CHAPTER 3

DATA AND METHODS

3.1 Introduction

This chapter presents the methodological approach to the study. Also provided is a model specification of the variables in the Mosley and Chen framework that will be studied. This is followed by a discussion of the statistical analytical techniques utilised in the study. We also present an evaluation of the quality of data from the 2005-06 ZDHS survey and an assessment of the assumption of the Cox proportional hazards model. Finally, the chapter ends with some concluding remarks.

This study used individual-level variables whose relationship to infant and child survival has been well established.[48,49] The relationship between infant and child mortality and maternal, environmental contamination and personal illness control variables is investigated. Other variables from the classical proximate determinants model such as nutrient availability and incidence of injury are not examined because of the absence of sufficient information on the variables themselves from the 2005-06 ZDHS survey data.

The study also incorporates socioeconomic variables. Socioeconomic variables such as wealth status determine the availability of nutritional resources, which is especially important because once infants reach the age of 6 months; they can no longer depend on nourishment from breast milk alone. Mother's education is important because it facilitates her integration into a society impacted by traditional customs, colonialism, and neo-colonialism. Education heightens her ability to make use of government and private health care resources and it may increase the autonomy necessary to advocate for her child in the household and the outer world.[24,43]

3.2 Source of Data

The study used data collected from the 2005-06 ZDHS survey. The 2005-06 ZDHS survey collected data from a sample of 8,907 women aged 15-49 years and 7,175 men aged 15-54 years.[21] This ZDHS is the fourth comprehensive survey conducted in Zimbabwe as part of the Demographic and Health Surveys (DHS) programme. The DHS are a rich source of data on developing countries in general, and Africa in particular. These national probability surveys provide a wealth of information on child health, the proximate determinants of fertility, fertility preferences, and other social and economic characteristics unmatched as a source of data from developing countries.

Retrospective data was collected in the four rounds of the DHS surveys in Zimbabwe and provide complete birth histories, as well as more detailed fertility, mortality and maternal and child health information on the five years preceding the survey, that is 1984-88, 1990-94, 1995-99, and 2001-05.[13,14,21,50] However, data on mortality are also available for 5-9 years and 10-14 years before the date of the survey.

The empirical analysis in this study for the independent variables for the next part is restricted to 10 years before the 2005-06 ZDHS survey, that is, 1996-2005 so that the hazard ratios are based on a sufficient number of cases in each category to ensure statistically reliable estimates.

3.3 Model Specification

Section 3 describes the specification of the dependent, independent and outcome variables which were components of the Cox proportional hazard model in this study.

3.3.1 Dependent Variable

Childhood mortality is analysed in two age periods: mortality from birth to the age of 12 months which will be referred to as infant mortality and mortality from the age of 12 months to the age of 60 months which will be referred to as child mortality. In both cases the dependent variable is risk of death occurring in an age interval such as from birth to age one, in a period, for example, a calendar year. This examination of two dependent variables is necessary since it has been observed that the effect of some determinants of childhood mortality (for example, maternal age and sanitary conditions) differ in relative importance from those in infancy.[33,56,57,58,59]

The children who died during infancy, that is, 0-11 months were included in the Cox proportional hazard analysis. Children were censored when they were alive at age 1 year old. Children aged 12 months and above were excluded from the proportional hazard analysis for the study of determinants of infant mortality.

In the case of child mortality, children who had died aged 12-59 months were included in the analysis. Children were censored when they were alive at age 5 years old. Children who had reached the age of 60 months and above (and were surviving at the time of the survey) were excluded from the child mortality analysis.

3.3.2 Independent Variables

Based on the Mosley and Chen[48] determinants of childhood morbidity and mortality framework, the independent variables studied were:

- Maternal factors: *(child's birth order, preceding birth interval, maternal age, child's sex, type of birth and perceived weight of child at birth),*

- Socioeconomic variables *(maternal education, paternal education, wealth index, province and area of residence),*
- Environmental contamination: *(toilet facility and source of drinking water),*
- Personal illness control: *(antenatal visits and place of delivery),* and
- HIV prevalence rate as at the year of birth of the child.

3.3.3 Outcome Variable

The outcome variable in the bivariate and multivariate proportional hazards models presented in this study is the hazard ratio (relative risk) of dying in a specific age range of childhood. The age ranges used are:

- Infant mortality (${}_1q_0$): the probability of dying between birth and the first birthday), and
- Child mortality (${}_1q_4$): the probability of dying between the exact age one and the fifth birthday.

3.4 Statistical Methods

Data from multiple demographic sources in Zimbabwe were used in the analysis of the levels and trends of infant and child mortality. This addresses the first and second objectives of the study. The third objective is addressed through the construction and analysis of bivariate and multivariate Cox proportional hazard models to estimate the relative effect of maternal, socioeconomic, environmental contamination (sanitation) and personal illness control variables on infant and child mortality in Zimbabwe during 1996-2005.[60,61] The fourth objective is addressed through the construction and analysis of frailty models in order to allow for the estimation of the effect of unmeasured and immeasurable factors on the risk of infant and child death. The final objective is addressed through detailing major conclusions and appropriate recommendations to facilitate the design of child health policies and programmes directed towards improving child survival in Zimbabwe.

The Child Data file that was used in this study was constructed from the Individual Woman's Data file - Individual Recode (IR) from the 2005-06 ZDHS survey using the CASESTOVARS command in SPSS 16.0.[62] The CASESTOVARS command restructures complex data that has multiple rows for a case. This command can be used to restructure data in which repeated measurements of a single case are recorded in multiple rows (row groups) into a new data file in which each case appears as separate variables (variable groups) in a single row.

The Individual Recode file contained all of the data collected from women aged 15-49 years identified through the household roster in the 2005-06 ZDHS survey. A subset of the child data file was created for live births and under-5 deaths during the 1996-2005 period. This was the data file that was used to study the impact of maternal, socioeconomic, environmental contamination and personal illness control variables on infant and child mortality.

The data were adjusted for sampling weights *(v001)* using the SPSS 16.0 weighting command, namely, WEIGHT and for clustering *(v005)* within the STATA estimation commands.[63] Weighting the data is important because if the data is not weighted then the derived estimates are biased toward the over-sampled sub-populations. If the clusters are not used the standard errors will tend to be too small, and some effects will appear to be significant when they are not.

The Cox proportional hazard models were constructed by using the COXREG command available in SPSS 16.0[62]. The frailty hazard models were constructed by using the STCOX and SHARED commands in STATA 10.0[63]. Separate hazard models were developed for infant mortality and child mortality. The significance tests in the hazard models were performed at three levels, that is, "*p*<*0.05*", "*p*<*0.01*" and "*p*<*0.001*".

Cox regression, which stems from the work of Cox[60] and which implements the *proportional hazards model* or *duration model*, was designed for analysis of time until an event or time between events. Cox regression was used for analysis of the determinants of infant and child mortality in this study because it can handle censored cases. Multiple and logistic regression cannot handle censored cases. Censored cases are cases for which the event, in this analysis – child death, has not yet occurred.

The central statistical output from Cox regression is the hazard or risk ratio. The "hazard" is the event of interest occurring. In this analysis, the hazard is infant or child death. A hazard ratio, also called the hazard function, is the estimate of the ratio of the hazard rate in one group to the hazard rate in another group for a coded covariate.[64] For a continuous covariate, the hazard ratio is the ratio of the hazard rate given a one unit increase in the covariate to the hazard rate without such an increase. The hazard ratio may be partitioned into the baseline hazard ratio (depending on time alone) and the covariate hazard ratio (depending on the covariate(s), controlling for time). The difference between the baseline model and the model with covariates shows the effect of the covariates in the model.[64]

The proportional hazards model assumes that for an individual with a vector of covariates in *x*, the hazard rate (death rate) at time *t* is given by:

$$h_i(t_i;\, x_i) = h_o(t_i)\exp(\beta^i x_i)$$

where $h_i(t_i;\, x_i)$ is the underlying hazard function at time *t* for *x=0* (that is, all covariates at their appropriate reference levels) and β^i is a vector of unknown coefficients of covariate effects.

The total number of live births during the 1996-2005 period was 9,491. The number of under-5 deaths during the same period was 603. Of these deaths, 465 occurred during infancy (0-11 months) and 138 during the childhood age (12-59 months). The number of under-5 children born 5 years before the 2005-06 ZDHS survey, that is during 2001-2005 was 5,474.

We have decided to retain type of birth as an important independent variable in this study taking into account that we are referring to extremely small numbers. Only 2.9 percent of the children born during the period 1996-2005 were multiple births. It is further assumed that half the twins born are concordant by sex (have the same sex) and half are discordant.

Figure 3.1 shows the survival plot for under-5 children in Zimbabwe during 1996-2005 plotted using data from the Child Data file constructed from the Individual Recode file. The data in Figure 3.1 shows that the majority of under-5 deaths occurred during the infancy stage. It is therefore important to study the risk profile of infants (0-11), separately from births in the childhood age (12-59), in order to determine the various factors that predispose them to mortality risk. Research has shown that endogenous (maternal) factors are more important during infancy than during the childhood stage. In turn, exogenous (socioeconomic and environmental) factors are more predominant during childhood than during infancy.[48] For this reason, in this study the analysis of mortality is divided into infant and child ages.

3.5 HIV prevalence estimates

The classical demographic framework developed by Mosley and Chen[48] did not provide for HIV/AIDS since by the time it was developed HIV/AIDS had not reached pandemic stages. In this thesis provision is therefore made for the inclusion of HIV prevalence in the multivariate modeling as was done by Hill, Bicego and Mahy[5] in their study in Kenya. In that study, Hill, Bicego and May used district level HIV seroprevalance data collected from antenatal sentinel surveillance sites in Kenya. HIV testing was done as part of the survey in the 2005-06 ZDHS survey, for the first time in Zimbabwe. Since HIV estimates between the period 1996-2005 by province of residence were not readily available from the Ministry of Health in Harare, similar estimates disaggregated by rural and urban area and for the period 1996-2005 had to be obtained for use in this study. A variable (HIVprevRU) was created in the child data file and assigned to each child in the dataset, separately for rural and urban areas, and an HIV prevalence rate as at the year of birth of the child. This variable was then incorporated in the Cox proportional multivariate analysis, separately for infant and child mortality. It was expected that the inclusion of HIV prevalence in the multivariate analysis should give an indication of the direct and/ or indirect impact of HIV/AIDS on infant and child mortality in Zimbabwe.

3.6 Direct and Indirect Demographic Techniques

In this thesis both direct and indirect estimates of childhood mortality were utilized to study mortality levels and trends. Direct estimates can be unreliable if the census or survey data are characterised by errors such as under- or over-enumeration and poor age-reporting on the part of the population canvassed. The development of indirect methods of demographic estimation was meant precisely to improve the accuracy and quality of demographic estimates.[65]

Indirect techniques are methods of demographic estimation that allow reasonable accuracy in the measurement of demographic parameters. Such techniques produce estimates of a certain parameter on the basis of information that is only indirectly related to the outcome. The most common indirect approach is the Brass child survival method, which uses data on the average number of children ever born and the number of surviving children of women in each five-year age group, along with a simple mathematical model linking the two.[65]

In the context of developing countries where the vital registration systems are often deficient and incomplete, indirect estimates offer more plausible estimates of demographic parameters than direct estimates. Moreover, even censuses and surveys are also far from yielding perfect demographic data. Differential coverage of the population is very often present in censuses and surveys.[65] It is therefore in order to assess the comparability of direct and indirect estimates of infant and under-five mortality in Zimbabwe.

The aggregate number of children ever-born (CEB) and the number of children dying (CD) to all women aged 15-49 years classified by 5-year age groups were used to calculate the proportion of children dead (PD) and the average parities (AP) from the 1988, 1994, 1999 and 2005-06 ZDHS surveys. These data are the input for computing the indirect infant and under-5 mortality estimates. Estimates of infant and under-5 mortality were computed in MORTPAK using the Coale-Demeny North Model Life Table system and Trussell Equations.[66] The indirect methods exploit the relationship between the proportion of CEB dying before the survey date and past levels of childhood mortality.[65]

3.7 Multiple-spline Regression

In this thesis, weighted least squares was used to fit a multiple-spline regression line to the data points from direct and indirect estimates and to extrapolate the estimated trend to cover the period from 1960 to 2005 in Zimbabwe. The multiple-spline statistical method is a recent technique in mortality estimation that was developed by the Inter-agency Group for Child Mortality Estimation[2] in an attempt to harmonise under-5 mortality estimates. This technique has been widely applied by United Children's Fund, the World Health Organisation and the United Nations Population Division in the estimation of infant and under-5 mortality rates in many countries in the World, including Zimbabwe.

The major strength of this technique is that it accommodates multiple data points in the estimation of the true levels depicted by the regression line.[2] In this thesis, the regression lines for infant mortality and under-5 mortality were fitted independently. Standard weights developed by the Inter-agency Group for Child Mortality Estimation were assigned to all the data sources. The LOWESS command in STATA was used to fit the weighted least squares regression lines to infant and under-5 mortality estimates, separately.[63]

3.8 Quality of the Data Used in the Mortality Measurement

3.8.1 Introduction

This section assesses the quality of the available data from the 2005-06 ZDHS survey used in the mortality measurement in this study. Retrospective data such as that from the ZDHS surveys are subject to a number of potential problems such as omission of dead children and age misreporting. It is not possible to determine directly whether the data are free from errors, but several tests are carried out to examine whether the data lead to plausible estimates.

The major concerns in this study are under-reporting of live born children, particularly those who died, and the accuracy of reporting on the dates of birth and age at death of the children. The accuracy of the data is particularly important in the interpretation of the direct and indirect estimates of childhood mortality analysed in Chapter 4 and the determinants of infant and child mortality analysed in Chapters 5, 6 and 7. In order to evaluate the quality of the data in the 2005-06 ZDHS survey, the following aspects were examined:

- Completeness of age at death reporting in the 2005-06 ZDHS survey,
- The age distribution of the samples of women in the four rounds of the ZDHS surveys conducted in 1988, 1994, 1999 and 2005-06,
- Age-specific average parities of the samples of women in the four rounds of the ZDHS surveys,
- Under-reporting of live births.

3.8.2 Completeness of Age at Death Reporting

Table 3.1 shows data on age reporting for under-5 children who died during 1996-2005. Close to 99 percent of the under-5 deaths had complete age at death information reported in the ZDHS2005-06 survey.

There were only 8 under-5 deaths (1.4%) during the 1996-2005 period that had missing information on age at death. Imputation of the month of death was used in these particular cases.

3.8.3 Age Distribution of Women in the Reproductive Age group

Figure 3.2 shows the percent distribution of women aged 15-49 years in the four rounds of the ZDHS surveys conducted in Zimbabwe. The proportions of women interviewed in the four surveys are fairly consistent across the seven reproductive age groups, with the highest proportion in the 15-19 year-age group and the lowest proportion in the 45-49 year-age group. This supports the view that there was no systematic omission of women from the four surveys.

3.8.4 Age-specific Average Parities

Figure 3.3 shows data on age-specific average parities of women in the four samples of the ZDHS surveys. The parity data is of good quality; is in the expected direction; and suggests declining fertility trends in Zimbabwe from 1988 to 2005. On average, women in their early twenties gave birth to about one child, women in their early thirties have had three children, and women currently at the end of their childbearing years have had more than five children.

3.8.5 Under-reporting of Live Births

We use the Brass P/F ratio method to test for under-reporting of live births in the 2005-06 ZDHS survey.[65] The Brass P/F ratio method is an indirect technique that adjusts the level of observed age-specific fertility rates, which are assumed to represent the true age pattern of fertility, to agree with the level of fertility indicated by the average parities of women in age groups lower than age 30 or 35, which are assumed to be accurate. We computed the fertility estimates from the Brass P/F ratio method using the MORTPAK-LITE programme. The results on the fertility estimates computed using the Brass P/F ratio method indicate that there is no evidence that older women seriously under-reported their live births as is often expected. The adjusted Total Fertility Rate (TFR) of 3.81 children per woman and unadjusted TFR of 3.80 children per woman are similar. This suggests that the fertility data in the 2005-06 ZDHS survey is of good quality. The similarities in the P/F ratios (adjustment factors) further suggest that the 2005-06 ZDHS survey had least distortions in age misreporting.

3.9 Test of the Cox Proportional Hazards Assumption

It is important to test the assumption of the proportional hazards model before any modeling will take place. The Cox proportional hazards model can only be applied when certain assumptions are met. The most important of these is the proportionality requirement. We assessed whether or not the requirement was met. In this regard we used a combination of statistical tests and graphical methods described below to test the assumptions of the proportional hazards model. Though the Cox model is non-parametric to the extent that no assumptions are made about the form of the baseline hazard, there are still a number of important issues which need be assessed before the model results can be safely applied. It is for this reason that in this section we present and discuss the tests of the Cox proportional hazards assumption that we conducted and the results thereof.

A key assumption in the Cox model is that of proportional hazards, that is, the ratio will remain constant over time. In a regression type setting this means that the survival curves for two strata (determined by the particular choices of values for the independent variables) must have hazard functions that are proportional over time (that is, constant relative hazard). The proportional hazards assumption is met when the curves are parallel[61]. We now discuss the statistical procedures and the results from the tests we conducted.

First, we used the STPHTEST command in STATA to test the proportionality of hazards in the Child Data file that we used for the analysis of determinants of infant and child mortality. The results of this statistical test are presented in Table 3.2. We found that the output from STPHTEST is non-significant (p=0.267), indicating an absence of evidence to contradict the proportionality assumption.

Second, we used the SURVIVAL command in SPSS 16.0 to construct Kaplan - Meier survival curves to evaluate the assumption of proportionality of hazards graphically. We arbitrarily selected one variable from each of the three categories of the Mosley and Chen[48] theoretical framework that are used to analyse the determinants of infant and child mortality. The three variables that we selected were sex of child, residence and presence of flush toilet. We expect that an evaluation of these three variables provide a fair assessment of the proportionality assumption.

The Kaplan - Meier survival plots for sex of child, residence and flush toilet are presented in Figures 3.4 to 3.6. First, Figure 3.4 shows that the survival curves from birth to age 5 for female and male children are fairly proportional over time indicating constant relative hazards. Second, Figure 3.5 illustrates the Kaplan - Meier survival plot from birth to age 5 by area of residence. Figure 3.5 shows that the survival curves for urban and rural areas depict constant relative hazards. Finally, Figure 3.6 shows the Kaplan - Meier survival plot until age 5 for children born to mothers in households with or without access to a flush toilet. The survival curves for the two strata for flush toilet (yes/ no) indicate proportionality of hazards.

The proportional hazards assumption is not violated when the curves are parallel. On the basis of the global test of proportionality of hazards and the Kaplan - Meier survival plots that we constructed and discussed in this section, we conclude that the Cox proportional hazard model can safely be applied to the Child Data file that we extracted from the 2005-

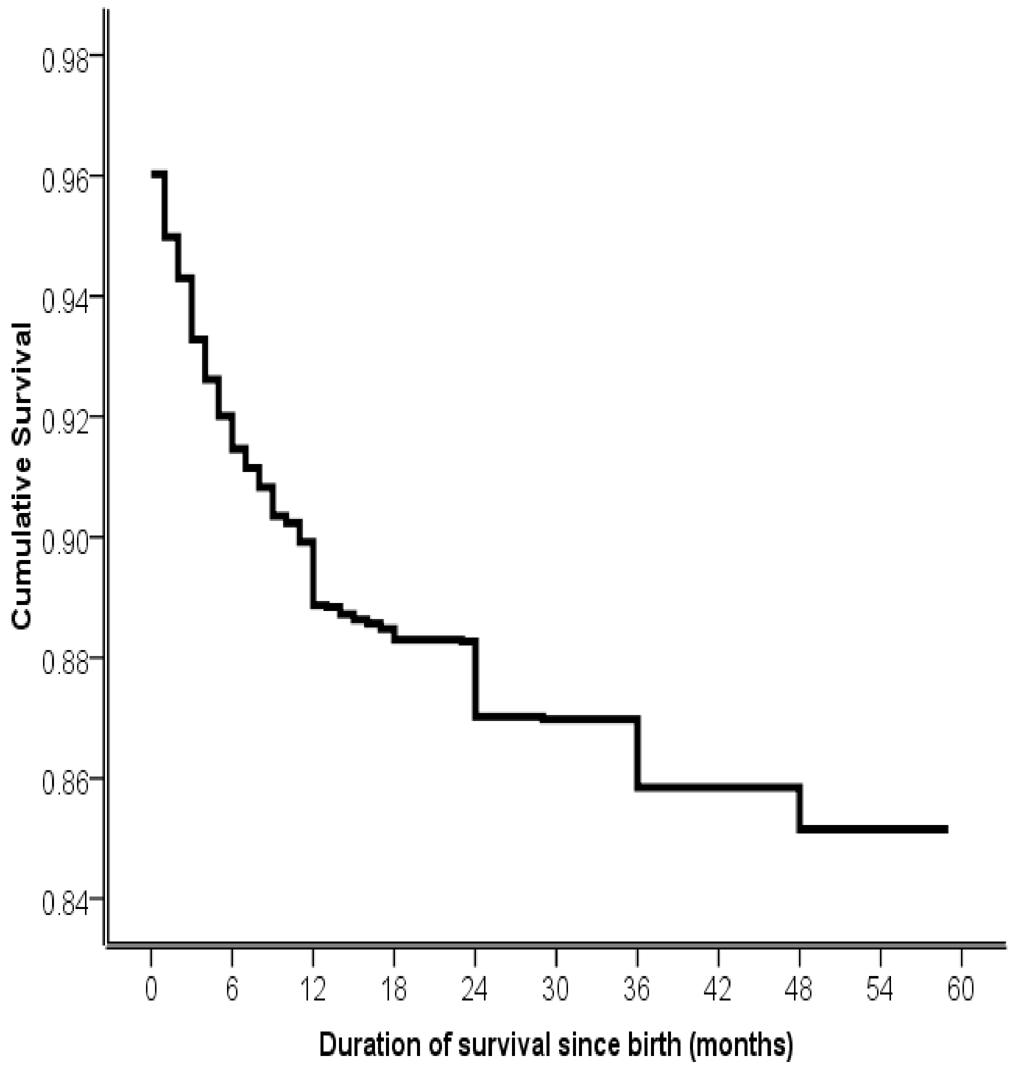
06 ZDHS survey to study the determinants of infant and child mortality during 1996-2005 in Zimbabwe.

3.10 Concluding Remarks

Chapter 3 presented the methodological approach employed in this study, statistical and analytical methods used and an evaluation of the quality of data from the 2005-06 ZDHS survey. None of the tests conducted to determine the quality of data is conclusive on its own. However, based on indicators discussed in this section, and in the absence of any systematic errors in the data, the quality of the mortality data in the 2005-06 ZDHS survey is satisfactory. The Cox proportional hazards model can only be applied when certain assumptions are met. The most important of these is the proportionality requirement. We assessed whether or not this requirement was met. Two tests were conducted; the global test of the proportionality of hazards and the Kaplan - Meier survival plots for testing whether the hazard functions are proportional over time. Both these tests indicated the absence of evidence to contradict the proportionality assumption. It is therefore plausible in this study to apply the Cox proportional hazard method to study the determinants of infant and child mortality during 1996-2005 in Zimbabwe.

We now turn to Chapter 4 which presents a detailed study of the levels and trends of infant and child mortality in Zimbabwe and offers an opportunity to further evaluate the quality of the mortality data in the 2005-06 ZDHS survey.

Figure 3.1: Kaplan - Meier Survival Curve for Under-5 Children Born during 1996-2005 (2005-06 ZDHS survey), Zimbabwe



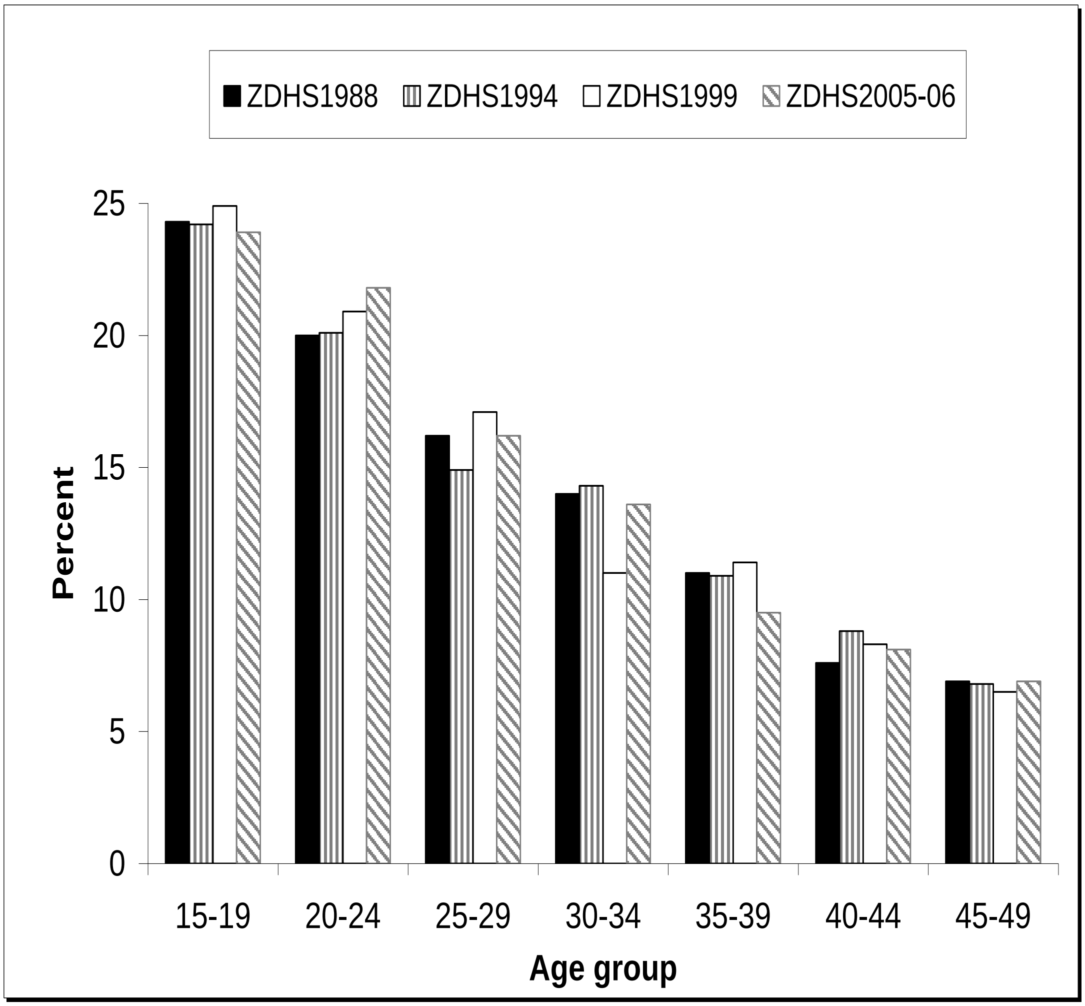
Source: Author's calculations Zimbabwe Central Statistical Office/ Macro International Inc21

Table 3.1: Completeness of Age at Death Information for Under-5 Children born during the 1996-2005 Period, 2005-06 ZDHS survey, Zimbabwe

Indicator	**Frequency**	**Percent**
Month and year	595	98.6
Year and age - month imputed	8	1.4
Total	**603**	**100.0**

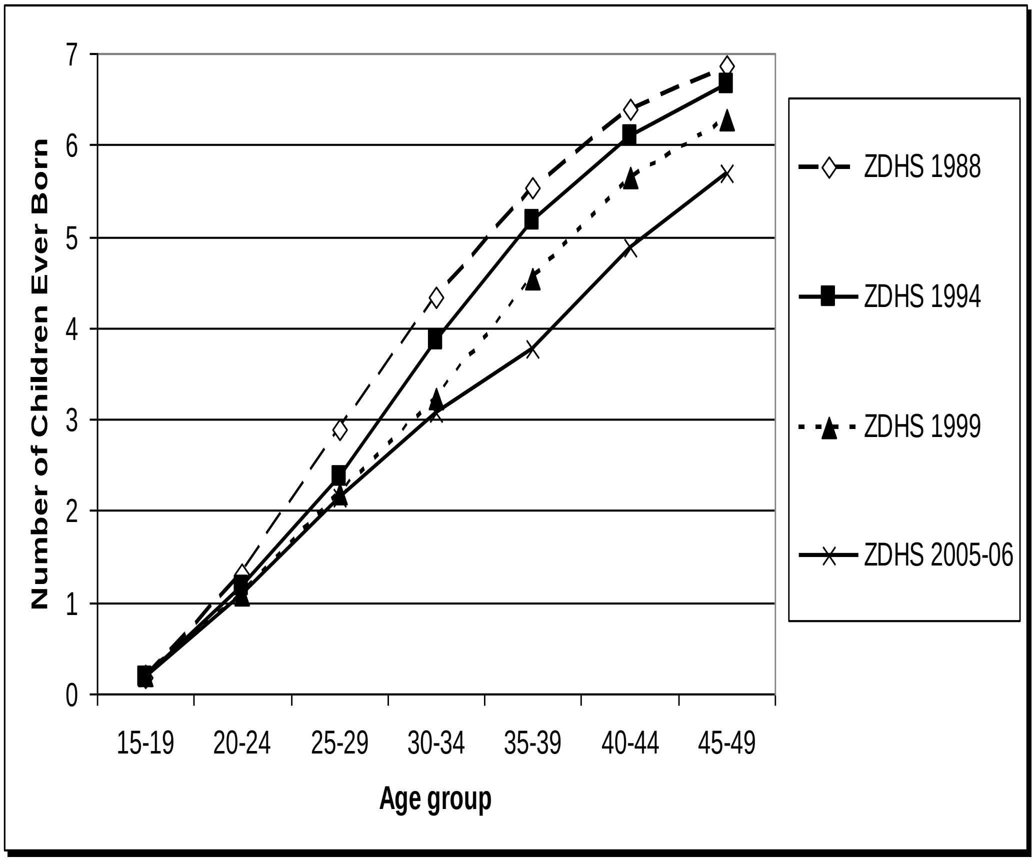
Source: Author's calculations Zimbabwe Central Statistical Office/ Macro International Inc21

Figure 3.2: Percentage Distribution of Women by Age (15-49) Interviewed during each of the 4 ZDHS surveys, Zimbabwe



Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc 13, 14, 21, 50

Figure 3.3: Number of Children Ever Born by Age of the Mother, 1988 ZDHS, 1994 ZDHS, 1999 ZDHS and 2005-06 ZDHS survey, Zimbabwe



Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc 13,14,21,50

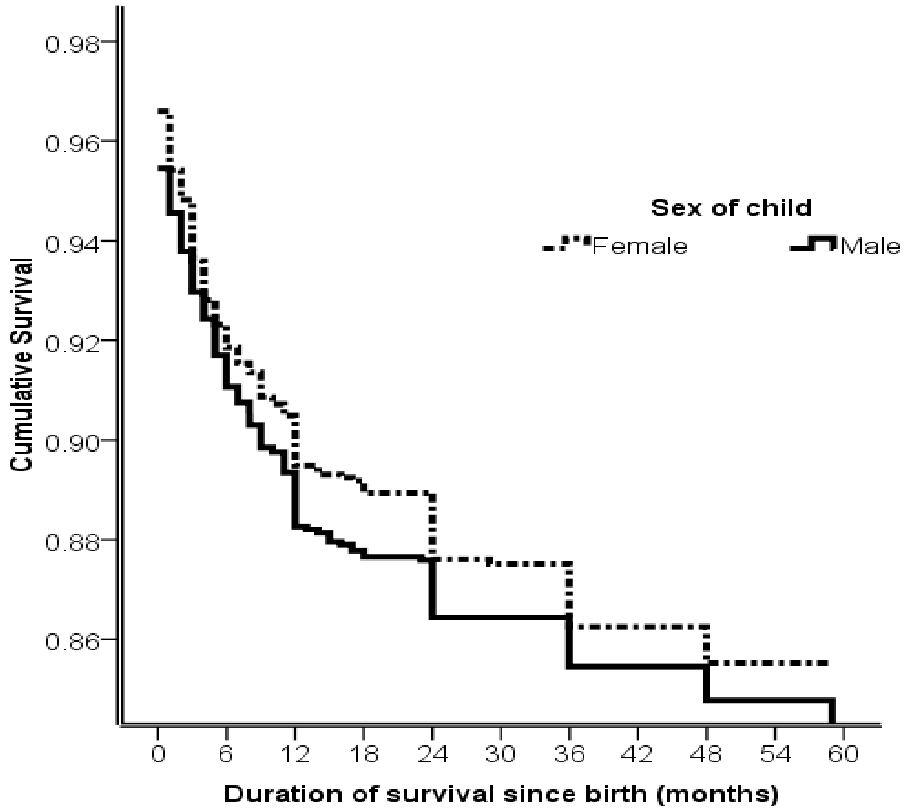
Table 3.2: Test of the Proportionality of the Hazard Assumption, 2005-06 ZDHS, Zimbabwe

	Chi-square	**Degrees of freedom**	**Probability of the Chi-square**
Global Proportionality Test	2.64	2	0.267

*p<0.05

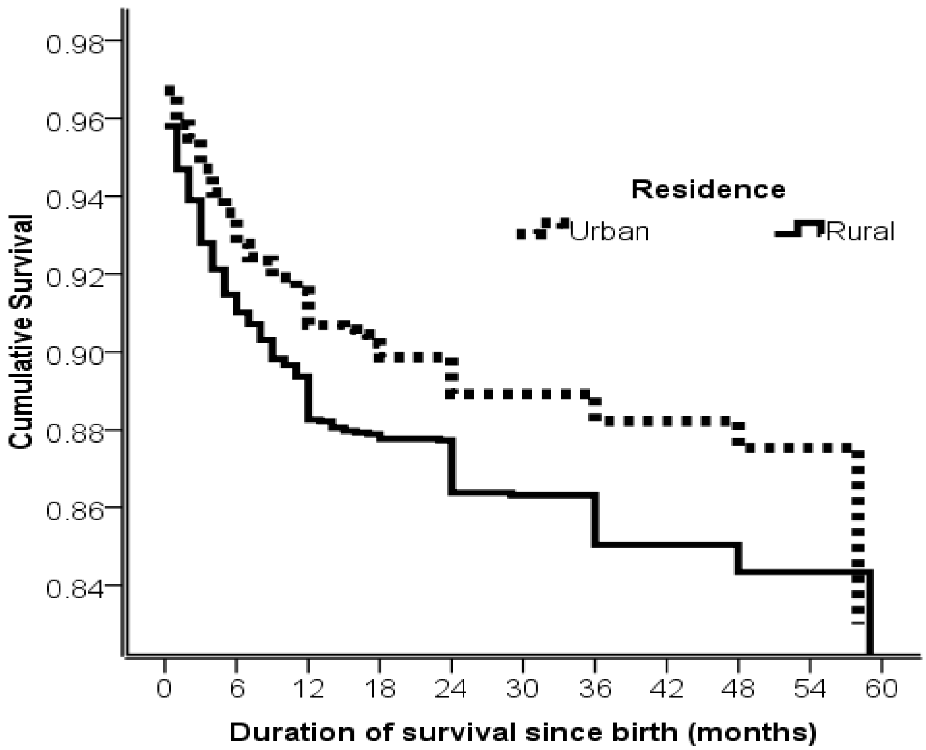
Source: Author's calculations Zimbabwe Central Statistical Office/ Macro International Inc 21

Figure 3.4: Kaplan - Meier Survival Curves Classified by Sex of Child for Under-5 Children Born during 1996-2005 (2005-06 ZDHS), Zimbabwe



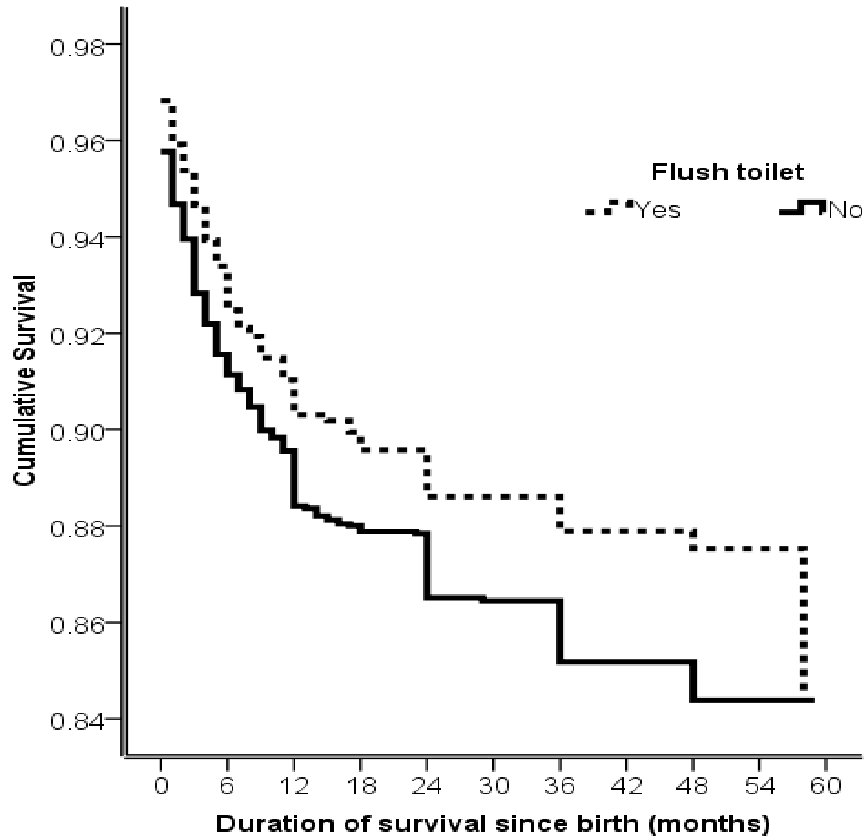
Source: Author's calculations Zimbabwe Central Statistical Office/ Macro International Inc 21

Figure 3.5: Kaplan - Meier Survival Curves Classified by Residence for Under-5 Children born during 1996-2005 (2005-06 ZDHS), Zimbabwe



Source: Author's calculations Zimbabwe Central Statistical Office/ Macro International Inc 21

Figure 3.6: Kaplan - Meier Survival Curves Classified by the Presence of Flush Toilet for Under-5s born during 1996-2005 (2005-06 ZDHS), Zimbabwe



Source: Author's calculations Zimbabwe Central Statistical Office/ Macro International Inc 21

CHAPTER 4

LEVELS AND TRENDS IN INFANT AND CHILD MORTALITY IN ZIMBABWE

4.1 Introduction

This chapter describes trends in infant and child mortality in Zimbabwe using direct and indirect demographic estimates. The study of levels and trends of early childhood mortality is fundamental to the bivariate and multivariate analysis of maternal, socioeconomic and environmental determinants of infant and child mortality conducted in Chapters 5, 6 and 7.

4.2 Analysis and Interpretation of Mortality Levels and Trends using Direct Estimates

Section 4.2 presents data on levels and trends of neonatal, postneonatal, infant, child and under-5 mortality rates in Zimbabwe. The estimates presented in this section are based on direct estimates from the Zimbabwe Demographic and Health Surveys conducted in 1988, 1994, 1999 and 2005-06. Indirect estimates of infant and under-5 mortality are provided in section 4.3. This section also presents a comparison of estimates obtained using these two approaches in order to derive a plausible trend of childhood mortality in Zimbabwe.

4.2.1 Neonatal and Postneonatal Mortality Levels and Trends

Figure 4.1 presents neonatal mortality (< 1 month) and postneonatal mortality (1-11 months) rates for the period 1990-1994, 1995 -1999 and 2001-2005. The neonatal and postneonatal mortality rates for the 1980-1984 period are not presented because the 1988 ZDHS survey report did not show these rates. The data show that survival at all ages below 12 months had not improved from the period 1990-1994 to the period 1995-1999. However, survival improved from the period 1995-1999 to the period 2001-2005. Most of this improvement was due to the decline in neonatal mortality from 29 deaths per 1,000 live births for the 1995-1999 period to 24 deaths per 1,000 live births during the 2001-2005 period.

4.2.2 Infant, Child and Under-5 Mortality Levels and Trends

Figure 4.2 presents infant mortality (0-11 months), child mortality (1-59 months) and under-5 mortality (0-59 months) rates for the period 1984-1988, 1990-1994, 1995-1999 and 2001-2005. The pattern obtained is similar to that observed for neonatal and postneonatal mortality. Survival at all ages below five declined from the period 1984-1988 (77 deaths per 1,000 live births) to the period 1995-1999 (102 deaths per 1,000 live births). A comparison of the under-5 mortality rate for the 1995-1999 period with the rate for the 2001-2005 period indicates that mortality declined from the level of 102 deaths per 1,000 live births during the 1995-1999 period to 82 deaths during the 2001-2005 period. Most of the difference in under-5 mortality between the two recent ZDHS surveys appears to be the result of a decline in child mortality because the infant mortality rate during the 2001-2005 period was 60 deaths per 1,000 live births, only slightly lower than the rate observed in the 1995-1999 period (65 deaths per 1,000 births). These mortality trends are largely unexpected. Especially unexpected is the decline in 2001-2005 compared to 1995-1999. There could be several reasons for this. First, it is possible that more women took antiretroviral drugs (ARVs) while pregnant, thereby increasing the survival chances of their children. Second, it is also possible that many women aged 15-49 years who were HIV positive died, thereby reducing the pool of women who were giving birth to HIV positive children who would then eventually die.

More evidence will now be provided throwing light on the plausibility of the infant and child mortality rates obtained in the 2005-06 ZDHS survey. Data on the health status of children between 1994 and 2005 in Zimbabwe are shown in Table 4.1. Data on measures such as anthropometry, low birth-weight and immunisation coverage suggest that child health deteriorated in Zimbabwe during this period. The coverage for all vaccines among children aged 12-23 months dropped from 80 percent to 53 percent from 1994 to 2005-06. The percentage of children aged 12 to 23 months who had not received any vaccinations was more than five times higher in 2005-06 than in 1994 (4 percent and 21 percent, respectively). The nutritional status of under-five children in Zimbabwe also declined between 1994 and 2005-06. The prevalence of stunting (low height-for-age) rose from 21 percent in 1994 to 29 percent at the time of the 2005-06 ZDHS. The proportion under-weight (low weight-for-age) decreased somewhat between 1994 and 1999 and then rose to a level of 17 percent at the time of the 2005-06 ZDHS.[13,14,21] It is therefore difficult to accept that childhood mortality declined between 2001 and 2005 as indicated by the 2005-06 ZDHS survey.

4.2.3 Comparison of Infant and Under-5 Mortality Rates for Periods 0-4 and 5-9 years Preceding four ZDHS Surveys

Table 4.2 shows infant and under-5 mortality estimates from the four rounds of the ZDHS and the reference periods to which the mortality estimates refer. Mortality estimates for the 5-9 year-period preceding the 2005-06 ZDHS survey should be roughly similar to those for the 0-4 year-period preceding the 1999 ZDHS survey. With the exception of the 2005-06 ZDHS survey, mortality estimates from the other three rounds of the surveys are fairly close. Comparison of the 1988 with the 1994 survey shows, for instance very similar rates in the comparable periods. The under-5 mortality rate 5 years before the survey in the 1994 ZDHS is similar to the under-5 mortality rate 0-4 years before the survey in 1988 (75 per 1,000 births in both surveys). However, the infant and under-5 mortality rates for the 5-9 year period from the 2005-06 ZDHS survey were 37 and 54 deaths per 1,000 live births, respectively, while the corresponding estimates for the 0-4 year period preceding the 1999 ZDHS survey were 65 and 102 deaths, respectively. The lack of similarity of these estimates is evidence that infant and under-5 mortality are underreported in the 2005-06 ZDHS survey.

4.2.4 Mortality Differentials by Sex of Child

This section presents differentials of childhood mortality by sex of child. The mortality estimates are calculated for the 10-year period before the survey. This is done so that the rates are based on as large number of cases as possible.

4.2.4.1 Neonatal and Postneonatal Mortality Differentials by Sex

Figure 4.3 and 4.4 show differentials in neonatal and postneonatal mortality by sex for the following 10-year calendar periods: 1985-1994, 1990-1999 and 1996-2005. The 1988 ZDHS survey report did not provide the neonatal and postnenonatal mortality rates hence they are not presented in Figures 4.3 and 4.4. Survival prospects for female neonates and postneonates are better than their male counterparts during the three 10-year calendar periods. During the period 1990-1999 to 1996-2005 neonatal mortality declined by a fifth for both sexes from 28 to 23 deaths per 1,000 live births (males) and 24 to 19 deaths per 1,000 live births (females). Postneonatal mortality also declined for both sexes during 1990-1999 to 1996-2005 period from 35 to 28 deaths per 1,000 live births (male) and 32 to 29 deaths per 1,000 live births (female).

4.2.4.2 Neonatal to Postneonatal Mortality Ratios

Figure 4.5 shows data on trends in the ratio of neonatal to postneonatal mortality by sex of the child during the period 1985-1994 to 1996-2005. These estimates show further evidence regarding the possible omission of deaths among children in the 2005-06 ZDHS survey. These ratios should be substantially similar (for female and male children) across all the 4 surveys in the absence of any omission of deaths. With the exception of the 1985-1994 period, the ratios for male children (0.94, 0.81, 0.82) are quite similar during the latter two calendar periods, that is, 1990-1999 and 1996-2005. Contrary to this pattern the ratios for female children (0.94, 0.75 and 0.66) are quite different across all the 3 surveys. This suggests possible omission of female deaths in the last 2 rounds of the ZDHS surveys.

4.2.4.3 Infant Mortality Differentials by Sex

Figure 4.6 shows infant mortality differentials by sex of child. In the period 1979-1988 the infant mortality rate for males and females was 65 and 50 deaths per 1,000 live births, respectively. The rates for infant mortality for males and females for the period 1985-1994 are 57 and 46 deaths per 1,000 live births, respectively, and those for the period 1990-1999 are 63 and 56 deaths per 1,000 live births, respectively. In the period 1996-2005 the infant mortality rate for males and females was 51 and 48 deaths per 1,000 live births, respectively. The period 1990-1999 to 1996-2005 witnessed a decline of infant mortality rates by 20 percent for males and 15 percent for females. After having decreased in the 1980s by close to 10 percent for both sexes, infant mortality rates increased by 10 percent for males and by 23 percent for females in the 1990s. This was most probably due to the impact of HIV and AIDS in Zimbabwe. Infant mortality declined once more for both sexes from the period 1990-1999 to the period 1996-2005. It is interesting to note that the survivourship gap between female and male infants considerably narrowed during the 1996-2005 period.

4.2.4.4 Child Mortality Differentials by Sex

Child mortality differentials by sex are shown in Figure 4.7. During the period 1979-1988 the survival prospects of male children were slightly better than their female counterparts. This phenomenon was reversed from the 1985-1994 period up to the 1990-1999 period in which the survivourship of male children worsened. During the latter period, child mortality reached its peak at levels of 31 and 35 deaths per 1,000 live births for females and males, respectively. The mortality gap between female and male children aged 1-59 months disappeared during the 1996-2005 period; female and male child mortality coincided at 21 deaths per 1,000 live births during the 1996-2005 period.

4.2.4.5 Infant to Child Mortality Ratios

Figure 4.8 shows the infant to child mortality ratios by sex of child for the 1979-1988 to 1996-2005 periods. These ratios show a rather unexpected pattern. They should be more or less similar in all the 3 surveys (for female and male children). The ratios for the 1996-2005 period, 2.43 and 2.29, for males and females, respectively, are not close to those of the other 3 surveys, which appear closer. This is evidence of either underreporting of infant and/ or child deaths or shifting of deaths in infancy to childhood or the reverse or both in the 2005-06 ZDHS survey.

4.2.4.6 Under-5 Mortality Differentials by Sex

The pattern obtaining for the sex differentials in under-5 mortality shown in Figure 4.9 is similar to that observed for infant mortality (see Figure 4.6). Under-5 mortality declined from levels of 85 and 95 deaths per 1,000 live births in the 1990-1999 period to 68 and 71 deaths per 1,000 live births in the 1996-2005 period, for females and males, respectively. It is further interesting to note that the survivorship gap between male and female under-5 children considerably narrowed during the 1990s.

4.2.5 Mortality Differentials by Rural- Urban Residence

This section discusses differentials in infant and childhood mortality by residence. The rates are presented for 10- year calendar periods.

4.2.5.1 Infant Mortality Differentials by Rural-Urban Residence

Figure 4.10 shows differentials in infant mortality by rural-urban residence. There was a steady increase in infant mortality levels in urban areas from the period 1979-1988 to the period 1996-2005 from levels of 38 deaths per 1,000 births to 47 deaths per 1,000 births, respectively. In contrast, the infant mortality rates in rural areas fluctuated from levels of 64 deaths per 1,000 births in 1979-1988 to 51 deaths per 1,000 in 1996-2005.

4.2.5.2 Child Mortality Differentials by Rural-Urban Residence

The trend in child mortality differentials by rural-urban residence shown in Figure 4.11 follows a similar pattern to that for infant mortality presented in Figure 4.10. Children in urban areas experience higher survival prospects than their rural counterparts. However, the gap in child mortality between rural and urban areas narrowed to 22 and 18 deaths per 1,000 live births in the 1996-2005 period from previous levels of 37 and 23 deaths per 1,000 live births in 1990-1999 period (rural and urban areas, respectively).

4.2.5.3 Under-5 Mortality Differentials by Rural-Urban Residence

Figure 4.12 presents trends in under-5 mortality by residence. The under-five mortality rate was 72 deaths per 1,000 live births in the rural areas, compared to 64 deaths per 1,000 live births in the urban areas, during the 1996-2005 period. For the 1990-1999 period, the under-5 mortality rate was 100 deaths per 1,000 live births in the rural areas compared to 69 deaths per 1,000 deaths in the urban areas. Similar to the trend in infant mortality, there are consistently higher under-5 mortality rates in rural areas than in urban areas of Zimbabwe. The decline in under-five mortality from 1990-1999 to 1996-2005 period was greater in rural areas (27 percent) than in urban areas (7.3 percent). We hypothesize that the much faster decline in infant, child and under-5 mortality between 1979-1988 and 1996-2005 in rural areas of Zimbabwe could be due to underreporting of deaths, especially in rural areas.

4.2.6 Mortality Differentials by Province

The differentials in mortality by province for infant and under-5 mortality are presented in Table 4.3. We observe that there are substantial provincial variations in infant and child mortality in Zimbabwe. During 1996-2005 under-5 mortality was highest in Manicaland province (100 deaths per 1,000 births) and lowest in Matabeleland South and Bulawayo provinces (45 deaths per 1,000 live births).

The decline in under-5 mortality between 1990-1999 and 1996-2005 varied by province. The decline in under-5 mortality was highest in Mashonaland province (34 percent) and lowest in Harare province (8.5 percent). Unlike the other 9 provinces which experienced mortality decreases, under-5 mortality increased by 17 percent between 1990-1999 and 1996-2005 in Matabeleland North province. We also observed that the decline in under-5 mortality during the same period was higher in Bulawayo (31.8 percent) than Harare (8.5 percent).

4.2.7 Regional Variations in Childhood Mortality

The regional trends in infant mortality rates are shown in Figure 4.13. The period 1980-1985 to 1990-1995 saw an improvement in infant survival prospects in Zimbabwe, South Africa, Botswana, Malawi, Lesotho, and in Sub-Saharan Africa and the Less Developed Countries. There was an initial increase in infant mortality in Zambia during 1980 to 1990 before a decline in 1985 to 1995. Infant survival prospects have either worsened or stalled in South Africa, Lesotho, Kenya and Zimbabwe from 1995-2000 to 2000-2005 and improved in Mozambique, Botswana, Malawi and Zambia. Infant mortality rates declined during 2000-2005 as compared to 1995-2000 in Sub-Saharan Africa and in Less Developed Countries.[67]

4.3 Direct and Indirect Childhood Mortality Estimates

The direct and indirect estimates of infant and under-five mortality are presented in Figures 4.14 to 4.17. Tables 4.4 to 4.11 are the basis for the computations of the direct and indirect estimates presented in Figures 4.14 to 4.17. Therefore, the discussion in this section will be limited to Figures 4.14 to 4.17. In the four periods of roughly 10 years each covered in the four ZDHS surveys, it can be seen that the results of the indirect method were somewhat higher than the direct method. Figure 4.14 shows that between 1979 and 1986 infant mortality rates were rather similar at 55 deaths per 1,000 live births. Figure 4.15 reveals that between 1980 and 1990 there was some decline in infant mortality from 58 deaths to 51 deaths per 1,000 live births. Contrary to the these patterns, Figure 4.16 shows that between 1989 and 1996 infant mortality increased from 45 deaths to 69 deaths per 1,000 live births. Finally, Figure 4.17 shows that between 1992 and 2002 there was some decline in infant mortality from 45 deaths to 40 deaths and then an increase to 70 deaths per 1,000 live births.

It should be noted that the estimates from the direct methods refer to a fairly long time interval, for example, 1974-1978 in Figure 4.14, whereas the indirect methods compute estimates that refer to a specific point in time. This is a constraint in comparison of direct and indirect estimates. For comparison purposes it is assumed that the indirect estimates refer to the mid-point of the interval. In general, the differences between the direct and indirect estimates are small with a tendency towards somewhat higher rates obtained with the indirect method. On the whole, the final conclusion is that both of them provide acceptable and reliable results.

4.4 Estimated Mortality Levels and Trends using Direct and Indirect Estimates and Multiple-spline Regression

The estimated levels of infant and under-5 mortality rates computed using the robust regression method are shown in Figures 4.18 and 4.19. The pattern and trend of the fitted regression lines of infant and under-5 mortality rates are similar. Both infant and under-5 mortality declined during the period from 1960 to 1990. However, the decline in mortality appears to have stalled from the 1990s to 2005. These results show that in 2005 in Zimbabwe child survival stagnated at levels of 61 and 82 deaths per 1,000 live births for infant and under-5 mortality, respectively.

The stagnation in the decline of the regression lines shown in Figure 4.18 and Figure 4.19 for infant and under-5 mortality respectively was probably caused by the inclusion in the multiple - spline regression equation of infant and under-5 mortality estimates from the 2005-06 ZDHS which were underestimates of the true mortality level during 2001-2005-6 in Zimbabwe. As we saw earlier, evidence was shown above which make it more likely that infant and under-five mortality increased between 1990 and 2005.[13,14,21]

4.5 Trends in Adult Mortality

In this section the recent trends of adult female mortality using data from the 1999 and 2005-06 Zimbabwe Demographic and Health Survey are studied. This is done as a result of the correlation between the risks of the mother and those of the children. Marindo and Hill[20] observed that survey data that solicit for information on child mortality from reports by women in the survey may fail to pick up childhood deaths due to AIDS as the mothers would not be there to report these deaths as they would themselves have died before the survey. It is therefore relevant to study the recent trends in adult female mortality in Zimbabwe in this thesis.

Table 4.12 shows a comparison of age-specific mortality rates for women in the childbearing age group for the period 0-4 years before the 1999 ZDHS and for the period 0-6 years before the 2005-06 ZDHS survey. We observe that mortality rises rapidly with age and the rates plateau starting in the 35-39 year age group. Mortality rates doubled for older women that are in the age group 30-44 years between 1996-1999 and 2000-2005. Overall, mortality among women aged 15-49 years increased by 40 percent between 1996-1999 and 2000-2005. Mortality among men aged 15-49 years increased by 20 percent between 1996-1999 and 2000-2005 (data not shown in Table 4.12). We hypothesise that this rapid increase in adult mortality was due to the impact of the AIDS epidemic in Zimbabwe.

4.6 Trends in HIV Prevalence Rates

The HIV prevalence estimates for adults aged 15-44 years for rural and urban areas in Zimbabwe for the period 1996-2006 are shown in Table 4.13. The estimates show a declining trend from 1996-2006 and are higher in urban than in rural areas. However, a large part of the decline in HIV prevalence rates in Zimbabwe could be due to the refinement in the methodology used to estimate these rates, while some of the decline could be due to the impact of the HIV prevention programmes. However, HIV prevalence at 18.9 % (urban) and 17.6 % (rural) as at 2006 still remains high in Zimbabwe. In this thesis, we will incorporate the HIV prevalence rates in the Cox proportional multivariate analysis so as to study the possible direct and/ or indirect impact of HIV/AIDS on infant and child mortality. This follows similar pioneering work done by Hill, Bicego and Hill in Kenya.[5] In their study Hill, Bicego and Mahy were able to show that in the presence of biodemographic, socioeconomic and environmental factors, a unit increase in HIV prevalence led to an increase of 10 percent in the odds of dying in childhood age.[5]

4.7 Concluding Remarks

Chapter Four examined childhood mortality levels and trends in Zimbabwe. The chapter further discussed selected demographic and socioeconomic mortality differentials and trends using the direct approach. Evidence was provided in support of the hypothesis that infant and child mortality rates in the 2005-06 ZDHS survey are or maybe too low. Such evidence included:

- Lack of similarity between infant and under-5 mortality rates for the 0-4 period preceding the 1999 ZDHS survey and the 5-9 period preceding the 2005-06 ZDHS survey.

- The worsening of child health indicators, that is, immunisation coverage, stunting and wasting, from 1994 to 2005-06.

- The narrowing of the gap in the mortality differentials by sex of child and rural-urban area of residence.

- The rapid increase in mortality among women aged 15-49 years by 40 percent between 1996-1999 and 2000-2005. This rise in adult mortality could have been due to the AIDS epidemic in Zimbabwe.

- The stagnation of infant and under-five mortality during the period 1990-2005 as observed from the multiple - spline regression analysis, and,

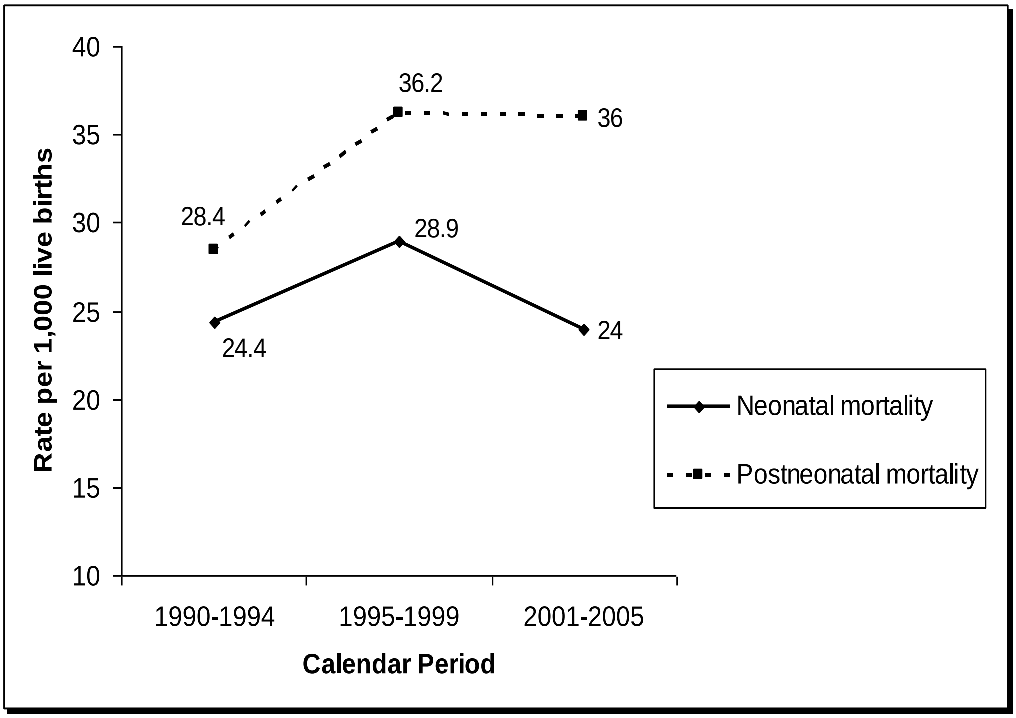
- The inconclusiveness of the trends in neonatal to postneonatal mortality ratios and the infant to child mortality ratios.

The mortality gap in Zimbabwe by rural-urban residence narrowed from 1979-1988 to 1996-2005 while the mortality gap by sex of child completely disappeared during the 1996-2005 period. These are unusual results, not observed in other DHS surveys in neighbouring countries such as South Africa.

It can be seen that the results of the indirect method are somewhat higher than those from the direct method. On the whole, the differences between the estimates computed using the two approaches were small. We therefore conclude that both the direct and indirect methods provide acceptable and reliable results of trends in infant and child mortality in Zimbabwe.

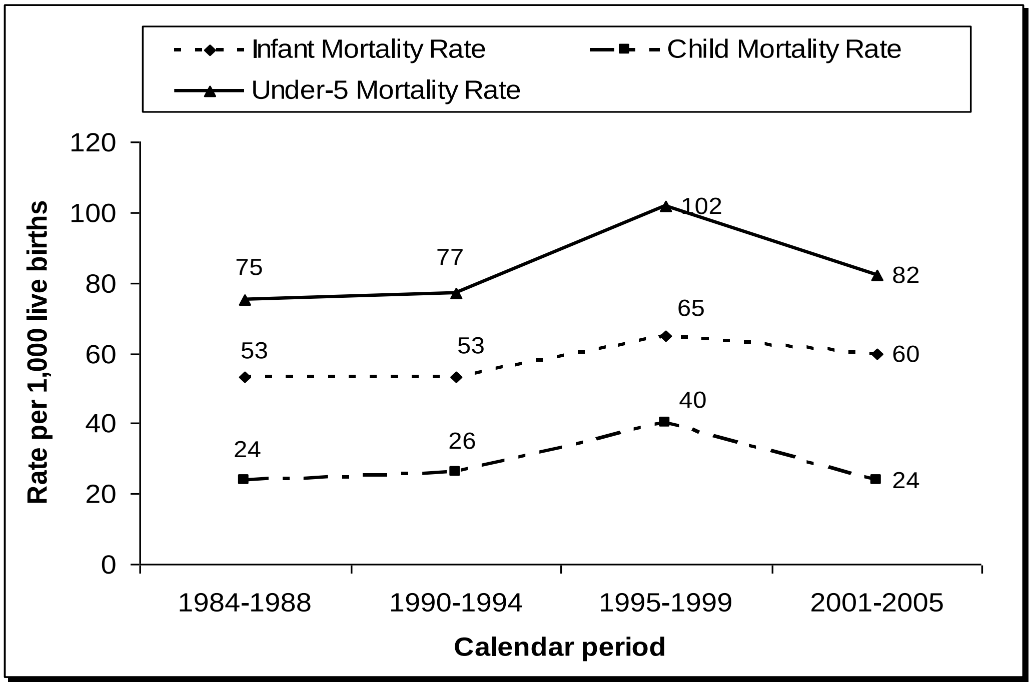
Chapter Five presents the bivariate analysis of the impact of the determinants of infant and child mortality in Zimbabwe during 1996-2005.

Figure 4.1: Trends in Neonatal and Postneonatal Mortality, Calendar Period, 1990-1994 (ZDHS1994), 1995-1999 (ZDHS 1999) and 2001- 2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc13,14,21,50

Figure 4.2: Trends in Infant, Child and Under-Five Mortality, Calendar Period 1984-1988 (ZDHS 1988), 1990-1994 (ZDHS 1994), 1995-1999 (ZDHS 1999) and 2001- 2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc13,14,21,50

Table 4.1: Selected Health Indicators, ZDHS 1994, ZDHS 1999 and ZDHS 2005-06, Zimbabwe

Year	**Health Indicator**			
	Percentage of Vaccine Coverage among Children aged 12-23 Months	**Percentage of Children aged 12-23 Months who Received no Vaccination**	**Height-for-age (Percentage of Children under-5 years below -2 SD)**	**Weight-for-age (Percentage of Children under-5 years below -2 SD)**
1994	80.1	4.1	21.4	15.5
1999	74.8	11.6	26.5	13.0
2005-06	52.6	21.0	29.4	16.6

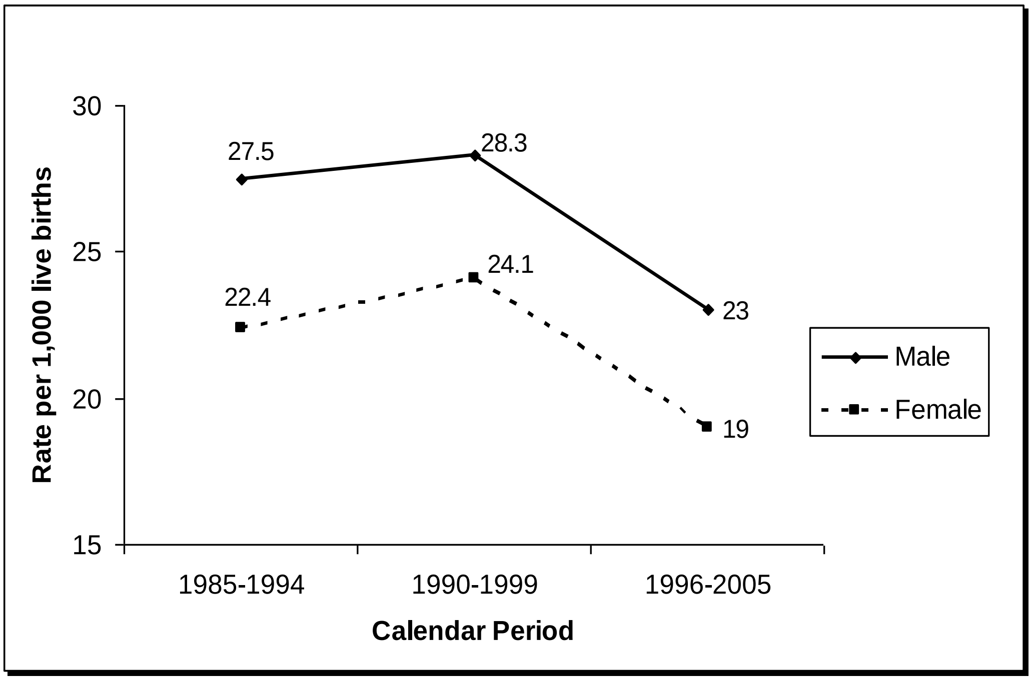
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc 13,14,21

Table 4.2: Assessment of the Comparability of Infant and Under-5 Mortality Rates per 1,000 Live Births across the Four ZDHS Surveys, Zimbabwe

Period in Years Preceding Survey	**1988 ZDHS**	**1994 ZDHS**	**1999 ZDHS**	**2005-06 ZDHS**
Infant Mortality				
0-4	53	53	65	60
5-9	64	50	54	37
Under-5 Mortality				
0-4	75	77	102	82
5-9	104	75	77	54

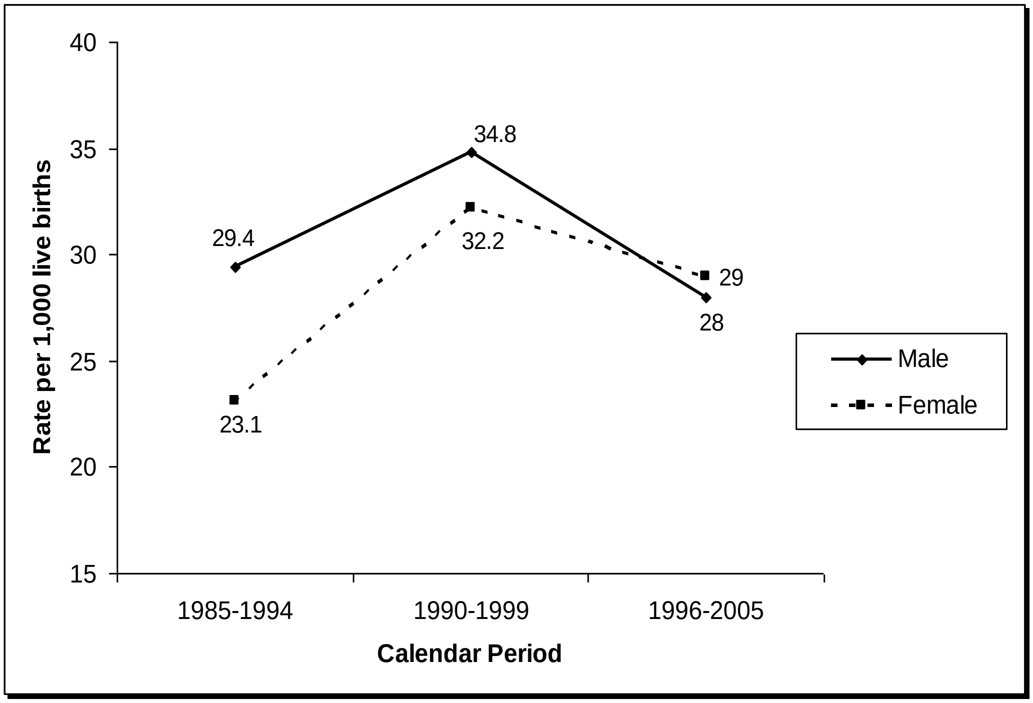
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc13,14,21,50

Figure 4.3: Trends in Neonatal Mortality by Sex of Child for the Calendar Period 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999) and 1996-2005, (ZDHS 2005-06), Direct Estimates, Zimbabwe



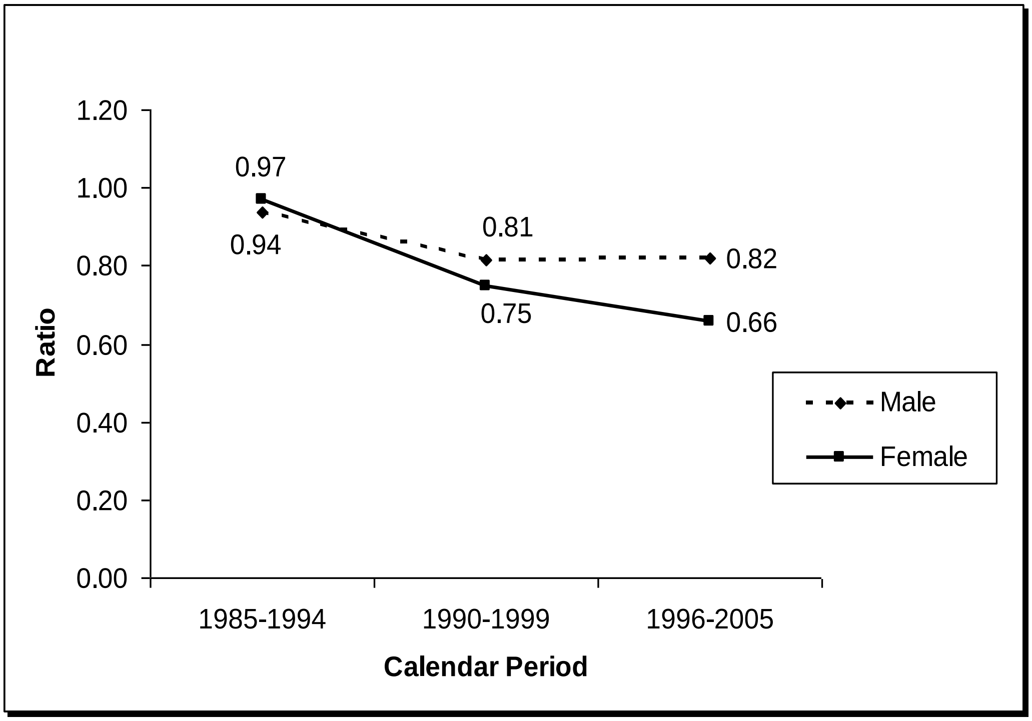
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc[13,14,21]

Figure 4.4: Trends in Postneonatal Mortality by Sex of Child for the Calendar Period 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999) and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



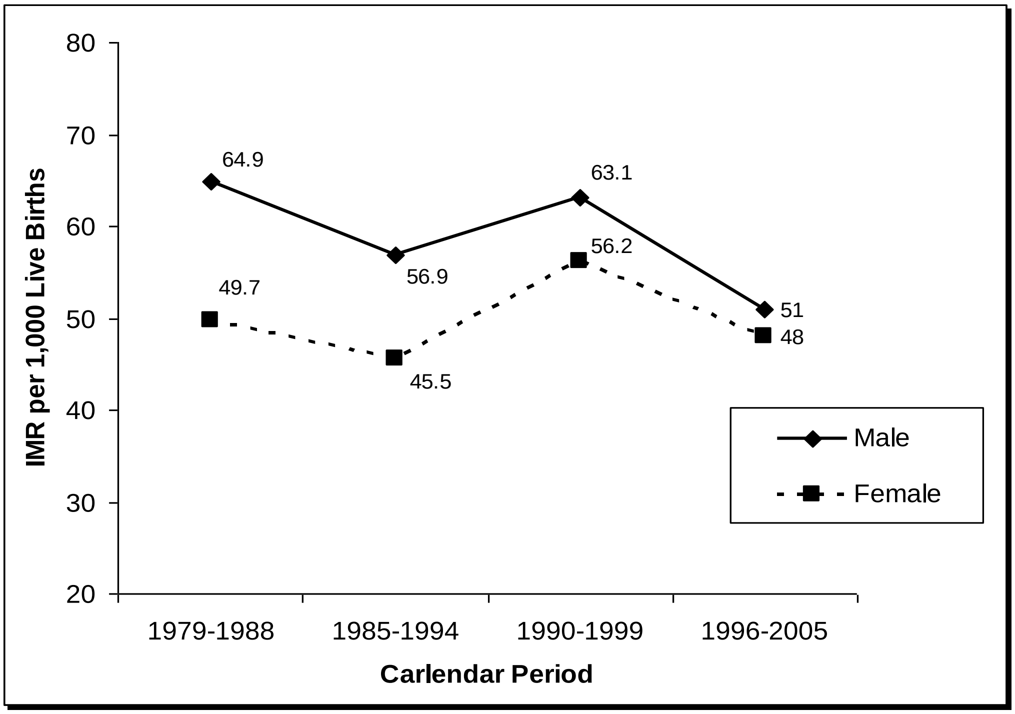
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc 13,14,21

Figure 4.5: Trends in the Ratio of Neonatal to Postneonatal Mortality by Sex of Child for the Calendar Period 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999) and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



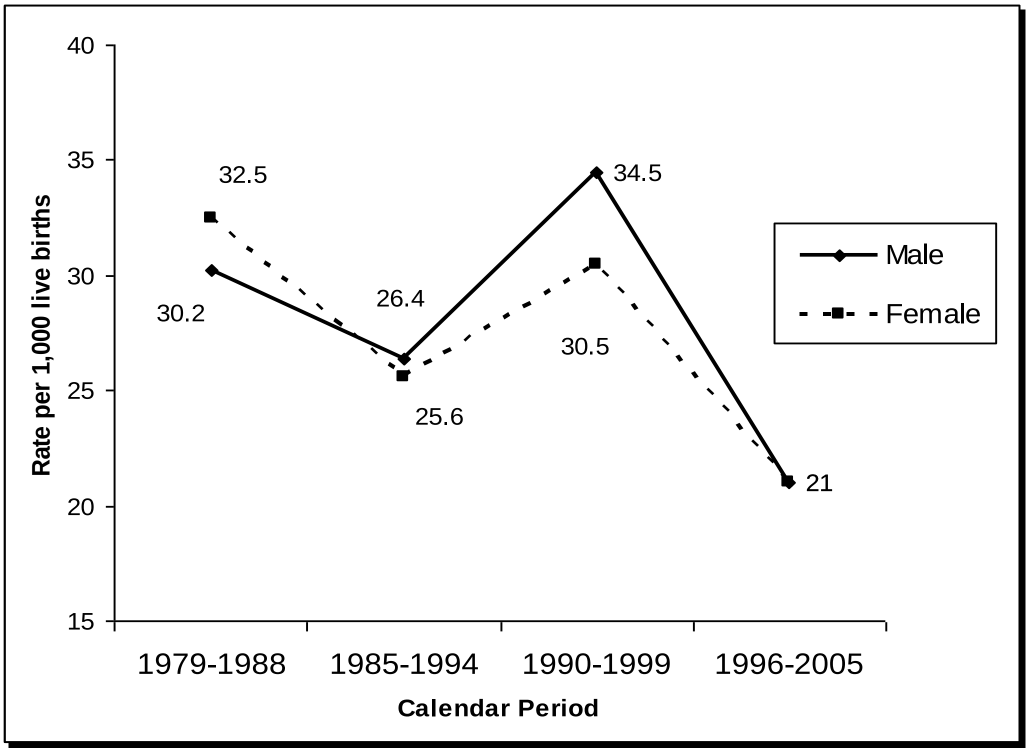
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro InternationalInc13,14,21

Figure 4.6: Trends in Infant Mortality by Sex of Child, for the Calendar Period 1979-1988 (ZDHS 1988), 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999) and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



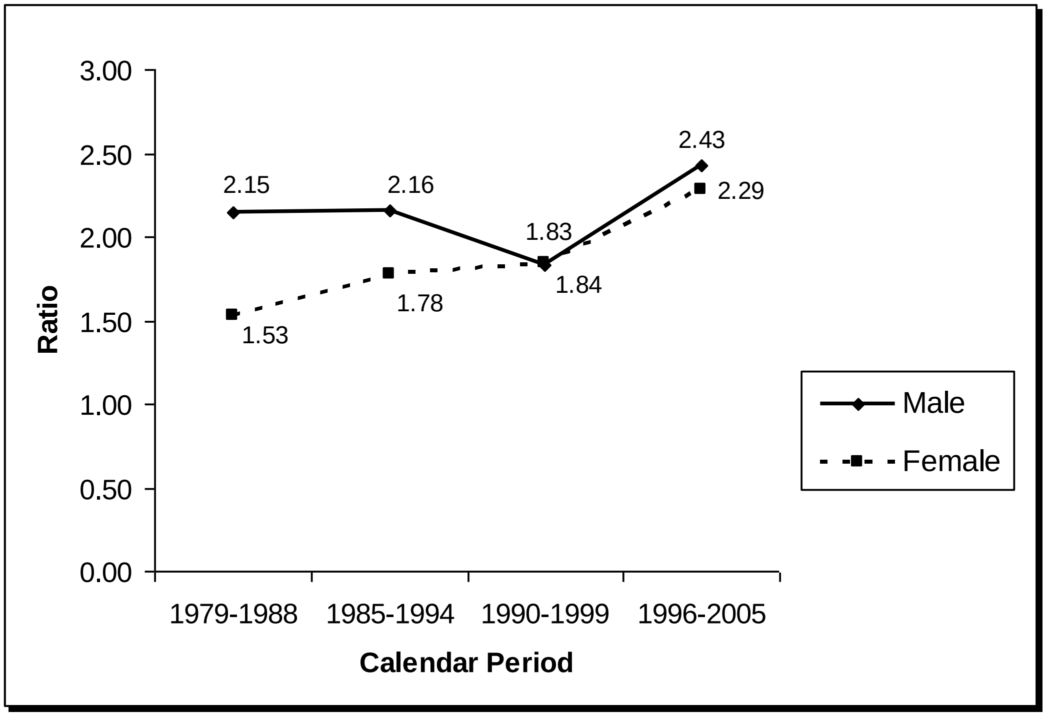
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro InternationalInc13,14,21,50

Figure 4.7: Trends in Child Mortality by Sex of Child, for the Calendar Period 1979-1988 (ZDHS 1988), 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999) and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



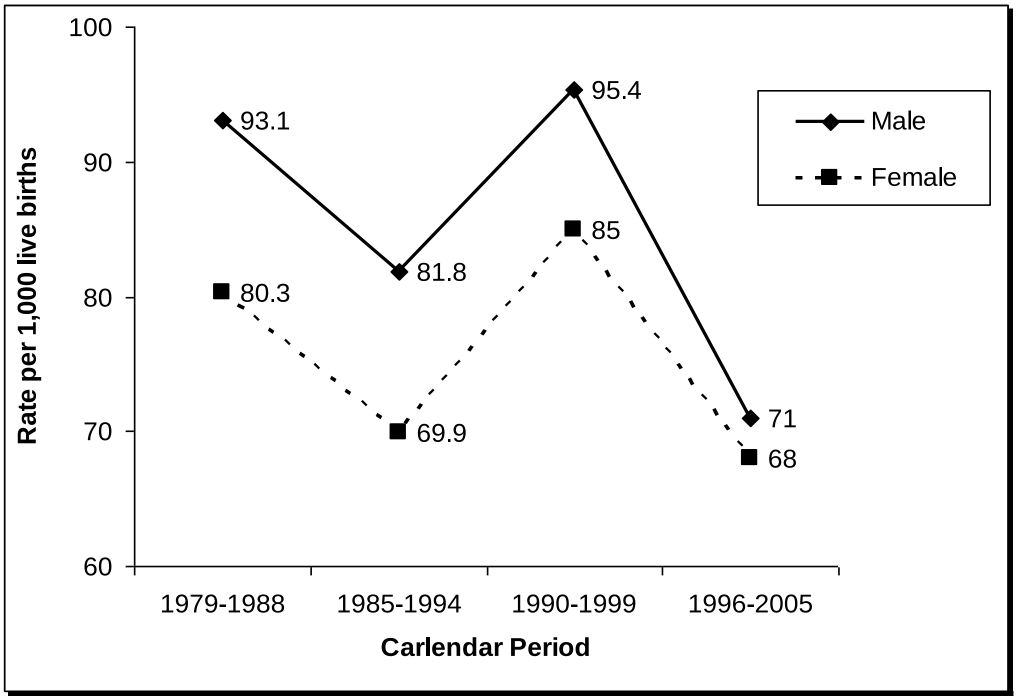
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro InternationalInc13,14,21,50

Figure 4.8: Trends in the Ratio of Infant Mortality to Child Mortality for the Calendar Period 1979-1988 (ZDHS 1988), 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999) and 1996-2005 ZDHS 2005-06), Direct Estimates, Zimbabwe



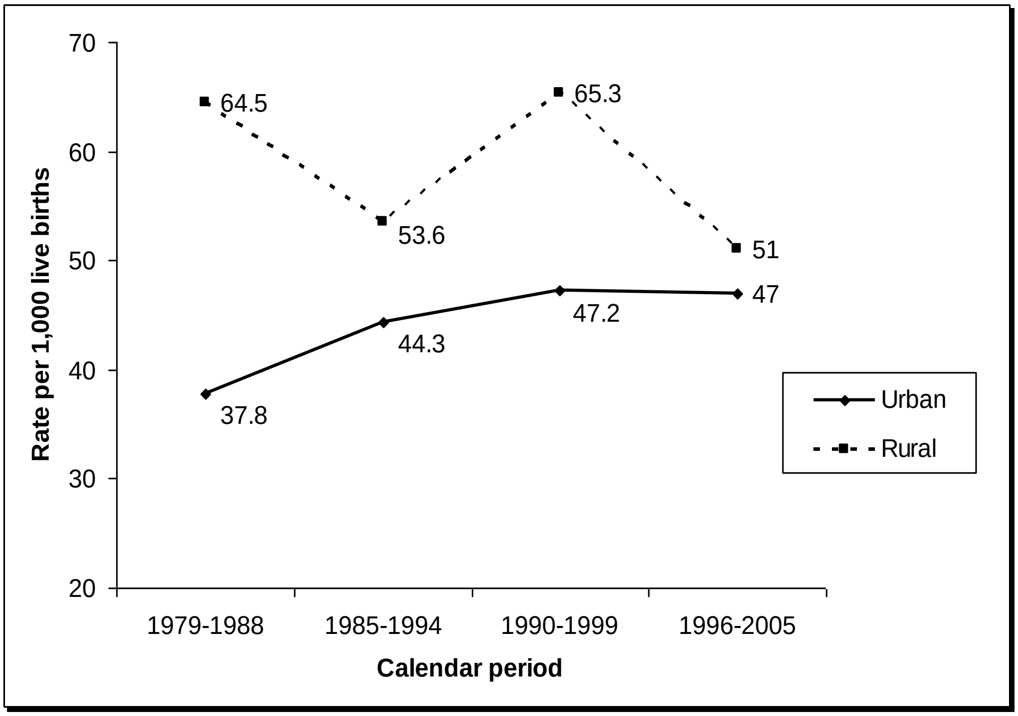
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro InternationalInc13,14,21,50

Figure 4.9: Trends in Under-five Mortality by Sex of Child, for the Calendar Period 1979-1988 (ZDHS 1988), 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999) and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



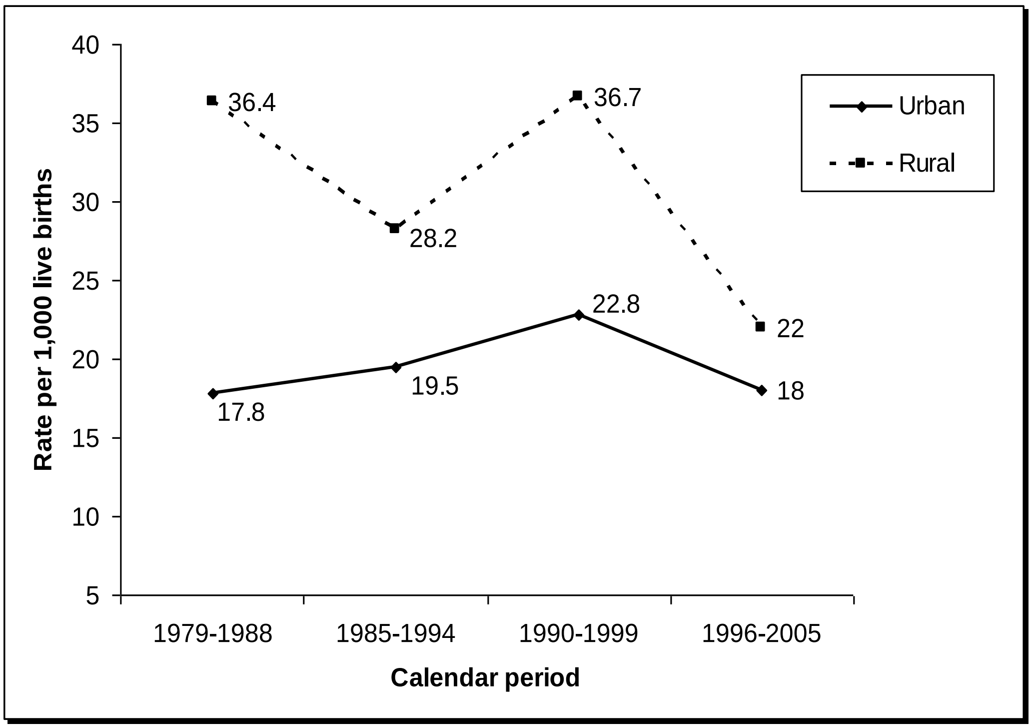
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro InternationalInc13,14,21,50

Figure 4.10: Trends in Infant Mortality by Rural and Urban Location, for the Calendar Period 1979-1988 (ZDHS 1988), 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999), and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



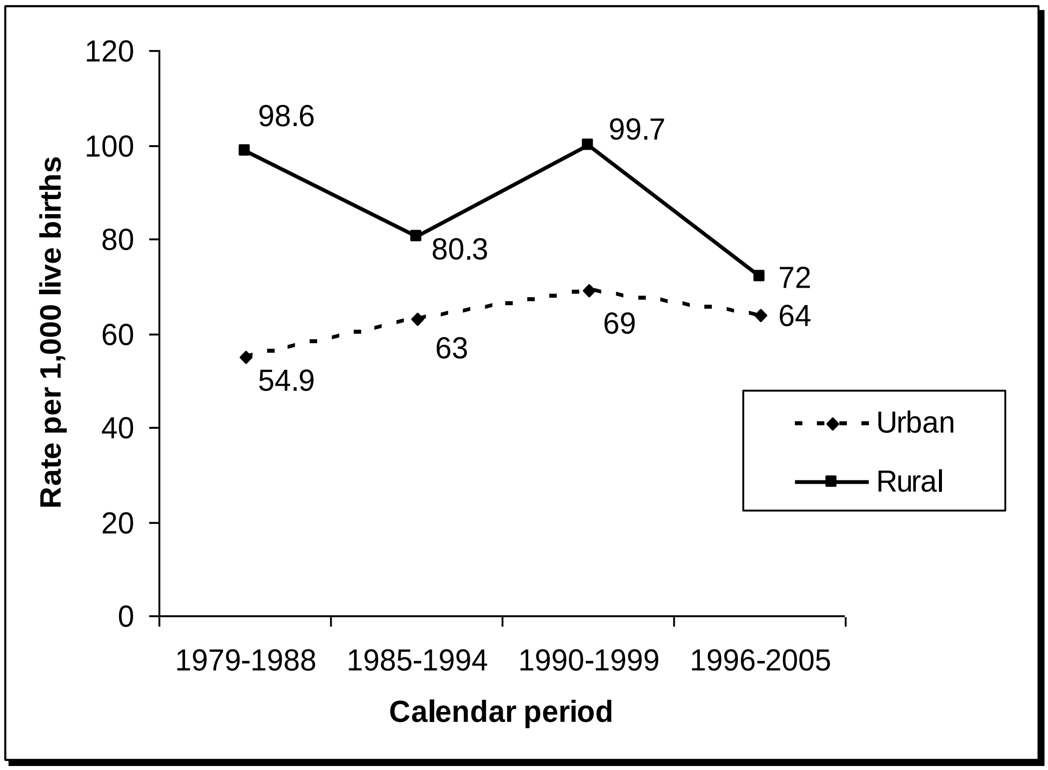
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro InternationalInc13,14,21,50

Figure 4.11: Trends in Child Mortality by Rural and Urban Location, for the Calendar Period 1979-1988 (ZDHS 1988), 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999), and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro InternationalInc13,14,21,50

Figure 4.12: Trends in Under-five Mortality by Rural and Urban Location, for the Calendar Period 1979-1988 (ZDHS 1988), 1985-1994 (ZDHS 1994), 1990-1999 (ZDHS 1999), and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe



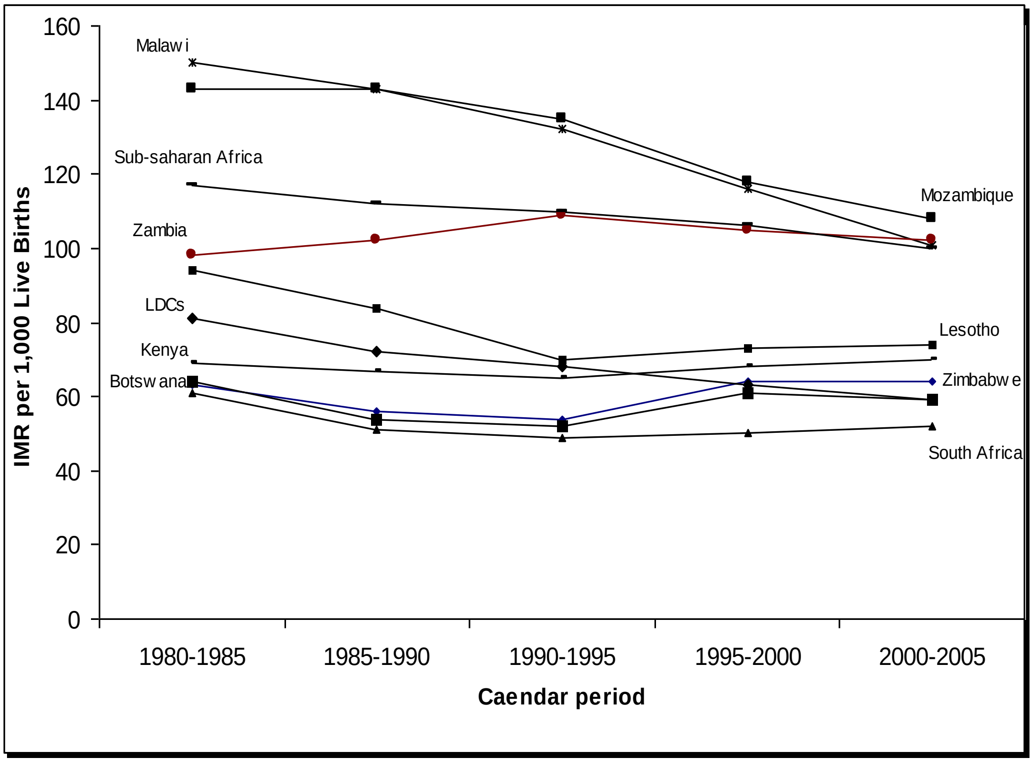
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro InternationalInc13,14,21,50

Table 4.3: Trends in Infant, Child and Under-five Mortality per 1,000 Live Births by Province, for the Calendar Period 1990-1999 (ZDHS 1999) and 1996-2005 (ZDHS 2005-06), Direct Estimates, Zimbabwe

Province	**1990-1999**			**1996-2005**		
	Infant mortality Rate	**Child Mortality Rate**	**Under-5 Mortality Rate**	**Infant Mortality Rate**	**Child Mortality Rate**	**Under-5 Mortality Rate**
Manicaland	76	54	126	71	32	100
Mashonaland Central	87	27	111	45	29	73
Mashonaland East	64	39	100	47	25	71
Mashonaland West	53	36	87	56	23	77
Matabeleland North	39	19	57	46	22	67
Matabeleland South	48	22	69	32	14	45
Midlands	70	30	98	53	13	65
Masvingo	47	23	69	42	17	58
Harare	45	27	71	46	20	65
Bulawayo	47	21	66	34	11	45

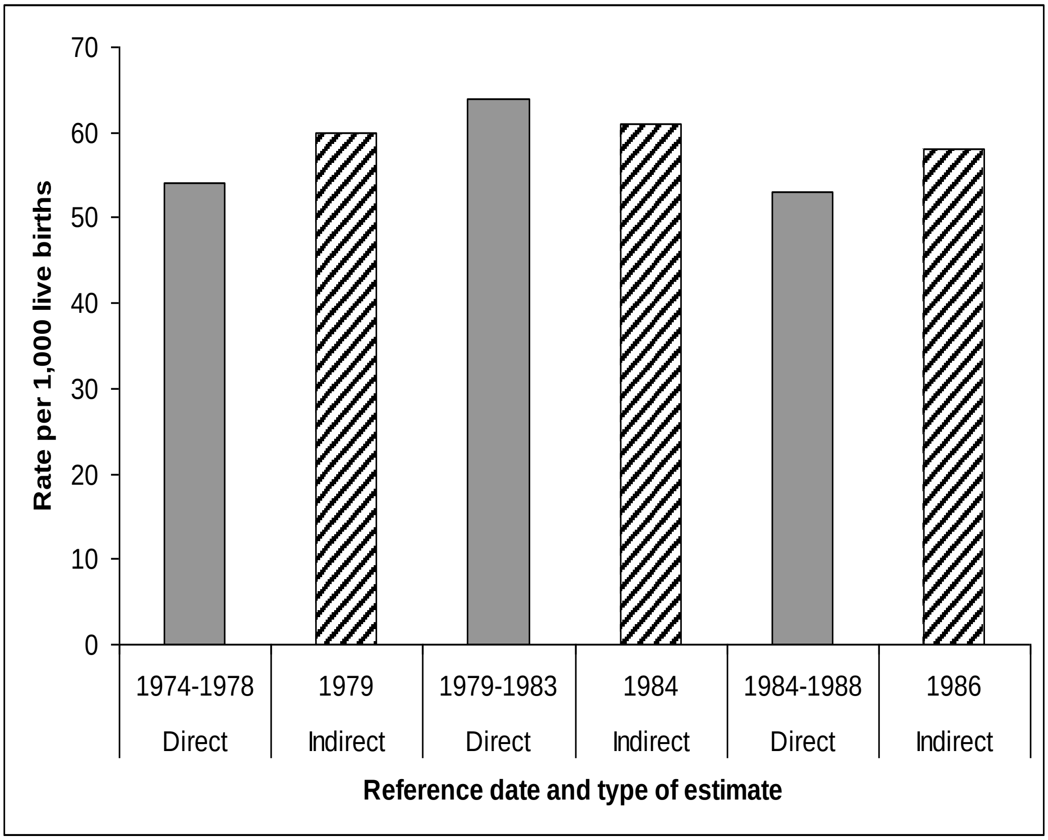
Source: Compilation from various published reports Zimbabwe Central Statistical Office/ Macro International Inc14,21

Figure 4.13: Comparison of Trends in Infant Mortality in Selected Neighbouring Countries, Sub-Saharan Africa, Less Developed Countries and Zimbabwe, 1980-1985 to 2000-2005



Source: Compilation from a published report United Nations67

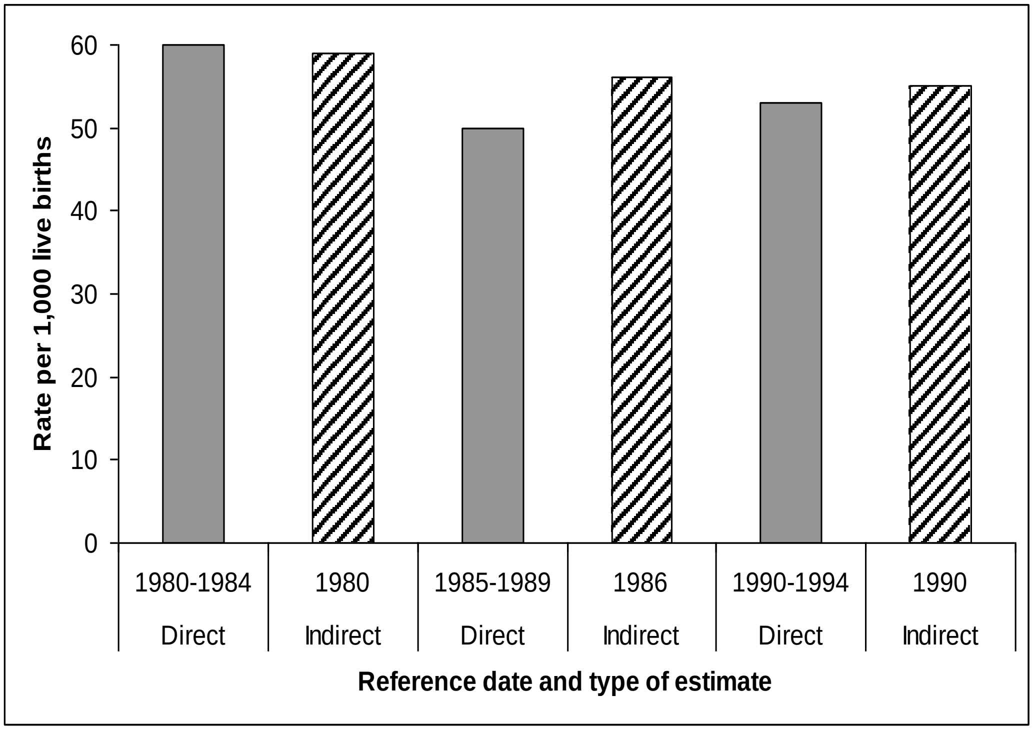
Figure 4.14: Direct and Indirect Infant Mortality Estimates, 1988 ZDHS, Zimbabwe



Source: Direct estimates: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc50

Indirect estimates: Output from MORTPAK

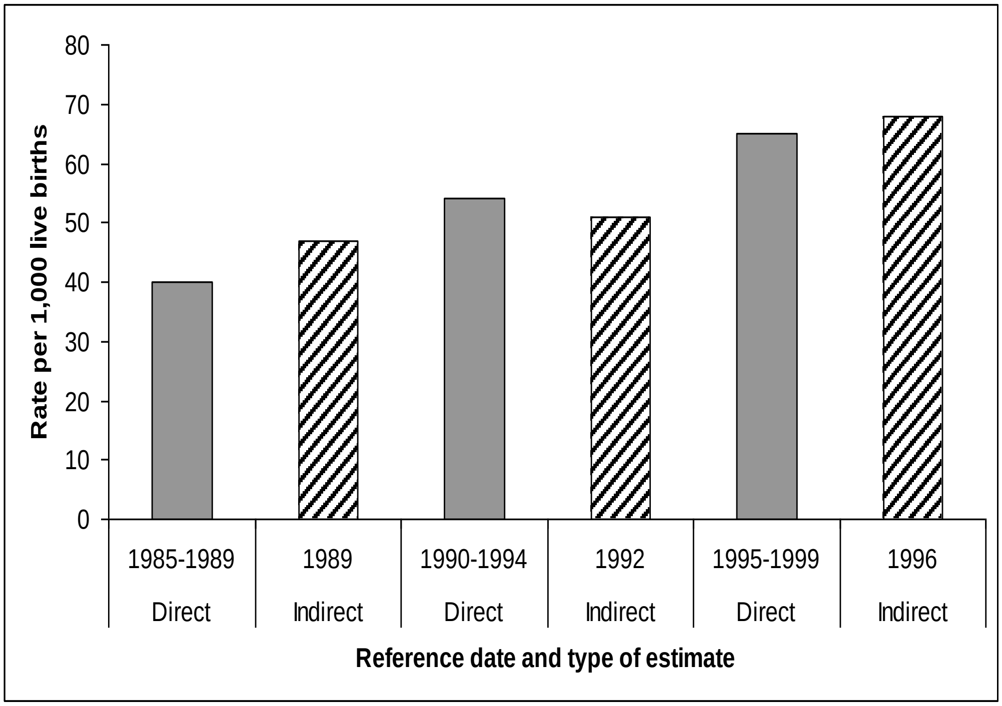
Figure 4.15: Direct and Indirect Infant Mortality Estimates, 1994 ZDHS, Zimbabwe



Source: Direct estimates: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc13

Indirect estimates: Output from MORTPAK

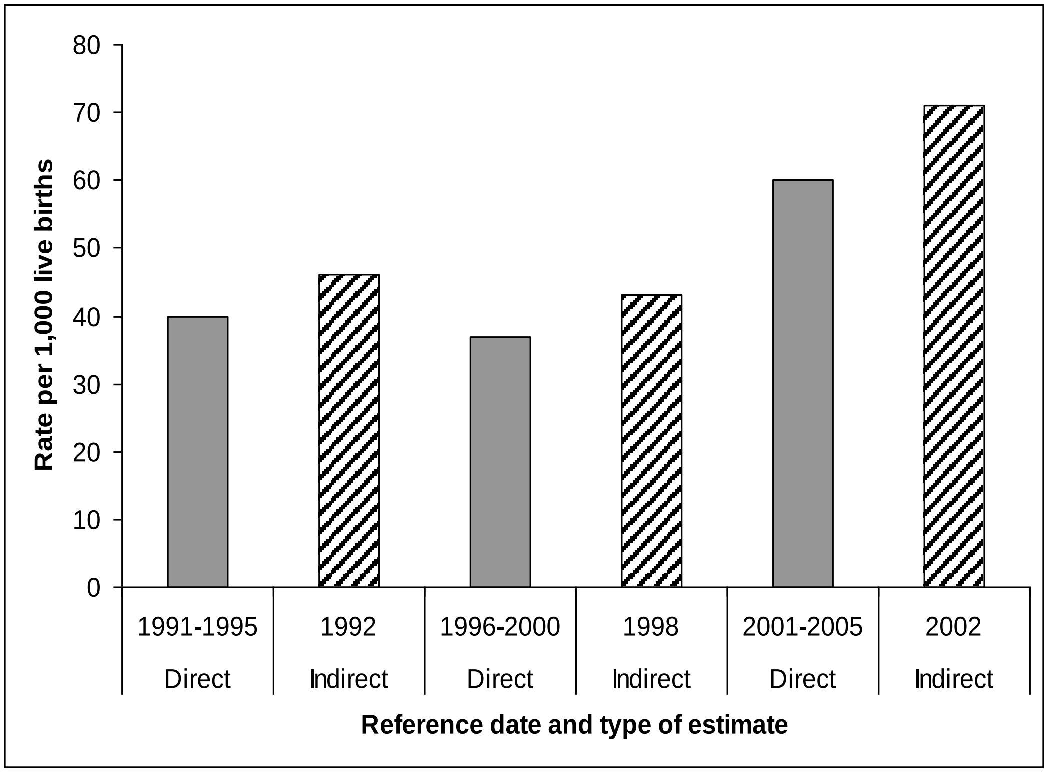
Figure 4.16: Direct and Indirect Infant Mortality Estimates, 1999 ZDHS, Zimbabwe



Source: Direct estimates: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc14

Indirect estimates: Output from MORTPAK

Figure 4.17: Direct and Indirect Infant Mortality Estimates, 2005-06 ZDHS, Zimbabwe



Source: Direct estimates: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc21

Indirect estimates: Output from MORTPAK

Table 4.4: Demographic and Health Survey 1988, Direct Estimates, Zimbabwe

Period	**Infant Mortality Rate** $_1q_0$	**Under-five Mortality Rate** $_5q_0$
1984-1988	53	75
1979-1983	64	104
1974-1978	54	92

Source: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc[50]

Table 4.5: Demographic and Health Survey 1988, Indirect Estimates, North Model, Zimbabwe

Age of Mother	Average Parity	Proportion of Children Dead	Reference Date	Infant Mortality Rate $_1q_0$	Under-five Mortality Rate $_5q_0$
20-24	1.300	0.069	1985.9	58	90
25-29	2.890	0.087	1984.1	61	96
30-34	4.350	0.083	1981.8	55	84
35-39	5.540	0.101	1979.3	60	94
40-44	6.400	0.111	1976.7	61	95
45-49	6.870	0.130	1973.8	63	99

Source: Output from MORTPAK

Table 4.6: Demographic and Health Survey 1994, Direct Estimates, Zimbabwe

Period	Infant Mortality Rate $_{1}q_{0}$	Under-five Mortality Rate $_{5}q_{0}$
1990-1994	53	77
1985-1989	50	75
1980-1984	60	101

Source: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc[13]

Table 4.7: Demographic and Health Survey 1994, Indirect Estimates, North Model, Zimbabwe

Age of Mother	**Average Parity**	**Proportion of Children Dead**	**Reference Date**	**Infant Mortality Rate** $_1q_0$	**Under-five Mortality Rate** $_5q_0$
20-24	1.10	0.082	1992.5	68	106
25-29	2.36	0.076	1990.7	55	83
30-34	3.89	0.085	1988.6	55	84
35-39	5.13	0.094	1986.2	56	85
40-44	6.08	0.104	1983.5	57	86
45-49	6.57	0.122	1980.6	59	91

Source: Output from MORTPAK

Table 4.8: Demographic and Health Survey 1999, Direct Estimates, Zimbabwe

Period	**Infant Mortality Rate** $_1q_0$	**Under-five Mortality Rate** $_5q_0$
1995-1999	65	102
1990-1994	54	77
1985-1989	40	59

Source: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc[14]

Table 4.9: Demographic and Health Survey 1999, Indirect Estimates, North Model, Zimbabwe

Age of Mother	**Average Parity**	**Proportion of Children Dead**	**Reference Date**	**Infant Mortality Rate** $_1q_0$	**Under-five Mortality Rate** $_5q_0$
20-24	1.060	0.085	1996.8	68	109
25-29	2.130	0.099	1994.8	67	108
30-34	3.090	0.078	1992.4	51	77
35-39	4.520	0.075	1989.8	47	70
40-44	5.540	0.096	1987.0	53	81
45-49	6.290	0.119	1984.1	58	90

Source: Output from MORTPAK

Table 4.10: Demographic and Health Survey 2005-06, Direct Estimates, Zimbabwe

Period	Infant Mortality Rate $_1q_0$	Under-five Mortality Rate $_5q_0$
2001-2005	60	82
1996-2000	37	54
1991-1995	40	58

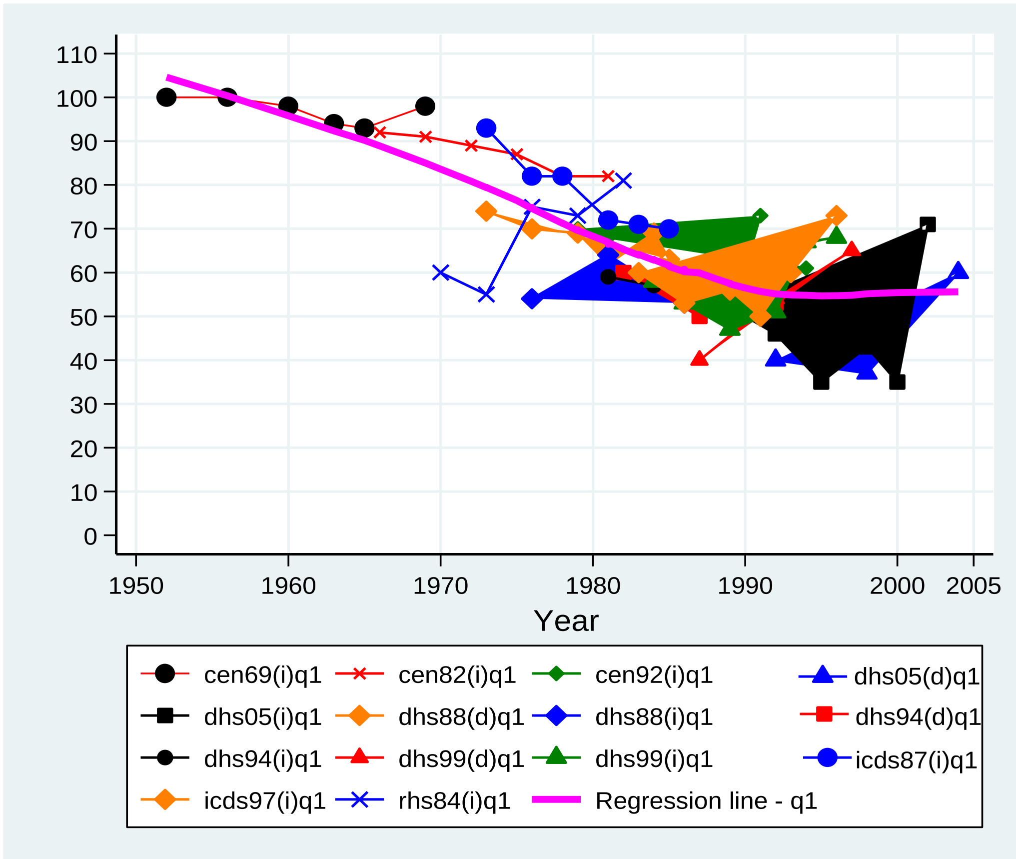
Source: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc21

Table 4.11: Demographic and Health Survey 2005-06, Indirect Estimates, North Model, Zimbabwe

Age of Mother	Average Parity	Proportion of Children Dead	Reference Date	Infant Mortality Rate $_1q_0$	Under-five Mortality Rate $_5q_0$
20-24	1.100	0.091	2002.7	71	115
25-29	2.100	0.048	2000.6	35	49
30-34	3.100	0.065	1998.2	43	63
35-39	3.700	0.054	1995.4	35	49
40-44	4.900	0.082	1992.7	46	68
45-49	5.700	0.105	1989.8	52	79

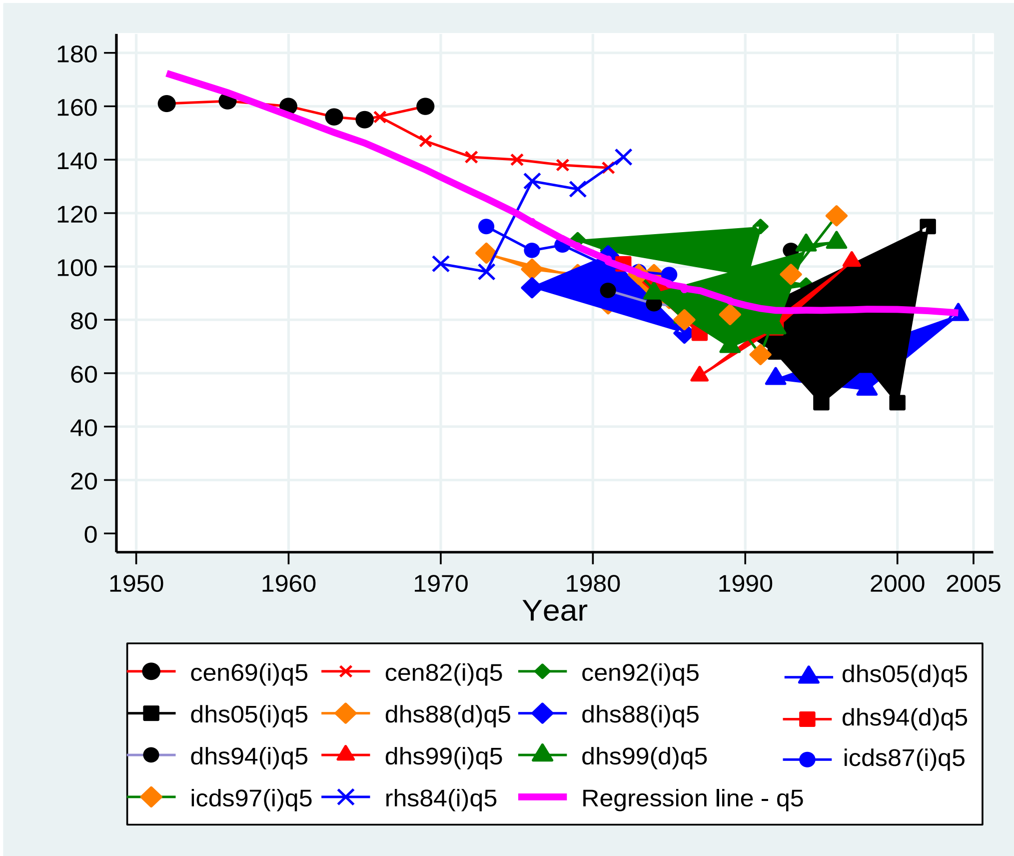
Source: Output from MORTPAK

Figure 4.18: Infant Mortality Data and Estimated Trend, (Direct and Indirect Estimates) 1950-2005, Zimbabwe



Source: Output from Stata based on published mortality rates obtained from various reports.

Figure 4.19: Under-5 Mortality Data and Estimated Trend, 1950-2005 (Direct and Indirect Estimates), Zimbabwe



Source: Output from Stata based on published mortality rates obtained from various reports.

Table 4.12: Age-specific Mortality Rates for Women aged 15-49 years based on the Survivorship of Sisters of Survey Respondents, Zimbabwe

Age	**1996-1999**	**2000-2005**
15-19	2.82	2.69
20-24	6.01	5.47
25-29	11.17	12.25
30-34	14.72	20.42
35-39	15.73	25.04
40-44	12.85	25.23
45-49	13.16	25.48
15-49	**9.14**	**12.66**

Note: Rates are age-standardised and are measured per 1,000 women in each age group. The rates for the 1999 ZDHS refer to the period 0-4 years before the survey and for the 2005-06 ZDHS to the period 0-6 years before the survey.

Source 1: Compilation from published report Zimbabwe Central Statistical Office/ Macro International Inc14,21

Table 4.13: HIV Prevalence Rates for Adults aged 15-44 years by Rural and Urban Area, 1996 - 2006, Zimbabwe

Year	**Rural**	**Urban**
1996	31.5	35.6
1997	29.9	33.7
1998	28.3	31.8
1999	26.7	29.9
2000	28.1	30.2
2001	20.9	25.3
2002	22.8	24.5
2003	18.8	20.1
2004	16.8	18.3
2005	17.2	18.6
2006	17.6	18.9

Source: 1996 -1999 & 2005 HIV prevalence rates are from author calculations based on estimates from Mahomva A, Greby S, Dube S, et al.68

2000 - 2004 HIV prevalence rates Mahomva A, Greby S, Dube S, et al.68

2006 HIV prevalence rates Central Statistical Office/ DHS Macro International Inc21