th century Sweden every third child died, and in 19th century Germany every second child died. With declining poverty and increasing knowledge and service in the health sector, child mortality around the world is declining very rapidly. Big countries like Brazil and China reduced their child mortality rates 10-fold over the last 4 decades. Other countries – especially in Africa – still have high child mortality rates, but it's not true that these countries are not making progress. In Sub-Saharan Africa, child mortality has been continuously falling for the last 50 years (1 in 4 children died in the early 60s – today it is less than 1 in 10). Over the last decade this improvement has been happening faster than ever before. Rising prosperity, rising education and the spread of health care around the globe are the major drivers of this progress (Max Roser, 2015)

Reliable information on the magnitude, patterns and trends of causes of death in children under 5 helps decision makers to address needs, prioritise interventions and monitor progress. The

Child Health Epidemiology Reference Group (CHERG), established in 2001, developed a methodological approach that is transparent and consistent across different diseases and conditions and produces estimates of the major causes of childhood death. The objective of this study was to supplement findings of the CHERG and provide estimates of deaths from diarrhoea in 2004 at all levels, in particular with incomplete or non-existent registration data. In countries that account for 98% of under-5 deaths, registration systems to support attribution of causes of death are limited. Therefore, to estimate diarrhoea-specific mortality, the main source of data was obtained from various epidemiological studies carried out between the late 1980s and early 1990s. That study employed a weighted regression model to assess the relationship between the observed proportion of deaths from diarrhoea and explanatory variables from characteristics found in the reviewed studies. The regression model related these characteristics to proportional mortality from diarrhoea in order to predict its distributions in national population's research and/or their website).

Out of 68 studies, 47 were included in the analysis. The model based global point estimate of 1.8 million diarrhoea deaths correspond to 19% of the 10 million under-5 deaths in 2004. Results of the study show that the African (AFR) and South America regions (SEAR) account for 78% of the diarrhoea deaths in the developing world. The lowest observations of diarrhoea deaths were observed in the America (AMR) and Eastern Mediterranean (EMR) regions. The top 15 countries ranked by under-5 deaths due to diarrhoea account for 73% of all deaths and India alone accounts for more than half a million of these deaths. Information on the causes of death for children aged under-5 has not increased significantly since the 1980s and CHERG methods provide an alternative to countries with insufficient access to information. The study estimated the burden of mortality using thorough literature research, data abstraction, strict inclusion and exclusion criteria and local covariates to predict national estimates. Results presented should allow settings without adequate information to draw a reasonable picture of the burden of under-5 diarrhoea mortality that should ultimately result in practical planning for the prioritization of interventions and decision making. However in Adetunji (2013), (Trends in under-5 mortality rates and the HIV/AIDS epidemic. *Bulletin of the World Health Organization,* 78(10), pp. 1200-1206), says that adult HIV prevalence and under-5 mortality rates have increased or stagnated in many countries. Conversely, among adult health problems, HIV and AIDS has become a major killer of under 5 children particularly in developing countries. The objective of Adetunji's study was to analyze trends in under-5 mortality in countries with differing levels of adult HIV prevalence and estimate how much of the observed

mortality rate is a result of HIV among adults - using the available data, this data was collected from the Demographic and Health Survey (DHS). HIV prevalence data was obtained from WHO and UNAID sources. To observe trends, data was collected for two periods namely 1994 and 1997. The study provides an estimate of the of the impact of HIV/AIDS through a separate mathematic equation based on the premise that the number of under 5 year olds who die of HIV is directly related to the number of children who were infected with HIV from their mother. The formula is as follows: under-5 mortality due to HIV/AIDS is equal to the product of the adult HIV prevalence, perinatal transmission rate, and the proportion of children infected with HIV/AIDS dying before the age of 5 multiplied by ten. The results of the study showed that between 1994 and 1997 the prevalence of HIV in adults increased in the majority of the 25 countries examined. Zimbabwe was found to have the highest adult HIV prevalence increasing by about 50%. In low prevalence countries, Turkey led with an increase of 400%, although there was a significant increase, the initial rate was so low the prevalence after the increase was only 0.01%. Majority of the countries with high adult HIV prevalence in 1997 experienced an increase in child mortality rates while countries with an adult prevalence of less than 5% tended to have declining child mortality rates.

The Adetunji study concluded that changes in under-5 mortality cannot be explained by the level of HIV prevalence. A regression analysis proved that adult HIV prevalence or its change over time is not a statistically significant predictor of under-5 mortality; it is not enough to determine trends in child mortality but rather another layer in the causes of child mortality. Under-5 mortality rates increase in countries with an adult HIV prevalence of equal to or greater than 5% - the contribution of adult HIV/AIDS to child mortality is most noticeable in countries experiencing a severe epidemic - while decreases are observed in countries with lower prevalence. The results of the article show that the effects of adult HIV/AIDS may not be as large as thought. Prevalence can affect the level and quality of health care services negatively and could affect under-5 mortality at the household level. Estimates in the study are found to be limited in their capability to determine the indirect effects of adult HIV prevalence on under-5 mortality (Adetunji, 2014) United Nations Children's Fund.

The under-5 mortality rate is a key indicator of child well-being including health and nutritional status. Millennium Development Goal 4 (MDG 4) calls for a reduction in the under-5 mortality rate by two-thirds between 1990 and 2015. The United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME), established in 2004, updates its estimates on an annual basis.

This study aims to present the UN IGME's latest estimates and assess the progress of MDG 4. The group was created to harmonize child mortality surveys and improves methods for estimation. To do so, it follows a three step strategy. It includes compiling relevant available data on child mortality, assessing data quality and making adjustments and finally fitting a statistical model to the data. Levels and trends in under-5 mortality according to the UN IGME estimates show that global under-5 mortality has decreased by about a half since 1999, a decrease of 49% from 1990 to 2013. This is the result of more effective and affordable treatments and further innovation in the delivery of preventative and curative interventions. All regions with the exception of Sub-Saharan Africa and Oceania have halved mortality by over fifty percent. Eastern Asia, Latin America and the Caribbean and North Africa have all reached MDG 4 by reducing child mortality by two-thirds. Western and South East Asia are also close to this target. This study showed that the world is reducing under-5 mortality faster than at any time in the last 2 decades, more than tripling from a 1.2 to 4.0 percent annual reduction rate from 2005 to 2013. Despite these gains the report concludes that it is insufficient to achieving MDG 4, concluding that this is due to conflict and political instability continuing to contribute to mortality rates. Many countries especially in Sub-Saharan Africa and Southern Asia still observe high levels of under-5 mortality. Evidence also shows a disparity at the micro level in these countries. Children from rural areas are seen to have a higher risk of dying before the age of five. Reducing inequities across regions and income brackets is key. The study concluded that the major improvements in child mortality are mainly a result of affordable, evidence based interventions against the most common infectious diseases. Accelerating the reduction in under-5 mortality rates is possible by expanding effective preventative and curative interventions targeted at the causes of post-neonatal deaths. Neonatal health will also need to be addressed effectively.

Africa

Infant mortality in Cabinda, Angola (Simao and Gallo, 2013): challenge to health public policies, states that vital events are inherent processes to the human being and understanding the reasons for death in childhood allows for the suppression of the factors causing it. Survival conditions can be assessed using a variety of specific indicators, the most commonly used indicator being the Coefficient of Child Mortality (CIM), which measures the health status of a society. Simao and Gallo's study focused on the Cabinda region of Angola due to its position as one of the first ten countries when compared to others, assessed by the Inter-agency Group for Child Mortality (IGME), when considering the death of children. The researchers

conducted a descriptive study that is structured from a database containing information contained in register books of deaths and births. The data was obtained from a coverage area of the Regional Hospital of Cabinda Province. Data collection occurred from December 2009 to March 2010 with participation from the office of the World Health Organization in Cabinda as well as the institutional support of technicians of epidemiological survey and statistics in the respective hospitals. The results confirmed that in 2008 there was a decrease in the death of children compared to the previous year (91 less casualties). For both 2007 and 2008, the underlying causes of death among children included malaria - the main cause which accounted for one in three deaths. In 2007, pneumonia was the second cause in but represented a reduction in 2008 (65 to 40 deaths). There were also registers of congenital malformation in 2007 which accounted for 2 deaths in the study. Other underlying causes included infection of contagious diseases. In this case tetanus was responsible for 5% of deaths among children. The contribution of diarrhoea to child deaths decreased from 2007 to 2008. The most significant contributors were perinatal causes particularly neonatal asphyxia as well as prematurity. These indicators were found to have increased from 2007 to 2008.

The study found that no deaths were a result of AIDS. One of the main questions of the study was the low reliability of official data of Sub-Saharan Africa as estimators of infant mortality in the region (Lui, et al., 2012). The data presented by the province hospital reflect the realities of infant mortality and oppose the estimates presented by the WHO, the World Bank and UNICEF. The study found much lower CIM rates than those internationally recognized. It also found that among the cases studied, most of the children died within the first 28 days with emphasis on the first 24 hours. There is evidence of a large percentage of birth and death sub-notification reinforcing the poor quality of health care. It was highlighted that there was a need to implement health actions and policies to reduce neonatal mortality, promote prenatal care and improved delivery and new born care.

Divergent female-male mortality ratios associated with different routine vaccinations among female-male twin pairs (Aaby, et al., 2004). *International Epidemiological Association (YEAR of report),* the introduction of routine vaccinations has been met with major reductions in mortality. Observational studies have shown that this reduction cannot only be explained by the prevention of the targeted infection. Routine immunizations may have non-specific effects on childhood survival. Both beneficial and negative effects of vaccines have been found to be stronger for girls than boys. The Aaby study looks to examine the importance of non-specific effects of vaccines and the possible differential effects of vaccines for boys and girls. In

particular, the study examines the mortality in female-male twin pairs according to the last received vaccine. It does this using four community studies from Guinea-Bissau and Senegal. Previous studies from rural Senegal have found no sex difference in mortality at 1-17 months of age in the pre-vaccination era. In Guinea Bissau, the study evaluates female male mortality patterns for children aged 1-17 months before the introduction of routine DTP (Diphtheria, Tetanus and Pertussis) and oral polio vaccine. The study area included an urban district in Bissau City and three rural areas. Female-male twin pairs were identified from population registers and survival was followed from December 1978 to June 1981 and from March 1979 to the time the first DTP and oral polio vaccines were introduced in 1981. This study examined twins registered before 18 months old who both had had vaccinations documented in available records before death occurred. 626 female male pairs were identified between 1978 and 2000.

Results of the study show that there was no female male mortality difference between 1-17 months of age. The female-male mortality rate differed significantly for recipients of Bacille Calmette-Guerin (BCG) compared to DTP. BCG as a last vaccine resulted in lower female than male mortality while DTP as a last vaccine showed increased female mortality. A combination of BCG and DTP saw a decrease in mortality for girls. The results of this study then support the claim that vaccines have major non-specific effects on child mortality in high mortality areas. This study remains significant in the planning of vaccination programmes which may enhance the beneficial impact of immunizations on child survival in low-income countries.

This goes in references: War, famine and excess child mortality in Africa: the role of parental education. *International Epidemiological Association,* Volume 30, pp. 447-455. Armed conflicts in many African countries have targeted civilian populations. These conflicts have a significant impact on the health of young children as a result of destruction of health service infrastructure and resource allocations. Civilians' targeted warfare remains a major challenge to public health. A study which looked at the role of parental education in reducing child mortality in Tigrai, Ethiopia which was devastated by war and famine from 1973 to 1991 (Kiros & Hogan (YEAR)). The main objective of the study was to explore the role of parents' education on reducing child mortality in a region affected by war, famine and ongoing drought. Empirical evidence has shown that infant and child mortality in sub-Saharan Africa decreases with greater paternal education – if you have mentioned this above then you should say as I mentioned previously. This study hypothesizes that both mothers' and fathers' education will have an accumulative effect on child survival as a result of the independent avenues of influence education creates.

Data was collected from the 1994 Housing and Population Census in Ethiopia. This data is based on a 20% sample of all households in Tigrai - a total of 144 090 households. Additionally, data on food security from 1978 to 1988 was collected from the World Food Program. Child mortality estimates were obtained by using the Trussell variant of the Brass child survival method to estimate child mortality from information collected in census and surveys based on the Coale-Demeny west model of the life table. To examine the associations between child mortality and parental education multivariate models were studied using Poisson regression.

The results of this analysis found that child mortality is highest for children born to illiterate parents and decreases with both parents' education. The gap between child mortality and parental education increases in periods of great destruction such as during the Great Ethiopian famine of 1984 to 1985 and diminished after the 1991 civil war. The difference in mortality between fathers with primary education and illiterate fathers were insignificant except in the early 1980s. On the other hand fathers with above primary school education had significantly lower levels of mortality than fathers with primary or no education. The effect of parental education on child mortality has been less effective when a crisis is long lasting, in drought prone areas or when there is a high concentration of war. The majority of deaths occurring in these areas are among children under 5 years of age. In communities less affected by war the effect of parents' education is significant and child mortality in Tagrai was higher in urban areas compared to rural areas. Policy implications for the study includes addressing food security, armed conflict and expanding educational opportunities.

Asia

Claeson, Bos, Mawji, & Pathmanathan (2000) document the slow decline of infant mortality in India and the most prominent causes of childhood mortality are examined. In 1998, India had the highest number of deaths of under-5s - a total of 2.5 million. Health goals for 2000 included reducing the mortality rate for children under 5 to less than 100 per 1000 live births for infant mortality less than 60 per 1000 lives and perinatal mortality rate to less than 85 per 1000 live births.

All measures of childhood mortality declined in India at rates slightly greater than the average for other low-income countries excluding China. The Indian Sample Registration System

(SRS), a source of infant mortality data, was started in a few states to track births. The study compared SRS estimates of annual infant mortality rates for the most recent 5 year period (1993-1997). Factors that contributed to the decline in infant mortality rate in India included medical and nonmedical factors during the antenatal period and care at birth, maternal factors such as age and birth intervals, and household and community factors such as water and sanitation.

The study concluded that a major part of the decline in infant mortality rate is possible without a marked improvement in economic development. Non-income factors played a bigger role than income factors in reducing India's infant mortality rate. Poorer states performed worse in infant mortality and total fertility rates, however, richer states did not fare much better. Child health programs were seen to be positively related to reduction in under-5 mortality rates and perinatal mortality studies link the mother's health to the birth outcome. High perinatal mortality rates in India reflect the poor health and educational status of its women. Gender disparities in education and health are also higher in India and girls in India are 30-50% more likely to die under 5 than a boy. The reason for this gender difference is boy preference (infanticide?). Malnutrition is a factor in more than 50% of global childhood deaths and is the main factor identified in hindering human development and reductions in infant mortality in India. In conclusion, India's infant and child mortality rates have declined over the past two decades and data indicates that non-income variables such as maternal and child health interventions have led to this marked decline.

Katz et al. (2003) sought to identify the risk factors for early infant mortality which could assist in the development of intervention programmes. Most infant deaths occur in the perinatal and neonatal periods and it is useful to identify factors that predict early infant mortality. This was a population-based study in rural Nepal where "socioeconomic and demographic characteristics, reproductive history, substance abuse, physical work, morbidity and diet during pregnancy, characteristics of labour and delivery and maternal mortality" (Katz, et al., 2003) were looked at for mortality in babies younger than 6 months. A randomized community trial in Sarlahi district, Nepal was launched and evaluated the effect of weekly nutritional supplement for all women of childbearing age on maternal and infant health and survival. 270 communities were randomized, given Vitamin A or placebo to childbearing women who were then observed and recorded.

Risk factors were grouped into demographic and socioeconomic traits, pregnancy history, exposures and morbidity during pregnancy. The supplements did have an effect on maternal mortality and morbidity. The results showed that mortality in the first week of life was 28.6 per 1000 live births. The husband's work, household caste, land ownership, animals, household objects, household construction and size were not associated with mortality. Infants that were delivered by their mother alone were more likely to die. Maternal and paternal education was a significant predictor of death for babies who died in the post neonatal period. Prior miscarriages were a risk factor in the first week of life. However, socioeconomic factors were not an important predictor of mortality. The sex of the child, tetanus vaccinations, smoking and drinking, morbidity and maternal mortality were all predictors of infant mortality.

The Katz et al. study makes note of the following interventions to reduce mortality - reduction of maternal morbidity in the last trimester, improving the mid-upper arm circumference of women before and after pregnancy and better access to health services for mother and child. Chang (2011) reports that the neonatal mortality rate (NMR) and infant mortality rate (IMR) are the two most important indicators of the public health level of a country. During the past 60 years NMR and IMR have been reduced greatly in Korea due to its government support, socioeconomic environment and its effective health care/medical system. This article reviews the changes in NMR and IMR in Korea and compares it to that of the USA and Japan. Korea's IMR is lower than the average IMR of the OECD nations for the past 15 years. Over time, the Korean government has "established nationwide programs to promote improved healthcare for pregnant women, childbirth newborns and infants" (Chang, et al., 2011). Programmes such as early diagnosis for deafness, campaigns for preventing blindness of preschoolers have been launched. Additionally, the Korean Center for Disease Control and Prevention (CDC) supports many of Korea's programs promoting healthcare for children. The improvement of NMR and IMR in Korea has been attributed to various factors such as technological advancement and improved health care. The number of births have decreased, but conversely, high risk or low birth weight births have seen an increase. NMR and IMR figures for Korea are very low but are still higher than that of Japan's. However, these rates are still lower than the average of OECD countries. Korea's strong point has been that there is no marked racial discrimination amongst races and the availability of a wide range of medical and health care options has been beneficial. Researchers note the need to overcome the low birth rate in Korean society. This can be achieved by government initiatives to encourage childbirth while providing a good environment for Koreans to raise healthy children.

Europe

Gibb et al. (2003) objective was to describe changes in demographic factors, disease progression, hospital admissions & ARV use in HIV infected children in the UK and Ireland. Participants included 944 children who acquired HIV-1 prenatally under clinical care. In general, ARV (antiretroviral) therapy with 3 or 4 drugs has been used to treat HIV positive adults since 1996. Difficult to develop dosage for children therefore treatment delayed, only one ARV drug available for children before 1991. Additionally, the study investigated the change in mortality, morbidity and hospital admission in HIV-1 positive children in UK & Ireland. The design of the research was a national study of HIV in pregnancy and childhood (NSHPC) which ran in partnership with the British Pediatric Surveillance Unit and the Royal College of Obstetricians and Gynecologists. The collaboration between the HIV pediatric study and the national surveillance established between. The results showed that half of the reported 944 children were girls and more than 60% were black African. A total of 193 children died. Prenatally infected children increased but their deaths decreased. Opportunistic infections were significant in the mortality rate. A reduction of 80% in mortality and 50% in progression to AIDS from 1997 onwards was noted. Hospital admissions also decreased and these declines were attributed to the use of ARV therapy. Ethnicity, sex and place of birth showed no marked effect on the outcomes and results. In conclusion, death, hospital admission and progression to AIDS in the UK and Ireland dramatically declined but the demand for improved child health care in the regions is emphasized.

Schulpen, van Steenbergen & van Driel (2000) investigated the differences in perinatal death and child mortality between the different ethnic groups in the Netherlands. The method utilised was a retrospective analysis of data collected from 1990 to1993. Many countries have reported differences in perinatal and childhood mortality rates between social and ethnic groups. Countries included Germany, Sweden & Belgium. The Netherlands has a 16 million population and 1.3 million of this population are ethnic minority. The largest minorities are from Turkey and Morocco. Ethnicity is known to influence perinatal and child mortality in the Netherlands. This is known from previous studies done in the country. 197 000 children are born in the Netherlands annually. Ethnicity in the study was divided into 7 categories – Dutch, Mediterranean, Hindustani, Black, Non-Dutch European, Asian and others. The socioeconomic status for 42 282 women was assessed who gave birth in the three major cities in the Netherlands – Rotterdam, Utrecht and Amsterdam and were divided into 4 socioeconomic status groups. Results showed that perinatal death occurred mostly amongst black women in

the Netherlands. Socioeconomic status, equality and age had no influence on the ethnic groups. The mortality risk for Turkish and Moroccan children decreased and the main causes of death were hereditary disorders. Infectious diseases such as meningitis and acute respiratory infections were the most common cause of death for Turkish and Moroccan children. The external causes of death included accidents – which were attributed to low socioeconomic status and poor housing facilities- and drowning. It was also found that Turkish children have a higher risk of sudden infant death syndrome. A study done in the USA reported that perinatal mortality and preterm birth in blacks is double that of whites, Chinese, South East Asians and immigrants from the Indian subcontinent and from South & Central America. Death abroad is also the number one reason for death of children from 0-5 years old. Native Dutch parents have their children enrolled for swimming lessons and this may be a reason for the difference in swimming skills between children of different ethnicities. Poor Dutch language skills as well as different cultural values were risk factors for child/infant mortality. The researchers believe that interventions should include the influence of language barriers, lifestyle, and cultural and religious factors at the same time (Schulpen, et al., 2000:225) as well as better integration of the various ethnicities in the Netherlands.

This study determines the occurrence of perinatal or infant Congenital Heart Defects (CHD) and foetal and perinatal mortality associated with it in Europe (Dolk, , Loane,. & Garne, 2010). The method was as follows – data was "extracted from the European Surveillance of Congenital Anomalies central database for 29 population-based congenital anomaly in 16 European countries covering 3.3 million births during the period 2000 to 2005" (Dolk, et al., 2010). CHD are the number one reason for the deaths of 1/3 of babies with congenital anomalies in Europe. The majority of women in European countries are afforded the opportunity of access to prenatal ultrasound screening for detecting congenital anomalies. Prenatal diagnosis may improve success of treatment and preparation for birth except for more severe CHD. Severe CHD may lead to pregnancy termination. The article uses European Surveillance of Congenital Anomalies (EUROCAT) data on CHD in Europe and outcomes of pregnancies relating to foetal and early postnatal survival. The information is used as a base to monitor progress in prevention, the effect of termination, to plan for better services and allow regions to compare their rates with those of European rates. Results highlighted the total prevalence of CHD in Europe was 8.0 per 1000 births (Dolk, et al., 2010). 88% of CHD was not attributed with chromosomal anomalies while 12% of cases were. There was a marked decline in severe CHD in the 2000s. In 2004 in the European Union, 25% of early neonatal

deaths were a result of congenital anomalies. However, the study notes limitations as the information presented is not representative of Europeans in general. In conclusion, the investment in primary prevention and cardiac services by governments and health professionals is imperative.

South America

Jimenez & Romero (2007) attribute the success of Chile reducing infant mortality to the influential intervention by government by way of effective public health systems focusing on child and mother health, education and other policies. Two phases of infant mortality were determined (early and late). In the early stage, deaths in the neonatal period are higher than in the post neonatal period. There is also a significant relationship between infant mortality, the environment and medical strategies. During the first phase, environmental factors are major predictors due to infections. In the second phase, infant mortality results from neonatal reasons and therefore medical care is more important due to technological advancements. The paper primarily discusses infant mortality in Chile over 50 years and the researchers hypothesise that the country has reached levels of attainment comparable to higher-income countries despite still being a developing country. In 1952, the National Health Service of Chile established and focused on child and maternal health. An effective strategy to combat malnutrition was launched as well as a food programme to encourage families to adopt healthy behaviour. As a result, malnutrition decreased from 40% in the 1950s to less than 3% at the turn of the century. An increase in scholarships also ensured trained doctors were nurtured and this was critical in reducing mortality rates as most doctors went to work in the public health system. During Chile's periods of economic hardship, primary health care and nutrition programmes were vital in reducing infant mortality. When democracy was restored in 1990 the new government reinforced and improved health equity. Infant mortality then dropped from 16.0 per 1000 live births in 1990 to 8.9 in 2000. The highest reductions were seen in acute respiratory infections, perinatal conditions and congenital malfunctions. In conclusion, researchers hypothesises that infant mortality rates can also be lowered in other middle income countries due to health interventions. Chile improved as a result of urbanisation which led to health facilities becoming closer to those who needed it most.

Victoria & Barros (2005) reviewed two papers published by The Lancet: The Child Survival Series (2003) and the Neonatal Survival Series (2005) which highlighted 11 million deaths of children under 5 annually and whereby 4 million died in their first month of life. It also

highlighted how important reducing inequities between and within countries was. The study examines the relevance of the two papers to the Latin America and Caribbean regions as well as existing information on the regions. Globally, investment in child survival had gone down as the success of the Child Survival Revolution may have led to the idea that child mortality was being handled. The Lancet Child Survival Series' first paper showed 90% of annual deaths of children happened in only 42 countries which included Mexico and Brazil. This was due to neonatal problems as well as pneumonia and diarrhoea. Measles, malaria and HIV/AIDS were also reasons for death in some countries. The second article identified 23 interventions against child mortality including breastfeeding, oral rehydration, antibiotics and antimalarial medicines. The third paper argued that countries needed to change how they delivered health initiatives in order to make a difference in child mortality. The fourth paper addressed the gap between the rich and poor and that satisfying the needs of the poor should be a priority. The final paper identified 4 needs – global leadership in child survival, strengthening of national health services, international community support and increasing public awareness (Victoria & Barros, 2005). Researchers felt that funders ignored neonatal mortality and as a result, prepared this new paper - The Lancet Neonatal Survival Series. The first three papers in this series followed the previous one and focused on epidemiology & cause of death, existing interventions and challenges on delivery. Looking at its relevance to the Latin America/Caribbean regions, a major point in the series is that global strategies will not work for every country but should be tailor made to each country's specifics. The Lancet series' messages address high mortality countries which do not apply to Latin America and Caribbean countries. Generally, high mortality level countries are those with political strife. The Latin America and Caribbean regions are closer to meeting the fourth Millennium Development Goal than other less developed regions. Even though the state in this region is better than in other regions, many under-5 deaths could be avoided. Researchers therefore ask how the poorest children can be reached and how interventions can be effectively delivered to maximise coverage.

Lara-Valencia (2012) examines the effect of circumstantial variables at neighbourhood level on a health marker in the Mexican city of Hermosillo and the importance of planners and health professionals working together to lessen the effect of these variables on urban health. The study made use of spatial analysis and geographical information systems to explore the link between infant mortality and an index used to measure urban contextual factors (Lara-Valencia, et al., 2012). Not much is known on how social and material context at neighbourhood level affects

a child's survival within urban areas. There are elements of the built environment which may damage or promote health and in this way, the built environment affects the heath of an urban area. The closeness to a health facility is directly related with a decrease in infant mortality in urban and rural areas. There is also a link between access to urban parks/community facilities and the increase in physical activities of children and adults. Results show a need to connect health systems and urban planning. The objectives were to explain public health in midsize Mexican cities, identify the link between the built environment and health inequalities and to examine the role of urban planners and health professionals in lowering these inequalities. Hermosillo had a population of 784 322 in 2010. The built environment vulnerability index was derived and the index had three dimensions namely; shelter conditions, neighbourhood quality and city connectivity. Calculations were performed using variables from a 2000 census and from fieldwork done in 2004. They then identified infant mortality hotspots. As a results, maps were created to observe any patterns. The link between the environment and health was indefinable. Mortality hotspots in Hermosillo were located in neighbourhoods with a good environment. Clusters with the highest infant mortality had the highest environmental vulnerability. These neighbourhoods had no parks, lack of public transport, poor housing, were far from medical facilities and basic sanitation and water was lacking. The study showed some link between community health and neighbourhood conditions and researchers believe the City of Hermosillo's health professionals and urban planners need to work together to improve the health of the city.

Study area: Zimbabwe

The issue of child and infant mortality has been a worrying factor especially in developing countries. According to a 2010 report by the United Nations, mortality rates among children under the age of five remain strikingly high throughout the majority of sub-Saharan Africa. Of the thirty countries with the world's highest child mortality rates in 2008, twenty-nine were in sub-Saharan Africa (United Nations, 2010). However, it is important to note that according to a report by the UNICEF, infant and childhood mortality had declined in Africa in the 1960s, 1970s and 1980s, but starting in the 1990s, the decline has been slower and in several countries there was even a reversal (UNICEF, 2009; United Nations, 2010).

When discussing or analysing a country like Zimbabwe, it is of utmost importance to look at the historical context of the country especially focusing on the past two decades. Factors in

particular that probably had a pronounced impact on infant and child mortality rates in the recent history of Zimbabwe are drastic changes in economic and social conditions and the HIV/AIDS epidemic. Zimbabwe experienced a collapse of its economy in the past decade which was due to the fast trek land reform movement which was brought by the ruling party under the leadership of President Robert Mugabe. According to Clemens and Moss in Joshua Kembo and Jeroen. Van Ginneken 2010, the extent of this collapse can be measured by looking at changes in the purchasing power in Zimbabwe over the past 50 to 60 years. Clemens and Moss (YEAR) estimated that the purchasing power for the average Zimbabwean in 2005 was at the same level as in 1953. They also calculated that this fall was so steep that it had an impact on health in general and on the mortality of infants and children in particular. They estimated that this economic shock has led to the death of at least 3,900 Zimbabwean infants per year between 2000 and 2005 (Clemens and Moss, 2005). This amounts to about 11% of all deaths under-1 YEARS OLD of children born each year in the early 2000s.

Mortality trends

According to the National Child Survival Strategy for Zimbabwe 2010 – 2015, fairly constant child mortality rates where noted from the year 2000 onwards. Mortality rates were seen to be heading towards meeting the MDGs of 2015.

Mortality patterns

The Zimbabwean infant mortality rate was estimated to be at 60 per 1,000 live births. The under-5 mortality rate was estimated to be at 86 per 1,000 live births (MIMS, 2009). These figures demonstrate little change since the ZDHS of 2005/6 which reported an infant mortality rate of 60 per 1,000 live births and under-5 mortality rate of 82 per 1,000 live births respectively. The neonatal mortality rate had increased to 29 per 1, 000 per live birth in 1999, preceded by a decline to 24 per 1000 live births in 2005-6.

It has also been noted that there where major differences in mortality by province and place of residence. The East province of Mashonaland was noted to having the highest under-5 mortality rate which was 103 per 1,000 live births. Furthermore, the South Province of Matabelend having the lowest under-5 mortality rate of 56 per 1, 000 live births (MMIS, 2009). Hence the realisation that where differences in the mortality rates between urban and rural areas. The rural mortality rate being 90 per 1, 000 live births and the urban rate being 70 per 1, 0000 live births. This greater highlighted the inequalities in access of quality care between urban and rural areas in Zimbabwe.

The rise and spread of the HIV and AIDS epidemic can never be ignored when dealing with INFANT MORTALITY, because the 1990s saw a large number of mortality rates being accounted for by the epidemic as it claimed many lives, not that of children but also mothers and the transmitting of the virus from mother to child. This epidemic had a substantial impact on the infant and child mortality rates both directly and indirectly. In support of the above statement, I will make reference to studies that were taken by the United Nations and UNICEF. The first study was carried out in 25 countries at varying levels of adult HIV/AIDS prevalence in the late 1990s. Zimbabwe was included as one of these countries in the group with very high HIV prevalence. The infant and child mortality rate was estimated at 77 per 1,000 live births in 1997. Using a mathematical model, it was further estimated that 61% of this mortality rate was due to HIV/AIDS (Adetunji 2000). The second study was conducted by the United Nations in the early 2000s. The UN estimated that the impact of the HIV/AIDS epidemic on the seven sub-Saharan countries with the highest adult HIV/AIDS prevalence, which included Zimbabwe, of these seven countries the infant and child mortality rate was estimated to be 109 deaths per 1,000 live births in the presence of AIDS in 1995-2000 and 80 per 1,000 in the absence of AIDS, AND Therefore the HIV/ AIDS epidemic was responsible for 27% of all infant and child mortalities. It is also important to note that projectors projected that this impact would be even larger in 2010-2015. According to the projections, the period 2010-2015 WOULD see a rise in the infant and child mortality rate as it is expected to be 100 per 1,000 live births in the presence of HIV/AIDS and 57 in the absence of AIDS which means that 43% of all deaths are due to HIV/AIDS (United Nations, 2004). Therefore, concluding from both studies that the direct and indirect impact of the HIV/AIDS epidemic on infant and child mortality in Southern Africa was extensive and the same applies to Zimbabwe which is one of the countries most affected by the epidemic. Thus looking at both the combined impact of the economic recession and the HIV/AIDS epidemic it is safe to say that they contributed and

resulted in the high rate of infant and child mortality rates are larger in the 1990s and 2000s than in the period before 1990.

It is important to note that these trends in infant and child mortality ARE DEPENDENT UPON the data quality. One of the concerns is the extent of similarity in the quality of the data collected in the five DHS surveys in Zimbabwe. If there are reasons to believe that this quality is not similar in all five surveys, then this may affect the rates obtained in these surveys. One factor in this group of factors dealing with data quality that needs special attention refers to a bias that is likely to occur in under-five mortality rates in cross-sectional surveys in countries with high levels of HIV/AIDS. According to an article by Joshua Kembo and Jeroen (2009). Van Ginneken (2010) on Infant and child mortality in Southern Africa, they said when looking at the surveys conducted (in reference to Zimbabwe), It could be possible that a number of HIV-infected mothers that were eligible to be interviewed in these surveys had recently died due to HIV/AIDS and were, therefore, not interviewed and were replaced by surviving mothers. Accurate information on this topic can actually only be provided by population-based longitudinal studies. Results of two longitudinal studies on this topic have recently become available and it is, therefore, necessary to analyse and summarize them.

A study that used pooled data from three longitudinal studies conducted in Uganda, Tanzania and Malawi (Zaba *et al*., 2005) found that infant and under-five mortality rates were determined for mothers who had died and were HIV-positive and were compared to mothers who were alive and HIV-negative. Using life table techniques, it was found that the risk in under-five mortality associated with the death of mothers due to HIV/AIDS was 3.9 times higher than under-five mortality associated with surviving mothers. The second study used longitudinal data and it was carried out in Manicaland in rural Zimbabwe (Gregson et al., 2009). Under-five mortality was classified by the survival status of the mother. Children of mothers who had died (due to AIDS) had infant and under-five mortality rates of 146.8 and 283.8 per 1,000 respectively; children of mothers who survived experienced infant and under-five mortality rates of 45.9 and 67.1 per 1,000 respectively. Infant and under-five mortality rates for all mothers together (deceased and surviving) were 48.9 and 73.7 per 1,000 respectively. The rates obtained for the surviving mothers are the uncorrected rates obtained in cross-sectional surveys such as ZDHS 2005-06 while the rates for both groups of mothers together are the corrected figures. This shows that standard cross-sectional surveys (such as ZDHS 2005- 06 in the case of Zimbabwe) under-state the true levels of infant and under-five mortality. Gregson et al (YEAR) estimate that in rural Zimbabwe in the period of 1990 until the middle of 2002 infant

mortality could be 6.7% (48.9-45.9/45.9) higher than observed in surveys such as the ZDHS 2005-06 and under-five mortality 9.8% (73.7-67.1/67.1) higher (Gregson et al., 2009). We have to keep in mind this bias in infant and child mortality rates that is likely to occur in a country like Zimbabwe with a high prevalence of HIV/AIDS. Adjustments in these rates are, therefore, needed and will be made in accordance with the findings by Gregson et al presented above.

CHAPTER 2
LITERATURE REVIEW

Before going on to discuss the issues affecting or causing the high levels of infant and child mortality in Zimbabwe, it is important to first have an understanding of the Country in question, in terms of where it is currently and its socio economic status in the International community. In Zimbabwe, there has been some notable improvement in child immunization under the Zimbabwe Expanded programme of Immunization coverage (ZEPI) since 1982. In the last three years, percentage of children aged 12-23 months who had received full vaccination had doubled since ZDHS 2005/06 to 80%. Diarrhoea is one of the top diseases affecting under 5-year olds and the other being acute respiratory infections, malaria and skin diseases. At national level, 11% of under 5 year olds had diarrhoea prior to the MIMS survey 2009 and comparable to the ZDHS 2005/06 prevalence of 12%. According to 1999 and 2005/06 ZDHS, the infant mortality rates for 5 years preceding the surveys declined from 65 deaths per 1000 live births

to 60. The desired infant mortality rate of 22 per 1000 live births might only be achieved with decline of HIV/AIDS prevalence, increase in the provision of Mother-to-Child transmissions and ART, reduction in malnutrition and improvement of health delivery system (UNDP 2010). Therefor having said that, it is important to note that, the issue of child mortality has been a major issue that has affected developing states in a very negative way. Child mortality has high influence on population growth, thus it hinders the developments of under developed states, case in point the recent publication by S. Appunni (2015) on the effects on Tanzania, in his paper, touched on the issues that have contributed to high child mortality rates in Tanzania, he looked at factors like the impact HIV and AIDS has had in influencing the high rates of child mortality.

Factors of child mortality are different in comparative importance from factors associated with infant mortality. This study reports on infant and child mortality issues in Zimbabwe to determine specifically the "impact of maternal, socioeconomic and sanitation variables on infant and child mortality" (Kembo & van Ginneken, 2009). In their study Kembo and Van Ginneken support health policy programmes to encourage family planning procedures to increase birth spacing. This was to determine how important variables such as maternal, sanitation and socioeconomic variables relate to infant and child mortality in Zimbabwe from 1996 until 2005. The relationship between infant and child mortality as well as birth order, maternal age at birth and preceding birth interval was the focus. Other socioeconomic and sanitation variables were controlled using various models.

Two age periods were identified to analyse child mortality. They were mortality from birth to 12 months of age ('infant mortality') and mortality from 12 months to 60 months of age ('child mortality'). The dependent variable in both age periods is "risk of death occurring in an age interval in a period" (Kembo & van Ginneken, 2009). Independent variables are identified as maternal factors, socioeconomic variables and sanitation. Outcome variables are identified as infant mortality (chance of death between birth and 12 months) and child mortality (chance of death between exactly 12 months and 60 months). In Kembo and Van Ginneken's study, data was collected from a sample of 8907 women between 15-49 years of age and 7175 men between the ages of 15-54 years in the form of a survey. Maternal and socioeconomic covariates, number of live births and number of under 5 deaths were compared.

As a result, the importance of parity and birth spacing to determine infant survival is emphasised. It is observed that socioeconomic variables do not have a definitive impact on

infant mortality. Place of residence, wealth index, maternal and paternal education, access to piped drinking water have an effect on infant mortality. Child mortality is increased by living in rural areas and sanitation is more important during childhood than infancy. The researchers expect children born to mothers 20 years of age and younger and to older mothers between 40-49 "should have higher mortality than those born to mothers aged 20-39 years" (Kembo & van Ginneken, 2009). The study addressed goals 4 and 5 of the Millennium Development Goals (MDGs) and in this case succeeded in identifying factors that contribute to the reduction of child mortality and improving maternal health (UN Millennium Project, 2006).

However as mentioned in my Introduction, the focus area of this paper is Zimbabwe, thus it is important to look at the figures since 1980. According to the UNDP, in Zimbabwe, infant and under-five mortality rates decreased substantially after Independence in 1980, but began to increase in 1996, possibly in response to the start of economic challenges and the introduction of cost-recovery policies (UNDP, 2010). This shows how factors like economic growth and development have a huge influence on Infant and Child Mortality. Recent statistics published by DHS, show that, the under-five mortality rate has risen from 77 per 1000 live births in 1994 to 82 per 1,000 live births in 2005. The infant mortality rate (IMR) followed the same trend. Neonatal mortality decreased from 29 per 1,000 live births in 1999 to 24 live births per 1000 in 2006.

According to the Zimbabwe Demographic and Health Survey Report of 2006, perinatal mortality was 25 per 1,000 live births. The Multiple Indicator Monitoring Survey (MIMS) of 2009 reported a small increase in the under-five mortality rate of 86 per 1,000 live births compared to 82 in 2005 while the 2009 estimates by the Inter-Agency Group for Child Mortality Estimation, using a method adjusting for HIV and AIDS-related mortality for each data observation, showed an under-five mortality of 96 per 1,000 live births. As mentioned above by Sathiya (2011) on Tanzania the issue of HIV and AIDS has had a huge influence on the rising numbers of Infant and Child mortality rates in developing countries, because in Zimbabwe this rise is mainly accounted for by the direct and indirect impacts of the HIV and AIDS epidemic and the concomitant rise in poverty levels due to economic challenges. Kurewa, et al. (2010), aimed "to describe infant mortality trends and associated factors among infants born to mothers enrolled in a prevention of mother-to-child transmission (PMTCT) programme." Kurewa's study assessed1045 mothers and single infant pairs. 474 HIV-positive and 571 HIV-negative mothers delivered 469 and 569 live infants. Children who are born to

HIV-positive mothers ARE three times more likely to die than those who aren't. The aim of the study was to find which PMTCT intervention influenced child mortality in Zimbabwe.

This was achieved using a "nested case-control study of HIV positive and negative pregnant women" (Kurewa, et al., 2010), who participated in a PMTCT programme at 36 weeks gestation at 3 different clinics in Zimbabwe. The mother and baby pairs were followed up on after delivery after 6 weeks, then 4 months and lastly after 9 months. The mothers were given an intervention of 200mg nevirapine dose at labour and their infants received 1-2mg within 72 hours of being born. Cord blood was collected from the infants at birth then on follow up visits, venous blood was drawn. At each follow up, the mother was asked about the health of the infant. Birth weight, breastfeeding, the infant's HIV serostatus, the mother's age, marital status and maternal HIV status were identified and risk factors for child mortality. Differences in anthropometrical measurements of babies at birth were seen in those born to HIV positive and HIV negative mothers. At the 9 month follow up, 51 infants of HIV positive mothers had died while 20 infants of HIV negative mothers died. This study by Kurewa then shows the direct link between HIV exposure and high child mortality in the beginning 4 months, therefor an infant's HIV status is the strongest predictor of infant mortality. Infants should be screened for HIV from delivery and throughout breastfeeding as prevention is the top priority.

To further analyse the role HIV/AIDS has on infant and child mortality, a study was conducted to observe the "risks of intra-uterine (IU) and early post-partum (IP/ePP) and late post-partum (LPP) mother-to-child transmission (MTCT) of HIV-1" (Zijenah, et al., 2004) and mortality in an infant's first 6 months of life. HIV MTCT happens in utero, intra-partum and post-partum through breast feeding. 13-45% of infants become infected through transmission in the absence of any intervention. The usage of ARVs, avoiding breastfeeding and delivery by caesarean section in developed countries has diminished MTCT. In developing countries, single-dose nevirapine is the most common intervention. Therefor the study by Zijenah was aimed to determine the timing of MTCT in the absence of ARVs and its impact on infant mortality within 6 months of delivery of 1000 babies who had been born to HIV-1-positive mothers. This was done by collecting whole blood from 996 babies born to HIV-1 seropositive mothers from at birth, at 6 weeks, and 6 months. Logistic regression models were implemented to ascertain the risk factors for HIV-1 transmission and survival analyses examined mortality by timing of transmission. Infants that were found to be positive at birth but died were regarded to have acquired HIV-1 in utero. Forward stepwise logistic regression models were used to analyse risk

factors for infection status and timing and Cox proportional hazard models for mortality (Zijenah, et al., 2004).

As a result, 30.7% of mothers had transmitted HIV-1 to their infants by 6 months. Infant mortality was higher among infected infants than uninfected infants. “Timing of infection, birth weight and maternal CD4 cell counts” were predictors for infant death (Zijenah, et al., 2004). In Zimbabwe, many women breastfeed and the mother is the one that takes care of the infant. In this case, if the mother is sick, early infant mortality increases as they are not taken care of, however promising studies have been conducted in South Africa on exclusive breastfeeding to reduce postnatal transmission and ultimately, infant mortality.

Challenges in Health systems and outbreaks Zimbabwe’s unprecedented economic decline saw spiralling inflation, deteriorating physical structures and, in 2008, the inability of the public sector to deliver basic social services. The country has been facing severe human resources capacity constraints in the public sector, and the health sector in particular. Drugs and medical supplies were largely unavailable for longer periods of time. The consequences of these challenges were further reflected in a major outbreak of cholera in 2008–2009, which saw 98,591 documented cases and 4288 deaths, and an outbreak of measles in 2009–2010. According to an article by Andrew Meldrum (Year), one in eight children in Zimbabwe will die before the age of five, the highest mortality rate in the world, according to figures published in 2005 by the United Nations Children's Fund (UNICEF). It was said that child mortality had risen sharply in the country since 1990, when one in 12 children died. About 70% of those deaths were due to HIV and AIDS. Zimbabwe has the world's fourth highest level of HIV/AIDS - 24% of the total population of 12 MILLION is infected but IT is getting very little international assistance to help overcome it. The UNICEF executive director, Carol Bellamy, mentioned in her 2005 report, that this has a negative effect on Infant and Child mortality because children in Zimbabwe were dying of HIV/AIDS. In addition to the rising rate of child deaths, Zimbabwe has a million children - one in five is orphaned by AIDS. In 1990 it had one of Africa's best healthcare systems. But in recent years the government has reduced the health and education budgets and channelled the funds to the army and its internal security network, the central intelligence organisation (Andrew Meldrum 2005)

Socio-Economic Issues

Zimbabwe has experienced improved economic growth rates in the past three years, rising from a negative GDP of 5.7% between 2001–2006 to 5.4% in 2009 and 9.3% in 2011. However, this

has not translated to growth in productive employment and hence poverty reduction. This is likely due to weak connections between the growth sectors and other sectors of the economy. In 2011, 72.3% of all Zimbabweans were considered poor, whilst 62.6% of the households in Zimbabwe are deemed poor. Poverty is more prevalent in rural areas compared to urban areas with about 76% of the rural households considered poor compared to 38.2% of urban households. Individual poverty prevalence is 84.3% in rural areas compared to 46.5% in urban areas, while extreme poverty is 30.3% in rural areas compared to only 5.6% in urban areas. The decline in formal employment, with many workers engaged in poorly remunerated informal jobs, has a direct bearing on both poverty and hunger. In 2011, 94% of paid employees received an income equal to or below the total consumption poverty line (TCPL) for an average family of five, while three out of every four employed persons in Zimbabwe are classified as 'vulnerable employment'. The percentage of food-insecure rural households at peak (January to March) declined steadily following the onset of economic recovery from 15% in 2010–2011 to 12% in 2011–2012. However, due to this year's poor rainy season, the percentage of food-insecure rural households is projected to rise sharply, up to 32% for the period in 2013–2014, reflecting Zimbabwe's reliance on rain-fed agriculture. The prevalence of underweight children under five years of age fell from 11.8% in 2009 to 10% in 2011, although this figure may be affected by the projected increase in food-insecure households. According to Appunni (2015), all these transform into malnutrition of infant and children and threat to their health status increases and eventually child mortality take its course. With its major impact on the survival chance of children, shortening of birth interval is very common practice in Sub-Sahara Africa. To clearly understand birth interval and its influence on the survival of the children, a distinction should be made between subsequent and preceding birth interval. A short preceding birth interval is strongly correlated with high Infant Mortality Rate while short subsequent birth interval is associated with high Child Mortality Rate (Andrew Meldrum: 2005). Regardless of the lack of an optimal length of time between two successful births has not yet been suggested. Appunni (2015) found that between 24 and 36 months or over is an ideal interval and children born with this interval have more survival chance than those born with less than 24 months of birth interval. On the other side high parity result in high child dependency ratio in the household that affect the quality and quantity to children care and competition of available resources in the household increases. Thus households with high parity have their children at risk of high mortality than household with low birth parity (Kembo and Van Ginneken 2010). Mortality among under-five children is disproportionally higher among high risk groups such as infant of multiple births (Appunni 2015). In this light, multiple births are complicated with

high risks of diseases and pregnancy complication; furthermore, children of multiple births are thought to suffer a high risk of malnutrition. Likewise study by Joshua Kembo and Jeroen Van Ginneken (2010) found that multiple births always related with high child mortality rate, specifically neonatal mortality, because of complications during delivery as most multiple births ARE delivered with low birth weight. Thus, high under-five mortality is experienced with children of multiple births than those of single BIRTH.

The order of children with respect to his/her sibling has an impact on child mortality. It has been set into the theory that high mortality is found to first order (first born) and to children of high orders. Authors Joshua Kembo and Jeroen K. Van Ginneken (YEAR) found an association between high child mortality and children of first and higher orders. A study mentions that the health of the children depends on the delivery of services by the government, NGO's, private sectors, traditional services and illegal providers (United Nations: 2010). Similarly, according to Appunni (2015) using the updated model of Mosley-Chen IN the World Bank Poverty Reduction Strategy Paper Sourcebook (2015) explains that the health outcomes of children and their overall survival chances are influenced by service delivery in the health sectors and other sectors like water, energy and sanitations. Regardless of these deliveries, questions still remain as to what extent can the household access these services? Thus, it has been postulated that the accessibility of services by the household is in turn influenced by their socio-economics status.

Furthermore, an access to proper sanitation, clean water, quality health facilities and source of energy in the household or neighbourhoods are central services that determine the odds of child mortality (UNICEF: 2010). It is estimated that approximately 1.5 million children deaths are due to drinking unsafe water, living in places with unavailability of proper sanitation, living far from health centres and lack clean source of energy. In his article, Appunni adds that unhygienic and unsafe environments put children at high risk of death compared to environments with proper hygienic facilities (Appunni, 2015). Large differential in child mortality is observed with respect to access to proper sanitation and clean water supply both in quality and quantity. However, it is important to note that the impact is experienced more by children than neonates and post-neonates while a 2010 report by UNICEF suggests that households with unsafe water and improper sanitation (e.g. traditional pit toilets) experience high neonatal mortality than post-neonatal and child mortality when birth interval is controlled. Nevertheless, a study on Tanzania found an indirect influence of access to proper sanitation and clean water on odds of under-five mortality through its impact on nutrition and disease status of the children. In this perspective, the risk of fatal diseases like diarrhoea increases with

an increase of deterioration of water quality and sanitations, additionally the nutritional status of the children is largely dependent on the water quality and quantity intake by the index children. The mechanism through which water and sanitation exert AN effect on child mortality is well established. A related study which was done by UNICEF in partnership with the World Bank shows that unsafe drinking water possibly affect child mortality as it carries vector bacteria that causes diseases like diarrhoea, cholera, dysentery and typhoid (Appuni,2015).

Socio-Cultural Factors

Refusal of medical treatment or advice, whether on religious or traditional grounds, is an important factor with regards to the shaping of the population's health-seeking behaviours. For example, both tradition and indigenous religions have a strong bearing on the child mortality rate in Zimbabwe. Some religious groups do not allow their children to be immunised, neither do they permit the use of modern medications for the treatment of their illnesses.

Environmental factors

The provision of a safe water supply and good sanitation is a major contributory factor to positive childcare. Of the total population, 33% still rely on the bush toilet for sanitation, and it is widely understood that diarrheal diseases can be exacerbated in environments where sanitation is poor. Another socio-economic factor which is also linked to environmental socio issue was the dependence on biomass in developing countries for cooking and warming exposes many women and young children to great levels of air pollution in the home. Mishra (2003) investigated the association between household use of biomass fuels for cooking and acute respiratory infections (ARI) in preschool age children (under 5 years) in Zimbabwe. Logistic regression was used to approximate the likelihood of suffering from ARI among children from households using biomass fuels (wood, dung, or straw) relative to children from households using cleaner fuels - liquid petroleum gas [LPG]/natural gas, or electricity - (Mishra 2003). ARI are the foremost root of childhood illness and death globally and the top cause for childhood mortality in Zimbabwe.

In his study (Mishra 2003) focused on the relationship between the use of high pollution biomass fuels such as "wood, dung or straw" and the occurrence of ARI in Zimbabwe's children. The fuels are used in modest, ineffective household stoves which in combination with

poor ventilation, results in great volumes of smoke in the households. Women and young children are more exposed to these fuels as the women do the cooking and children stay indoors or are carried on the backs of their mothers while they cook. Biomass smoke exposure is strongly related to ARI in pre-schoolers and to chronic obstructive pulmonary disease (COPD) and chronic bronchitis in women and has been linked to tuberculosis and asthma.

A population sample of 3559 children aged 0–59 months was taken from the Zimbabwe Demographic and Health Survey (ZDHS) of 1999. The sample is 6369 households and 5907 women from 15-49 years of age. The sample was selected in two stages. Survey questionnaires were used to collect data over 4 weeks and translated into Shona and Ndebele then back translated to ensure accuracy. The primary question asked was, "What type of fuel does your household mainly use for cooking?" (Mishra 2003). Logistic regression models estimated the effects of the type of cooking fuel and other causes of ARI. The GENMODE procedure analysed data, results showed that the majority (66%) of children subjects live in homes that rely on highly pollutant biomass fuels and that children 6-23 months were more susceptible to ARI. However, the rate of children developing ARI decreased with age. This then raised the fact that Zimbabwe has a real ARI problem and this study (Mishra 2003) showed that exposing children to biomass cooking smoke is strongly related to ARI in young children regardless of their "age, nutritional status, maternal education, household living standard, and other factors" (Mishra 2003). The researcher urges government to develop awareness programmes on the harmful effects of biomass fuels and promote the usage of cleaner fuels such as electricity, which will decrease the infant mortality rate as this is also a contributor to the infant and under5 mortality.

Health Care Services

Although the government does have an existing user fee policy which should provide free of charge health services for pregnant and lactating mothers, children under five and the elderly (60 or more years of age), it has proved extremely difficult to implement. At present, user fees provide the main income for a very large number of facilities to provide at least the minimum service in the absence of substantial government support. During the decade 2000–2010, state investment in health varied from 4.2% of the state budget in 2001 to 15.3% in 2009. An important commitment would be to keep to the Abuja Recommendation (2009) of 15% of the state budget for health. However, this proportion of the national budget falls significantly short of

the per capita health cost allowance, which, according to the Ouagadougou Declaration (2009), should be US$34-US$40. Currently, Zimbabwe's annual budgetary allowance only stretches to US$9 per capita.

Generally speaking, various factors have an influence on trends in infant and child mortality. Factor such as advances in medical technology, changes in disease patterns, in health care provision and in economic and social conditions (Kembo & van Ginneken, 2011). Drastic changes in Zimbabwe's economy, social conditions and the HIVAIDS pandemic had a major impact on under five mortality rates. The researchers estimated the change in Zimbabwe's economic landscape resulted in the deaths of at least 3,900 infants per year from the year 2000 to 2005 (Clemens and Moss, 2005). Data from four Demographic and Health Surveys conducted in Zimbabwe in 1988, 1994, 1999 and 2005-2006 as well as censuses and demographic surveys were used for analysis. The following were results obtained regarding neonatal and post neonatal mortality levels and trends, mortality went down from 102 deaths per 1 000 live births in 1995-1999 to 82 deaths in 2001-2005 (Kembo & van Ginneken, 2011). A decrease was also seen in neonatal, infant and child mortality in the same period while post neonatal mortality did not change. Results also showed that vaccinating of under-five children in Zimbabwe decreased between 1994 and 2005 and that the nutritional status and general health of these children dramatically worsened, the declines in under-5 mortality between 1995-1999 and 2000-20005 were unexpected as infant and under-5 mortality rates were expected to increase during both periods due to declining political and economic conditions as well as the AIDS pandemic in Zimbabwe during those years (Kembo & van Ginneken, 2011). Several reasons were determined as to why an increase in under-5 mortality was not observed in the early 2000s. It is implied that infant and child mortality rates reported in 2000-2005 in Zimbabwe were too low.

HIV and AIDS

HIV and AIDS is one of the leading causes of under-five mortality in Zimbabwe, accounting for 21% of the deaths. Over 95% of the paediatric cases of HIV in children less than five years of age are vertically transmitted from mother to child during pregnancy, childbirth and/or breastfeeding. At the end of 2009, of the 387,649 who needed ART, 53% (215,123) of all HIV-positive patients (public and private) were receiving it. Of these, about 21,000 (9.5%) were children below 15 years of age, with only about 700 of them younger than 18 months, thus implying that most of the children on treatment are long-term 'survivors', since it is known that

over 50% of infants infected with HIV die before two years of age unless they receive medical treatment. Thus, preventing mother-to child transmission and screening infants for HIV after delivery and throughout breastfeeding are critical measures to reducing the numbers of children dying from HIV-related conditions.

However, it is important to note that in Zimbabwe both under-five and infant mortality rates are improving but very slowly. The under-five mortality rate declined from 102 deaths per 1,000 live births in 1999 to 84 per 1,000 in 2010/2011. The infant mortality rate declined from 65 deaths per 1,000 live births in 1999 to 57 deaths per 1,000 live births in 2010/2011. Even so, this decline is not fast enough to achieve the MDG 4 target. Rural children have a higher mortality rate than their urban counterparts; findings indicate that socioeconomic status and the education level of the mother lead to lower mortality rates for children. Four preventable conditions have led to the vast majority of under-five deaths: AIDS, neonatal problems, pneumonia and diarrhoea. Immunisation coverage has improved in general, but the high cost of obtaining treatment and the lack of easy access to safe drinking water and improved sanitation are major obstacles to reducing under-five and infant mortality rates.

Another factor that contributes to one infant and child mortality is maternal mortality and reproductive health of the mothers. Because this has a huge influence on infant and child mortality, access to neonatal care has a significant reduction in infant and child mortality, as studies have shown, that in developing countries, access to neonatal care has had a huge influence in reducing infant and child mortality. According to Appunni (2015) the fertility behaviours of the mothers has also in developing countries is directly associated with the wellbeing of their infants and children. Many studies found that characteristics of the mother such as age at giving birth, birth interval, multiplicity of birth, parity, the biological and physical characteristics of children like birth order, mother's age at marriage, at present age and gender are associated with child mortality. The wellbeing of the baby depends much on the age of his/her mother during the delivery time. Normally teenage and older pregnancies are associated with physical immaturity, birth complication and delivering a baby with low birth weight, all these translate into high risk of death among the newly baby born (Arunachalam & Naidu, 2008). Similarly, a U-shaped relationship between age of the mother and child mortality have been established by many scholars (Appunni, 2015). This relationship means that more children are dying to mothers with age less than 23 and 40 to 49 years (Arunachalam &Naidu, 2008). On the contrary some studies identify that high risk of dying among infants and children is found to mothers of older age specifically 35 year old and above (Arunachalam & Naidu,

2008). However it is important to note that these authors did not control for other variables like birth interval and parity in their analysis. The consensus has however been reached that raising the age at giving birth probably to about 25 years old and stopping reproductive activities at age 34 year old as suggested by (Senderowitz & Paxman, 1985) reduces child mortality indirectly through lowering fertility level (reduce birth parity). Birth interval is the period between a child birth and succeeding and/ or previous sibling birth (Appunni, 2015) it influences child mortality in a number of ways. Short birth interval means that (i) children have short time for breastfeeding (ii) mothers' time to restore nutrient become insufficient and probably will continue to give birth to unhealthy children and (iii) increase total fertility rate which result into resource competition among siblings.

In Zimbabwe, the current maternal mortality rate of 960 deaths per 100,000 live births is significantly higher than the rate of 612 deaths per 100,000 live births recorded for 2005–2006. Maternal health-related issues are responsible for the death of 12% of women aged 15-49 as of 2010–2011. There has been a decrease in the proportion of births attended by skilled health personnel, especially in rural areas. Major challenges remain, including unaffordable maternity fees, reduced attendance of expectant mothers at antenatal clinics due to associated costs or distances to clinics and the inability of some women to make choices on reproductive health issues due to social or cultural pressures. Thus this then negatively affects the infant and child mortality rates as it increases the rates. However, it is hoped that this situation will be greatly improved by 2015, given that the Government of Zimbabwe, the United Nations and the donor community have assembled a health transition fund, Maternity Waiting Home Programme, Integrated Support Programme to address HIV and Reproductive Health Rights as well as the Global Fund to Fight HIV, Malaria and Tuberculosis. These programmes aim at improving the maternal, new-born and child health and nutrition through increasing the availability of medical products, vaccines and technologies; increasing human resources for health; and improving health policy, planning and financing.

CHAPTER 3

DATA AND METHODS

This paper attempt to link with key causes of child mortality in Zimbabwe with selected socioeconomic, bio-demographic, maternal fertility behaviour and services delivery factors in the study area. This paper also analyse levels and trends in infant and childhood mortality in Zimbabwe. The study uses secondary data from the Demographic and Health Survey Zimbabwe of 2010-11. This is a theoretical and descriptive study which uses odds and hazard rates of analysis which also uses bio-demographic variables to understand the problem by exploring the data. The demographic techniques that will be used are direct and indirect demographic techniques, which will be applied in order to obtain the most plausible estimates of infant and child mortality in the past decades. However, it is important to note that child mortality is mostly influenced by the fertility behaviours of the mother like basic amenities, birth intervals, age at birth and multiplicity of birth than other determinants of socio-economic and services delivery, parity rate because according to. Appunni (2010) finds that children who belong to mothers with parity 4-8 and 9+ had 1.27 and 1.08 times more risk of dying respectively compared to children in parity <3. It is also important to note that birth interval is one of the most important key factors that have an influence on infant and child mortality. Other factors that have a huge influence on trends in infant and child mortality are, access to prenatal care, sexual reproductive health of the mothers, changes in use of medical technology, in disease patterns, in health care provision and in economic and social conditions.

1.1 Study Area

As mentioned in chapter one, the study area is Zimbabwe. Zimbabwe is a country in the SADC region (Southern Africa) it's a former British Colony which was previously named Rhodesia. Zimbabwe has 10 Provinces thus the study takes a sample of woman in each province to explore the factors causing the high infant and child mortality in Zimbabwe.

1.2 Map

Below is a map of the study area which is Zimbabwe, it also shows all its 10 Provinces as there are named in the map.

1.3 Study Data

The study uses the Demographic and Housing Survey of Zimbabwe which was conducted during 2010-11. The data set is a sample of the woman population in Zimbabwe across its 10 Provinces. The sample size is of 9171 woman who are both married and unmarried between child bearing age 15-49 years old. There are 9756 households, 5596 children under 5 and there were 19 255 births.

1.4 Selected Variables

The following are the selected variables that will be analysed in the study**.** Age, Marital Status, Religion, Residential area, Number of Visits to a health care facility, Highest Education, Type

of Drinking Water, Type of Toilet, Electricity, Children Ever Born, Abortion, Age at marriage, Breastfeeding, Disease, Pregnancy, Place of Delivery, Literacy, Wealth Index and Number of Children ever born n It is of utmost importance to note that these variables will be categorised in two groups which will be socio-economic and demographic variables.

1.5 Variable Definition

As mentioned above the variables will be grouped in two groups and those groups are socio-economic and demographic variables. The table below show which variable are which.

Socio-Economic Variables	Demographic Variables
Highest level of Education	Age
Type of Drinking water	Marital Status
Type of Toilet facility	Religion
Electricity	Residential Area
Literacy	Number of Visits to Healthcare Facility
Wealth Index	Children Ever Born

1.6 Statistical Analysis

In this study the following statistical analysis will be used to analyse the data and answer some key questions like the causes of high Infant and Child mortality rates in Zimbabwe and if possible explore the extent of each cause and how to reduce the high infant and child mortality rates in Zimbabwe in the future, as mentioned in my introduction, the analysis will also explore the extent to which MDG 4 and 5 were achieved in Zimbabwe. Thus the following statistical analysis will be used.

Method 1

Percentage distribution, a frequency (distribution) table shows the different measurement categories and the number of observations in each category. Before constructing a frequency table, one should have an idea about the range (minimum and maximum values). A frequency distribution is a table that displays the frequency of various outcomes in a sample. Each entry in the table contains the frequency or count of the occurrences of values within a particular group or interval, and in this way, the table summarizes the distribution of values in the sample (Dawson 2004).

Cross Tabulation, cross tabulation is a tool that allows you compare the relationship between two variables. It is also a tool that is used to analyse categorical data. Categorical data is data or variables that are separated into different categories that are mutually exclusive from one another. An example of categorical data is marital status or number of children ever born (Norman, Streiner 2000).

Chi-square, a chi-squared test, also written as $\chi 2$ test, is any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. The Chi-Square test of Independence is used to determine if there is a significant relationship between two nominal (categorical) variables. The frequency of one nominal variable is compared with different values of the second nominal variable. The data can be displayed in an R C contingency table, where R is the row and C is the column. For example, when examining the relationship between infant and child mortality to a socio-economic variable (infant and child mortality vs. number of visits to a healthcare facility). The chi-square test of independence can be used to examine this relationship. If the null hypothesis is accepted there would be no relationship between IMR and number of visits to a healthcare facility. If the null hypotheses is rejected the implication would be that there is a relationship between IMR and number of visits to a healthcare facility (e.g. females who visited a healthcare facility have a high chance of having their children survive than those that didn't).

Method 2

Logistic Regression is the appropriate regression analysis to conduct when the dependent variable is dichotomous (binary). Like all regression analyses, the logistic regression is a predictive analysis. Logistic regression is used to describe data and to explain the relationship between one dependent binary variable and one or more metric (interval or ratio scale) independent variables. Logistic regression is a statistical method for analysing a dataset in which there are one or more independent variables that determine an outcome. The outcome is measured with a dichotomous variable (in which there are only two possible outcomes).

In logistic regression, the dependent variable is binary or dichotomous, i.e. it only contains data coded as 1 (TRUE, success, pregnant, etc.) or 0 (FALSE, failure, non-pregnant, etc.).

The goal of logistic regression is to find the best fitting (yet biologically reasonable) model to describe the relationship between the dichotomous characteristic of interest (dependent variable = response or outcome variable) and a set of independent (predictor or explanatory)

variables. Logistic regression generates the coefficients (and its standard errors and significance levels) of a formula to predict a *logit transformation* of the probability of presence of the characteristic of interest (Dawson & Trapp 2004).

$$logit(p) = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_kX_k$$

Where p is the probability of presence of the characteristic of interest. The logit transformation is defined as the logged odds:

$$odds = \frac{p}{1-p} = \frac{probability\ of\ presence\ of\ characteristic}{probability\ of\ absence\ of\ characteristic}$$

And

$$logit(p) = \ln\left(\frac{p}{1-p}\right)$$

Rather than choosing parameters that minimize the sum of squared errors (like in ordinary regression), estimation in logistic regression chooses parameters that maximize the likelihood of observing the sample values (Dawson & Trapp 2004)

Indirect Estimates, to find trends of under-five child mortality, direct or indirect methods of estimation can be used. In 1968, Brass and Coale developed indirect methods of estimation. This method uses statistics on total numbers of children ever born and children alive or dead reported by women (Brass & Coale 1968 pp. 88–139). This is categorized by age group to access under-five mortality. The level of under-five child mortality can be reflected by the proportion of dead children born to women by age. Similarly, under-five mortality can also be affected by the age distribution of child birth and the age distribution of child mortality. Furthermore, the assessed probabilities of dying reveal the mortality rates that have occurred at a range of ages and dates. This can be achieved if mortality changed over time. Therefore, the probabilities of dying estimate can be found from different age groups of women. This estimated value can be interpreted into a common index of mortality. The estimated statistics value will refer to different dates. Therefore, this predictable value can be used to comprehend the wide trend in mortality over time (Coale & Trussell 1977).

Method 3

Construction of Life Table in Zimbabwe

The life table (also referred to as the mortality table) is a statistical device used to compute chances of survivorship and death and average remaining years of life, for specific years of age. The concept of the life table is applicable not only to humans (Spiegelman 1957) and other species of life (Haldane 1953; Ciba Foundation 1959) but also to items of industrial equipment (Dublin, Lotka, & Spiegelman [1936] 1949) and other defined aggregates subject to a measurable process of attrition. Life tables can also be developed further for computing the chances of other vital events in human life, such as marriage and remarriage, the birth of children, widowhood, illness and disability, and labour force participation and retirement (Spiegelman 1957); and they enter into a wide variety of annuity and life insurance computations (Hooker & Longley-Cook 1953–1957; Jordan 1952).

The original data are recorded deaths and the census of population classified according to age. From these data were computed the *rates of mortality,* conventionally designated as q_x, for each year of age, x. These rates show the proportion of deaths occurring within the year of age among those who attain that age; the rates are usually shown per thousand (1,000 q_x). Typically, mortality rates for a general population start at a high point in the first year of life, fall rapidly to a minimum at about age ten, and then rise with advance in years. The rise is gradual to about age 40, and then becomes increasingly rapid; since the maximum attainable age for human beings is in the neighbourhood of 110 years, life tables seldom go beyond that point. Once one knows the mortality rates at each age of life, it becomes possible to compute the number of *survivors* (column l_x of the life table) and also the number of *deaths* (column d_x). It is usually most convenient to start the population life table with a base (radix) of 100,000 new-born individuals.

It is of utmost importance to recognize that except for the mortality rates, which represent an actually observed situation, *all other columns of figures in the life table represent a hypothetical situation*. Thus, the survivorship column and the column of life table deaths show only the expected number of survivals and deaths for successive ages, on the assumption that the mortality rates observed during the specified calendar period continue without change over time. The same assumption underlies the column of figures for expectation of life.

Life Table Computation

The first task to be carried out in computing a life table for any specific population is to convert the *central death rate*, m_x—that is, the average annual death rate for persons of a given age—into a *mortality rate*, q_x, such as has already been described. A means of doing this is illustrated as follows. In any specified community, let D_x denote the number of deaths recorded within a calendar year of individuals at age *x* on last birthday (or average annual deaths for a calendar period). Also, let P_x denote the number of people at age *x* on last birthday on the mid-date of the calendar year or period; this is an approximation to the average number living and, therefore, to the number of years of life lived within the year of age. Then the central death rate at age *x* for the community is 20.217.The problem is to convert the central death rate, m_x, into a mortality rate,q_x. In the life table the number of years of life lived during the year of age x is L_x and deaths during age x number d_x, so that the central death rate m_x.

In practice, however, the mortality rates at the very early ages are usually computed on the basis of a population estimated from recorded births and deaths, since census data for this stage of life are usually unreliable. The risk of mortality in infancy is highest in the first month following birth, and decreases rapidly thereafter; accordingly, the assumption of a uniform distribution of deaths is not valid for the first year of age. For the terminal ages of life, the basic data are usually meagre and un-reliable; various artefacts are therefore used to compute these mortality rates. The mortality rates for the broad range of intervening ages are generally subjected to mathematical procedures of interpolation and graduation in order to produce a smooth progression of figures (Spiegelman 1955, p. 72). A complete life table shows the figures in each column for every age of life. An abridged life table shows figures for only selected ages, such as every fifth or tenth year of age.

1.7 Computing Package

SPSS, is one of the data analysis software that was used in analysing data for this study, SPSS is a Windows based program that can be used to perform data entry and analysis and to create tables and graphs. SPSS is capable of handling large amounts of data and can perform all of the analyses covered in the text and much more. SPSS is commonly used in the Social Sciences and in the business world. SPSS is updated often. This document was written around an earlier version, but the differences should not cause any problems. Another statistical software package that was used in analysing the data is **MORTPAK** which is a software package for

demographic measurement in developing countries, with special emphasis on mortality measurement.

1.9 Limitations

The limitations of this study are, the study was conducted using secondary data which was obtained from ZDHS (Zimbabwe Demographic Housing Survey) which was conducted between 2010-11.

The 2010-11 Zimbabwe DHS interviews were conducting using PDAs (personal digital assistants) using CSPro data collection software. The following programming issues in the software affected the final recode data file:

Q1206C1 (partner twisted arm/pulled hair) and Q1206C2 (how often in last 12 months) were being asked in the incorrect order through two months of field work. Responses to Q1206C2 during this period cannot be taken as valid because the respondent and interviewer may not have known which action Q1206C2 was referring to, so these 109 cases were set to missing.

Through three months of fieldwork, Q947 in the Shona version of the woman's questionnaire was incorrectly displaying the question text for Q949 instead of Q947. 3460 responses out of 9171 total responses to this question were set to missing in the final data to account for this mistake.

For QM507 in the man's questionnaire, the data collection program did not correctly record whether the response was in months or years. As a result of this error, 1524 out of 2198 total cases for MV602 ("Preferred waiting time for birth of a/another child") have missing values.

CHAPTER 4

ANALYSIS OF SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

Introduction

Demographic variables are variables collected by researchers in order to describe, "The nature and distribution of the sample used with inferential statistics" (Scale live, 2016). They are variables such as age, gender, ethnicity, socioeconomic measures, marital status and occupation. As these variables cannot be manipulated, they can assist in explaining relationships between the demographic variables and dependent variables (Kaur, 2013).

Socio Economic Variables

Socio-economic variables are lifestyle components and measurements of financial capability and social standing. These variables directly influence social privilege and financial independence. Factors such as income and health are studied to determine how they affect human behaviour and circumstance. As lifestyle measurements, they are believed to be directly correlated to the prevalence of disease and mortality rates in human populations (McLeod, 2017). The study will look at the following socioeconomic variables explained by Mosley & Chen (1984);

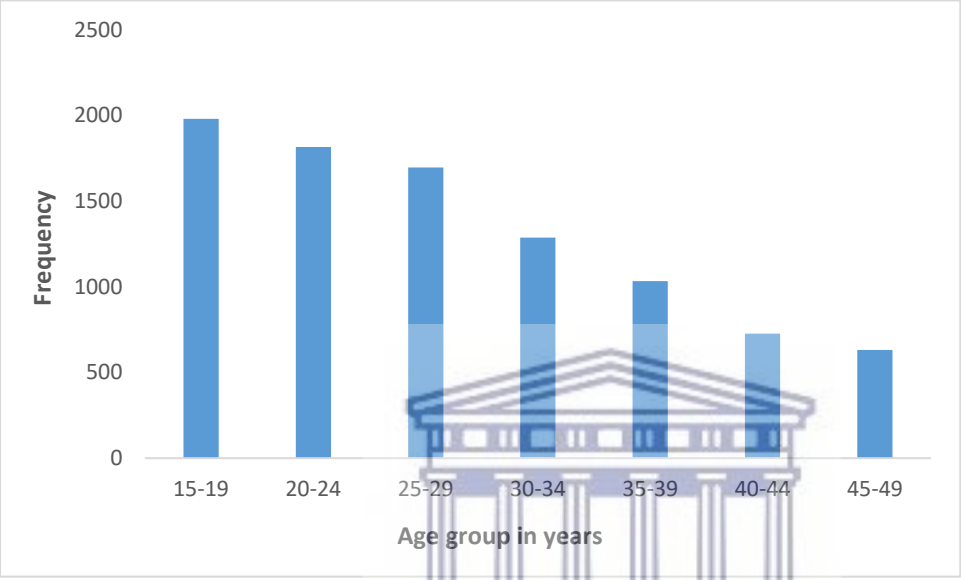
- Individual-level variables such as individual productivity of mothers and fathers and traditions/norms/attitudes.
- Household-level variables such as income or wealth.
- Community-level variables such as ecological setting, political economy and the health system.

Table 1: Age distribution of mothers with infant and child mortality in Zimbabwe

Age group	Frequency	Percentage
15-19	1980	21.6
20-24	1815	19.8

25-29	1696	18.5
30-34	1287	14.0
35-39	1034	11.3
40-44	727	7.9
45-49	632	6.9
Total	9171	100

Figure 1



The table and the graph above shows the population distribution according to age groups. The population distribution shows that this is a young population, however whats alarming is the low life expectancy, the woman life expectancy in Zimbabwe is analysed to be at about 49.56 as per the graph if one looks at the percentage frequency.

Cross tabulation & Chi square

This section considers socio-economic differentials of infant and under-5 mortality by background characteristics of the mother. These indicators are affected by the nexus of

environmental, economic, cultural, social, political and demographic factors. Factors considered in this analysis place of residence rural-urban, province, educational attainment and marital status of mother. The total numbers of live births considered for this study were 2097 with 50% deaths occurring before the age of 5 years. Of the total live births, 24.6% and 24.4% of under-five deaths have occurred for males and females, respectively. Regarding mothers' age at birth, 43.4% of children were from mothers of age less than 16 years, out of whom 18.5% died before the age of five years, while the remaining 54.6% were from mothers aged 17 years and above, out of whom 16.6% have died before the age of five years. The under-five mortality was 18.6% and 13.5% for children whose mothers have no education and primary and above education, respectively. Almost two-thirds (65.3%) of the children were born to mothers that are resident in rural areas, with 18.3% dying before their fifth birthday. Of the children born to mothers that are resident in urban areas, 14.0% died before their fifth birthday. Of the total of 2097 children, 44.4% were breastfed. Among the mothers, 79.6% were married. There were 46.8% households of size 1–3 members, 46.2% had household size of 4–6, and 7.0% of the households had more than 6 members. In addition, 18.6% of the households had pipe home water while 81.4% used water from unprotected source. Finally, children with preceding birth interval shorter than 2 years were subject to higher risk of under-five mortality (26%).

Table 2: Socio-economic differentials of women by background characteristics.

Covariates	Category	Censored	Death	Death percentage	Total
Child's sex	1(male)	869	184	17.47388414	1053
	2(female)	862	182	17.43295019	1044
Mother's age at first birth	0 (</= 16)	775	176	18.50683491	951
	1(>16)	956	190	16.57940663	1146
Breastfeeding status	0(no)	932	233	20	1165
	1(yes)	799	133	14.27038627	932
Mother's education	0 (no education)	1314	301	18.6377709	1615
	1(primary and abov	417	65	13.48547718	482
Father's education	0 (no education)	1000	227	18.5004075	1227
	1(primary and abov	731	139	15.97701149	870
Marital status	0(married)	1670	349	17.28578504	2019
	1 (others)	61	17	21.79487179	78
Preceding birth interval	0 (</=2 years)	574	204	26.22107969	778
	1 (2-3 years)	535	103	16.14420063	638
	2 (>/= 3 years)	622	59	8.663729809	681
Area of residence	1 (urban)	362	59	14.01425178	421
	2 (rural)	1369	307	18.31742243	1676
Type of birth	0 (single birth)	1668	329	16.47471207	1997
	1 (multiple births)	63	37	37	100
Income of mother	0 (more than husba	291	76	20.70844687	367
	1 (less than husban	1440	290	16.76300578	1730
Source of drinking water	0 (pipe)	344	46	11.79487179	390
	1 (others)	1387	320	18.74633861	1707
Family size	0 (1-3)	852	130	13.23828921	982
	1 (4-6)	775	193	19.93801653	968
	2 (>/= 7)	104	43	29.25170068	147

The table above shows the level of education of the population, it is important to note that education is one of the key contributors to the high rates of infant and child mortality. It is very evident in the table above that 63% of the population did not complete secondary school which might have a negative impact on the infant and child mortality rates, because a highly educated society is expected to have low rates on infant and child mortality rates.

Education is considered a pervasive factor in demographic analysis. Research has established relationships between the educational level of the mother and the mortality of the children. Research has found that infant mortality falls as the educational attainment of the mother increases. Education, for example, helps to unlock benefits that can be derived from health education by enabling mothers to read and interpret health messages. In 2007 infant and under five mortality among children of mothers with no education were highest (66 and 103

respectively) compared to the rest of the mothers. What is evident is that as educational attainment of the mother increased, infant and under five mortality of children born to them decreased (Arunachalam& Naidu, 2008).

The table above also shows the population distribution according to access to electricity and type of residence. Again majority (63%) of the population is the rural areas this have a negative impact on infant and child mortality, the same can be said regarding access to electricity as some studies have shown that urban areas have lower infant and child mortality rates in comparison to rural areas.

Residing in a rural or urban area influences levels of childhood mortality through living conditions, behaviour patterns of people mainly influenced by some cultural practices and beliefs. Access to health services also plays a part in influencing the levels of childhood mortality between the two areas. In Zimbabwe rural areas compared to urban areas have poor access to water and sanitary facilities. In 2007 infant and under-five mortality rates were higher in rural than in urban areas. Infant mortality in rural areas was 53 deaths per 1,000 live births compared with 43 deaths per 1,000 live births in urban areas. The under-five mortality rate during the same period was 80 deaths per 1,000 live births in rural areas compared with 62 deaths per 1,000 live births in urban areas (Arunachalam & Naidu, 2008).

The type of toilet facility has an effect on the rates of infant and child mortality. Majority of the population does not have access to flush to piped sewer type of toilet, this badly impacts the mortality trends as hygiene is essential in combating infant and child mortality rates. Cholera is a huge cause of Infant and child mortality, as shown in the literature thus type of toilet facility can impact negatively on the rates. As previously mentioned, cholera claims large numbers in the infant and child mortality rates. Cholera can be caused by type of toilet facility and also the sources of drinking water, as shown in the table above, since majority of the population is in the rural areas, they have access to unsafe drinking water as shown in the distribution on the table above.

Table 3: Health care accessibility distribution of respondents

Variables	Number of cases	Percentage	Chi-square
Number of Health Facility Visits			0.000
One	8744	95.34	
Two	308	3.35	
Three +	119	1.29	

Above is a table showing the population distribution according to health care facilities available, as shown in the table, 95% of the population only has one health care facility available to them. This is a major concern and could be the smoking gun evidence in terms of the infant and mortality numbers in Zimbabwe. Again it is important to note that such health care facilities especially in the rural areas are far from the communities thus it becomes challenging for a pregnant woman to visit.

Table 4: Distribution of births, under-fives and living Children in last five years

Variables	Number of cases	Percentage	Chi-square
Number of Living Children	2529	27.57	0.000
zero	1838	20.04	
one	1861	20.29	
two	1227	13.38	
three	810	8.83	
four	906	9.88	
five+	2529	27.57	
Number of Children Under 5 in De jure			0.000
zero	3316	36.16	
one	3670	40.02	
two	1679	18.31	
three	378	4.12	
Births in the last 5 years			0.000
No Births	4774	52.06	
One	3315	36.15	
Two	1003	10.94	
Three	75	0.82	
Four	3	0.03	
Five +	1	0.01	

The tables above show the population distribution according to the following, number of children living, number of children under 5 and number of births in the last 5 years. If we look at the number of children living and number of children under 5 and compare it with the number of births in the last 5 years we notice an alarming change in numbers, for an example there 40% of the woman gave birth to one child in the last five years, now if we look at the number of children living from the same women who gave singular births in the last five years we notice a 20% decrease as it is on 20% for the number of living children. This means that half of the children died before their 5th birthdays thus the rate 1:2, there is a 50% probability of dying before 5th birthday in Zimbabwe as per the tables above.

Table 5: Results of univariate Cox proportional hazards model of factors influencing infant and child mortality in Zimbabwe.

Covariates	B	SE	Wald X^2	df	Sig.	exp(B)	LR X^2	Sig.
(</=2 years)	0	0	64.519	2		1		<0,0001
2-3 years	-0.491	0.121	16.47	1		0.612014		
>/= 3 years	-1.15	0.148	60.516	1		0.316637	65.9208	
(1-3)	0	0	29.093	2		1		<0,0001
(4-6)	0.437	0.113	14.837	1		1.548056		
>/= 7	0.874	0.176	24.688	1		2.396478	29.1003	
BTYPE (single birth)	1.019	0.174	34.418	1		2.770423	34.4193	<0,0001
BFDINGS (yes)	0.348	0.109	10.251	1		1.416232	10.2506	0.0014
SDWTR (pipe)	0.472	0.158	8.958	1		1.603197	8.9579	0.0028
MEDU (primary and above)	0.333	0.137	5.92	1		1.395147	5.911	0.015
MINCOM (more than husband)	-0.252	0.129	3.834	1		0.777245	3.8381	0.0501
ARSID (urban)	0.251	0.142	3.117	1		1.28531	3.1141	0.0776
FEDU (primary and above)	0.15	0.108	1.944	1		1.161834	1.9443	0.1632

Note: *PB VITAL= preceding birth interval; FSIZE = family size; BTYPE= type of birth; BFDINGS = breastfeeding status; SDWTR= source of drinking water; MEDU= mother's education; MINCOM= income of mother; ARISD= area of residence; FEDU= father's education*

From the table above, we can identify candidate covariates to be considered for the multivariate model. Inclusion of covariates was based on a significant reduction in the value of -2logL the value of -2logL for the null model is 5348.115. Including preceding birth interval, family size, type of birth, breastfeeding status, source of drinking water, and mothers' educational level in the model, one at a time, resulted in a significant reduction in -2logL using the chi-square test. Also, the covariates income of mothers, area of residence, and fathers' educational level are significant at the 20% level of significance. Hence, all these covariates were considered in the multivariate Cox regression model. We then applied stepwise variable selection procedure to obtain the reduced model.

Conclusion

The population is largely rural, there are bimodal in that almost that equal numbers have flush toilets or no bathroom facility.

CHAPTER 5

INDIRECT ESTIMATION OF INFANT AND CHILD MORTALITY

Introduction

To find trends of under-five child mortality, direct or indirect methods of estimation can be used. In 1968, Brass and Coale developed indirect methods of estimation. This method uses statistics on total numbers of children ever born and children alive or dead reported by women (Brass & Coale, 1968). This is categorized by age group to access under-five mortality. The level of under-five child mortality can be reflected by the proportion of dead children born to women by age. Similarly, under-five mortality can also be affected by the age distribution of child birth and the age distribution of child mortality. Furthermore, the assessed probabilities of dying reveal the mortality rates that have occurred at a range of ages and dates. This can be achieved if mortality changed over time. Therefore, the probabilities of dying estimate can be found from different age groups of women. This estimated value can be interpreted into a common index of mortality. The estimated statistics value will refer to different dates. Therefore, this predictable value can be used to comprehend the wide trend in mortality over time (Coale & Trussell, 1977).

Results

Table 1: Comparison of birth and death proportion

Age Group of Woman	Marital Duration Group of Woman	Average Number Children Ever Born	Average Number of Children Surviving	Proportion Dead
15-20	0-5	2.0	1.5	0.25
20-25	5-10	2.5	1.7	0.32
25-30	10-15	2.7	1.8	0.33
30-35	15-20	2.9	1.9	0.35
35-40	20-25	3.0	2.0	0.33
40-45	25-30	3.2	2.2	0.31
45-50	30-35	3.5	2.3	0.34

Figure 1

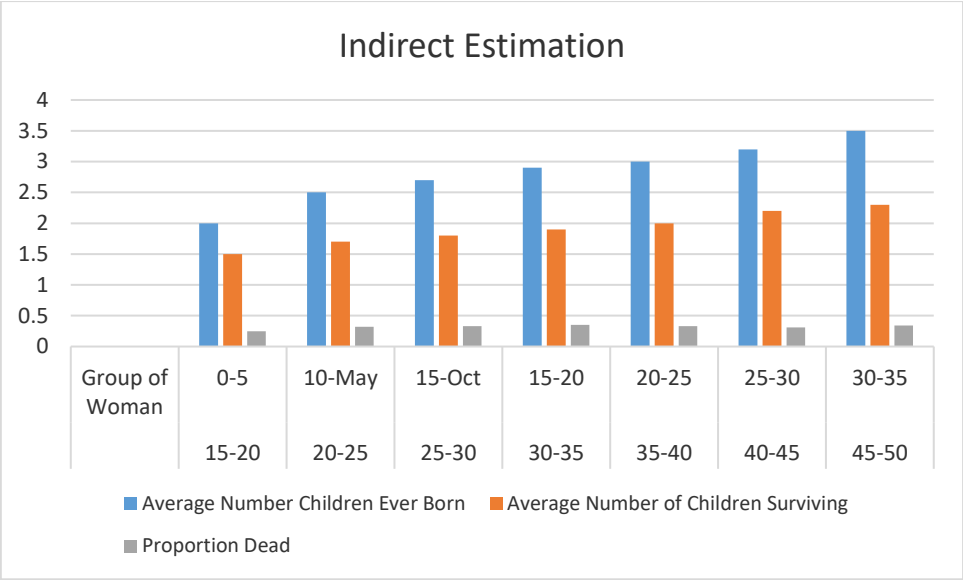


Table 1 above and the graph above shows the average number of children ever born and the average number of children surviving. There is a drop in the numbers from children ever born compared to children surviving. The graph shows how these compare to each other and it further proves that 1:2 rate mentioned earlier on in the analysis.

Table 2: Result of probability of dying before 5th birthday using Coale-Denemy and United Nations models.

	Probability of Dying Before..								
	United Nations Models (Palloni-Heligman Equations)				Coale-Demeny Model (Trussel Equations)				
Age	**Latin America**	**Chilean**	**South Asia**	**Far East**	**General**	**West**	**North**	**East**	**South**
15-20	0.032	0.072	0.025	0.086	0.063	0.000	0.000	0.000	0.000
20-25	0.229	0.270	0.233	0.249	0.240	0.186	0.139	0.215	0.163
25-30	0.290	0.311	0.297	0.293	0.292	0.283	0.248	0.295	0.285
30-35	0.311	0.322	0.320	0.306	0.309	0.332	0.319	0.337	0.340
35-40	0.303	0.306	0.312	0.289	0.300	0.340	0.350	0.343	0.349
40-45	0.263	0.277	0.289	0.254	0.261	0.319	0.330	0.319	0.322
45-50	0.299	0.297	0.318	0.272	0.293	0.346	0.352	0.345	0.347

Table 11 shows the probability of dying before 5th birthday, it uses both Coale-Demeny model and United Nations model, comparing it across regions, as seen the probability of dying before 5th birthday is not that prevalent in other parts of the world when one looks at Africa where Zimbabwe is which is very high compared to the regions above.

Table 8: Mortality Indices using United Nations Model

Age Group of Woman	Reference Date	Corresponding Mortality Indices United Nations Models (Palloni-Heligman) Latin America	Chilean	South Asia	Far East	General
Infant mortality rate						
15-20	Jul 2008	0.032	0.072	< .032	0.086	0.063
20-25	Feb 2005	0.196	0.228	0.174	0.190	0.182
25-30	Aug 2002	0.185	0.242	0.193	0.197	0.194
30-35	Jun 2001	0.177	0.234	0.186	0.184	0.184
35-40	Feb 2001	0.159	0.212	0.171	0.160	0.160
40-45	May 2000	0.136	0.187	0.157	0.135	0.135
45-50	Oct 1996	0.144	0.188	0.164	0.130	0.130
Probability of Dying						
15-20	Jul 2008	0.010	0.014	<.008	0.041	0.025
20-25	Feb 2005	0.153	0.110	0.146	0.158	0.152
25-30	Aug 2002	0.177	0.122	0.172	0.167	0.167
30-35	Jun 2001	0.163	0.115	0.163	0.149	0.153
35-40	Feb 2001	0.137	0.095	0.142	0.118	0.126
40-45	May 2000	0.106	0.076	0.122	0.089	0.097
45-50	Oct 1996	0.116	0.076	0.132	0.083	0.102
Life expectancy at birth						
15-20	Jul 2008	73.800	64.400	>75	51.000	62.500
20-25	Feb 2005	38.300	35.000	42.600	28.300	34.800
25-30	Aug 2002	35.000	32.900	39.000	27.200	32.600
30-35	Jun 2001	36.800	34.100	42.100	24.400	34.500
35-40	Feb 2001	40.600	37.700	43.100	33.900	38.500
40-45	May 2000	45.800	41.900	46.100	39.100	43.700
45-50	Oct 1996	44.000	41.800	44.500	40.300	42.700

Table 9 : Mortality Indices using Coale_Demeny Model

Age Group of Woman	Reference Date	Corresponding Mortality Indices Coale-Demeny Model (Trussell Equations) West	North	East	South
Infant mortality rate					
15-20	May 2006	< .013	< .017	< .016	< .036
20-25	Jan 2004	0.151	0.109	0.183	0.126
25-30	Dec 2001	0.207	0.168	0.232	0.183
30-35	Apr 2000	0.223	0.189	0.247	0.194
35-40	Jan 1999	0.211	0.181	0.235	0.185
40-45	Aug 1997	0.186	0.159	0.210	0.167
45-50	May 1995	0.189	0.160	0.217	0.170
Probability of Dying					
15-20	May 2006	< .002	< .004	<.002	< .005
20-25	Jan 2004	0.087	0.080	0.081	0.084
25-30	Dec 2001	0.129	0.139	0.111	0.166
30-35	Apr 2000	0.141	0.160	0.120	0.181
35-40	Jan 1999	0.132	0.152	0.112	0.169
40-45	Aug 1997	0.114	0.131	0.097	0.143
45-50	May 1995	0.116	0.131	0.101	0.147
Life expectancy at birth					
15-20	May 2006	< 75	<75	>75	<75
20-25	Jan 2004	45.000	49.800	45.300	51.500
25-30	Dec 2001	36.600	38.700	39.100	38.900
30-35	Apr 2000	34.600	35.400	37.400	37.000
35-40	Jan 1999	36.200	36.600	38.800	38.600
40-45	Aug 1997	39.500	40.100	41.800	42.100
45-50	May 1995	39.100	40.000	40.900	41.500

Chapter 6

Construction of Life Table

Introduction

The first task to be carried out in computing a life table for any specific population is to convert the *central death rate*, m_x—that is, the average annual death rate for persons of a given age—into a *mortality rate*, q_x, such as has already been described. A means of doing this is illustrated as follows. In any specified community, let D_x denote the number of deaths recorded within a calendar year of individuals at age x on last birthday (or average annual deaths for a calendar period). Also, let P_x denote the number of people at age x on last birthday on the mid-date of the calendar year or period; this is an approximation to the average number living and, therefore, to the number of years of life lived within the year of age. Then the central death rate at age x for the community is. The problem is to convert the central death rate, m_x, into a mortality rate, q_x. In the life table the number of years of life lived during the year of age x is L_x and deaths during age x number d_x, so that the central death rate m_x.

Results

Table 10: Probability of death before next birthday for each age group.

Life Table

Age Group	q(x,n)	Age	m(x,n)	I(x)	d(x,n)	L(x,n)	S(x,n)	T(x)	e(x)	a(x,n)
0-1	0.16000	0	0.17857	100000.	16000.	89600.	0.78470	1787865	17.879	0.350
1-5	0.15000	1	0.04162	84000.	12600.	302749.	0.84621	1698265	20.217	1.361
5-10	0.14000	5	0.03011	71400.	9996.	332010.	0.86462	1395517	19.545	2.500
10-15	0.13000	10	0.02781	61404.	7983.	287064.	0.81850	1063507	17.320	2.500
15-20	0.25000	15	0.05684	53421.	13355.	234960.	0.71148	776443	14.534	2.593
20-25	0.32000	20	0.07670	40066.	12821.	167171.	0.67118	541483	13.515	2.414
25-30	0.33300	25	0.08086	27245.	9073.	112201.	0.66031	374312	13.739	2.352
30-35	0.34500	30	0.08462	18172.	6269.	74088.	0.65916	262111	14.424	2.324
35-40	0.33300	35	0.08116	11903.	3964.	48836.	0.67810	188023	15.796	2.306
40-45	0.31300	40	0.07504	7939.	2485.	33116.	0.66924	139187	17.532	2.352
45-50	0.34300	45	0.08441	5454.	1871.	22162.	0.70186	106072	19.448	2.269
50-55	0.25000	50	0.05759	3583.	896.	15555.	0.71102	83910	23.416	2.363
55-60	0.32000	55	0.07776	2688.	860.	11060.	0.83820	68355	25.434	2.235
60-65	0.16000	60	0.03190	1828.	1828.	57295.	……	57295	31.351	31.351
65-70	0.15000	65								
70-75	0.14000	70								
75-80	0.13000	75								
80-85	0.12000	80								
85-90		85								

*First entry of S(x,n) is for survivors of 5 cohorts of birth to age group 0-4 = L(0,5) /500000
*Second entry of S(x,n) is for S(0,5) = L(5,5) / L (0,5)
*Last entry of S(x,n) is S(55+, 5) = T(60) / T (55)

Conclusions

Life table for females was constructed based on the empirical sets of age-specific central death rates n mx. As noticed in the evaluation of data, age specific central death rates from the Census show the impact of HIV/AIDS deaths in the middle ages. Applying model life tables will mask the impact of HIV/AIDS deaths on the life table. The Mortpak procedure LIFTB was used. Based on a given set of n mx values for age groups 0-1, 1-5, 5-10, ..., up to the last closed age group available (maximum of 95-100 is allowed; value for the final open age group is not given), an abridged life table is constructed. The usual life table columns are then calculated and labelled. This procedure is based on a method developed by (Greville, 1943). Household death and population data used to calculate age specific central death rates, n mx, is provided in Appendix Tables A4a and A4b. Life tables based on the procedure described above are presented in Tables 14. In 2012 life expectancy at birth in Zimbabwe was 60.7 years for both sexes combined. Males had a life expectancy of 57.4 compared to 64.0 for females. This marks a big improvement in life expectancy when compared to the 2002 Population Census.

CHAPTER 7

DISCUSSION AND CONCLUSION

In the absence of reliable vital registration such as birth and death data and information on children ever born and children surviving are used to estimate mortality levels in a population. However due to errors in reporting of these events, careful treatment of data is necessary. A historical analysis of death trends in relation to HIV/AIDS deaths shows that the death trend conforms to developments of the HIV/AIDS condition in Zimbabwe. A brief look at the ASDRs showed a bulge in the middle age groups – reflecting the impact of HIV/AIDS deaths on the population.

The Maternal Mortality Ratio (MMR) was estimated at 544 per 100,000 life birth; less than half of the ratio from the 2002 Population Census. Ten percent of the reported deaths of females aged 15-49 years were pregnancy-related deaths. The indirect method (Brass, as modified by Trussells) was also used to estimate childhood mortality. The Coale-Demeny North model was assessed as most suitable for Zimbabwe. Results show that in 2011 the Infant and Under 5 Mortality rates were 50 per 1,000 births and 74 per 1,000 children, respectively. Childhood mortality was comparatively higher for children of women who were widowed. The higher the educational level of mothers, the lower the mortality experience of their children. Children born to mothers residing in rural areas experienced higher mortality than children born to mother in urban areas; so were children born to mothers with a disability compared to children born to mothers without a disability. Provincial variations in childhood mortality are also evident. Under five mortality rate has generally been on the decline since the 1970s. Life expectancy at birth, for both sexes combined, increased from 44.2 to 60.7 from 2002 to 2012, i.e. adding 16.5 years in a decade.

In this study, the covariates, namely, preceding birth interval, family size, birth type, breastfeeding status, source of drinking water, mother education, mother income, area of residence, and father education, are significantly associated with under-five mortality in univariate analysis but in multivariate analysis, we obtained six factors, namely, preceding birth interval, family size, type of birth, breastfeeding status, source of drinking water, and income of mothers, to significantly affect the survival of under-five children.

The result of this study shows that preceding birth interval has a negative association with under-five mortality. A study in Ethiopia showed that children born after 18–23, 24–35, 36–47, and more than 47 months of the preceding birth intervals have lower risk of child mortality by 49, 78, 79, and 89 percent, relative to children born after less than 18 months, respectively (Desta, 2011). A similar study based on DHS data from Bolivia, Guatemala, and Peru suggested that under-five mortality in children born after birth intervals of 24–29 months was higher by 70–90% than in children born after intervals of 36–41 months (Desta, 2011). In Bangladesh, a study showed that if all birth intervals were between 3 and 5 years long, early neonatal mortality would fall by 5.8%, late neonatal mortality by 4%, postneonatal mortality by 7.6%, and mortality in the 1–4-year age group by 8.7% (J.DaVanzo, , Razzaque & Rahman, 2004). This may be due to the fact that shorter birth intervals are associated with maternal nutritional depletion, particularly folate deficiency.

There is a higher under-five death among children who were not breastfed than those breastfed. A study conducted in Kenya showed that children who were breastfed for more than 6 months have significantly lower probability *($p \leq 0.05$)* of mortality compared to children breastfed for less than 6 months (R. E. Black, S. S. Morris, and J. Bryce, 2003). Also, in Bangladesh, a study revealed that the duration of breastfeeding was an important determinant of childhood mortality (Shahidullah, 1994). This may be due to the fact that antimicrobial and anti-inflammatory factors in breast milk provide protection from infection.

The findings of this study also revealed that family size was a significant determinant of under-five mortality. As expected, the number of family members increased the under-five death rate; that is, the risk of dying for a child born in a family of size 4–6 is higher by 71% relative to those born in a family with size of 1–3. Contrarily, the study by Desta carried out in Ethiopia found an inverse relationship between under-five mortality and family size (M. Desta 2011). This discrepancy could be due to the time gap between the current study and the study conducted by Desta (Desta 2011).

The result also showed that multiple birth type was a significant factor for under-five death in four selected regions in Ethiopia. Children of multiple births were 2.907 more likely to die before the age of 5 as compared with single birth. In Ethiopia, a study by Desta found multiple births to be a significant determinant factor (Desta 2011). A study carried out by Kembo and Van Ginneken in Zimbabwe also found multiple births as a determinant factor of under-five mortality (Kembo & Van Ginneken, 2009)

As per the analysis above, the source of drinking water was significant. A child born in a family without access to pipe drinking water was highly exposed to under-five death. In Kenya, a study by Mutunga found source of drinking water to be a determinant factor (C. Mutunga, 2004). A study in China showed that access to safe water reduced child mortality risks by about 34% in rural areas (Jacoby & Wang, 2003). This may explain why children exposed to water sources that are more likely to be contaminated such as river water are more likely to have diarrheal diseases.

The risk of under-five mortality for a child whose mother earns less than her husband is higher as compared with those who earn more. This could be due to the fact that mothers who earn more have the chance to spend money any time they wish without waiting for their husbands to provide care for their child. In Bangladesh, a study by Abir *et al*. found income of mother to be a determinant factor (Abir *et al*., 2015).

In every country studied and regardless of the period under consideration, mothers' education turned out to be one of the main determinants of the mortality of children aged from 1 to 5 years. Findings from (Caldwell, 1979) suggested that education in general, and female education in particular, exerts a great influence on children's health and survival with regard to pregnancy, childbirth, immunization, and management of childhood diseases. Mothers' educational level increases their skills in healthcare practices related to disease treatment, preventive care, hygiene, and nutrition, thus improving chances for child survival. A study in Kenya showed that deaths among under-five children differed significantly with the level of maternal education in rural areas compared with urban areas *($p \leq 0.001$)* (Mutanga, 2004). In addition, other studies (Kembo & Van Ginneken, 2009) revealed that women with low educational level have high rates of infant and child mortality and those with a few years of schooling have lower infant and child mortality rates.

In conclusion, the finding of this study revealed that preceding birth interval, family size, birth type, breastfeeding status, source of drinking water, mother income, area of residence, and father education influenced under-five mortality in Zimbabwe. However, in this study, mother's educational level was not found to be a determinant factor, a result that was not in line with other studies (Kembo & Van Ginneken, 2009). The influence of family size on under-five mortality is also contrary to the finding by M. Desta, 2011, this discrepancy could be due to the time gap between the current study and the study conducted by Desta.

Despite the fact that the data used for this study is nationally representative and reflected the selected region in Zimbabwe, a number of weaknesses were also present in this study. The birth history section of 2011 ZDHS begins with questions about the respondent's experience with childbearing (i.e., the number of sons and daughters living with the mother, the number who live elsewhere, and the number who have died). Hence, 2011 ZDHS was subject to possible data collection errors (e.g., only surviving women aged 15–49 were interviewed); therefore, no data were available for children of women who had died. Respondents were likely to forget events that occurred in the past. Also, causal effects could not be measured because the study was based on a retrospective cross-sectional study.

As a result of the findings from this study, certain recommendations should be made to policy makers and the population as a whole, so as the reduce infant and child mortality in Zimbabwe. There should be awareness about the influencing factors and how to control them. Enlightenment on the need of birth control and family size and benefit of breastfeeding is vital. Improvement on the socioeconomic status and empowerment of citizens most especially women is essential to reduce infant and child mortality.

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