

CHAPTER 5

RESULTS OF THE BIVARIATE ANALYSIS

5.1 Introduction

Chapter Five presents results of the bivariate Cox proportional hazards models depicting the impact of maternal, socioeconomic, environmental contamination and personal illness control variables on infant and child mortality. This chapter also presents crude mortality rates. These are crude unadjusted mortality rates which have not been calculated through the life table approach. The results on the multivariate hazards models are presented and analysed in Chapter 6.

5.2 Description of the Covariates

5.2.1 *Maternal Variables*

The maternal variables included in this analysis are presented in Table 5.1 and include birth order, preceding birth interval, mother's age at birth, sex of child, type of birth and perceived birth size as these have been demonstrated to be strongly related to infant and child survival.^{33,53,58} The Maternal and Child Health care programme in Zimbabwe considers a woman to be at high risk of pregnancy complications if she has (among other factors) a preceding birth interval of less than 24 months and/ or has had five or more births. The two related variables: birth order and preceding birth interval share the category of first births so this creates a problem in that the design matrix would be similar. Specifically the problem is that two variables cannot share a similar category. Combining birth order and the preceding birth interval into a single variable avoids this problem.³³ Sex of the child was included as female infants generally experience lower mortality than males, unless there are strong sex-of-child preferences in favour of males, in which case the position may be reversed. This variable was

included in the group of maternal variables because it has strong links with many of the other maternal variables.

5.2.2 Socioeconomic Variables

Several background measures of socioeconomic status are included in the analysis. These variables are presented in Table 5.2. The variables selected were rural-urban residence, maternal and partner's education, wealth status and province of residence. The inclusion of rural-urban residence and province variables enables the study of geographical effects on infant and child mortality. The Zimbabwe Demographic and Health Surveys have repeatedly shown infant and child mortality variations by province and rural-urban residence in Zimbabwe. Infant and childhood mortality has always been lower in urban than in rural areas of Zimbabwe.^{13,14,21,50}

Maternal education not only acts as an indicator of socioeconomic status but is also thought to have a direct effect by influencing maternal behaviour.^{24,43} Partner's education may act in a similar way and may be more influential in societies where female education is universally low and where mothers have little or no autonomy.⁴³ It is further expected that children born to mothers with a low wealth status experience lower survival rates than those born to mothers of middle or high wealth status.

5.2.3 Environmental Contamination Variables

The variables included under environmental contamination are presented in Table 5.3 and include the availability in the household of piped drinking water and flush toilets. The availability of these amenities has a direct effect on infant and child mortality through influencing exposure to water-borne diseases such as cholera, dysentery and blastocystosis (chronic diarrhoea).^{69,56}

5.2.4 Personal Illness Control Variables

Variables included in this category are antenatal visits and place of birth of the child. These variables are presented in Table 5.4. We do anticipate a positive relationship between antenatal visits and child survival. The Ministry of Health in Zimbabwe encourages mothers to attend antenatal care as this has direct benefits for the survival of their children. With respect to place of birth, various studies have shown that births that occur in a clinic or hospital have greater chances of survival than those that occur at home.^{33,38,58} The children may get better treatment in hospitals during and after delivery, but they are also often high-risk births to begin with. The advantage of treatment in hospitals outweighs that of the selection bias of high risk cases. Therefore we expect births occurring at clinics or hospitals to experience higher survival prospects than those that occur at home.

5.3 Bivariate Proportional Hazards Regression Models

5.3.1 Impact of Maternal Covariates on Infant and Child Mortality

Table 5.5 presents data on the impact of maternal covariates on infant and child mortality. The covariates analysed are birth order and preceding birth interval, mother's age at birth, sex of child, weight of child at birth and type of birth. Relative to children of order 2-5 and long birth interval, children of order 6+ and short birth interval are 2.56 times more likely to die in infancy ($p < 0.001$). First births are associated with a 14 percent more chance of dying in infancy relative to births of order 2-5 and long birth interval. Children of birth order 6+ and long birth interval have a 25 percent higher probability of dying in infancy relative to children of order 2-5 and long birth interval. The impact of birth order and preceding birth interval on child mortality is smaller than that on infant mortality. The relative risk of dying in child age for births of order 6+ and short birth interval is 1.11 times more relative to births of order 2-5 and long birth interval. Children of birth order 2-5 and short preceding

birth interval are 1.38 times more likely to die in child age than those of birth order 2-5 and long birth interval. These findings support the hypothesis that birth spacing enhances infant and child survival but it should be added that the differences shown above often did not reach statistical significance.

There is a U-shaped relationship between maternal age and infant mortality. Children born to younger women (below 20 years of age) experience higher mortality in the first year of life relative to those born to women aged 30-39 years (RR = 1.12). There is an even more elevated mortality risk of 1.18 to infants born to older mothers, which is those aged 40-49 years, relative to mothers aged 30-39 years. However, there is hardly any relationship between maternal age and child mortality and the risk ratios are also not statistically significant.

We expected a U-shaped relationship between birth order and mortality and between maternal age and mortality. We find this more or less the case in infancy but not in childhood. We also observe in Table 5.5 very low child mortality among first births (RR = 0.70) relative to children of birth order 2-5 and long birth interval and very low mortality of children born to women aged 40-49 years (RR = 0.32) relative to those born to women aged 30-39 years. These last two results are deviations from the expected pattern. These deviations are only observed in the 2005-06 ZDHS survey and not in the other three rounds of the ZDHS surveys.

We also found that female children experience lower mortality risks of dying in infancy than their male counterparts. The risk ratio of dying in infancy for female children is 0.97. We further observe that there is hardly any relationship between sex of child and child mortality.

Multiple births have an elevated risk of death during infancy of a factor of 2.07 ($p < 0.001$) relative to singleton births. The impact of the type of birth during the childhood period is diminished and non-significant as compared to the infancy period.

Children perceived to be “average or larger” at birth by their mothers at the time of the survey experience significantly lower mortality relative to those perceived to be “small or very small” at birth. The relative risk of a birth perceived to be “average or larger” is 0.63 ($p < 0.001$) relative to a birth perceived to be “small or very small”.

5.3.2 Impact of Socioeconomic Covariates on Infant and Child Mortality

In this section we describe the impact of residence, maternal education, paternal education, wealth status and province on infant and child mortality. This data is presented in Table 5.6. The effect of living in a rural area increases the risks of infant and child mortality in Zimbabwe by a factor of 8 percent and 33 percent, respectively. The impact of type of residence is larger on child mortality than on infant mortality.

Maternal education increases the survival prospects of children. However, this could only be shown for child mortality. Children born to mothers with secondary education or more are 0.59 times less likely to die in child age than children born to mothers with no education but this difference did not reach statistical significance.

Paternal education improves child survival prospects. But once more, this is clearer in the childhood period than in infancy. Children born to fathers with secondary education or more have a 0.94 relative risk of dying in infancy and a 0.64 relative risk of dying in child age than those born to fathers who with no education.

Wealth status has a higher impact in childhood than during the infancy period. Children whose mothers were classified as “rich” are 0.83 less likely to die in child age than children born to mothers of “poor” wealth index. That those children whose mothers were classified as “middle” are associated with higher infant and child mortality is unexpected. This differential could be due to use of child care practices.

Provincial differentials on infant and child mortality are also present in Zimbabwe. The impact of province of residence is higher on child mortality than on infant mortality. Living in Matabeleland North province significantly reduces the risks of infant death by 44 percent ($p < 0.01$) in relation to living in Manicaland province. Living in Matabeleland South province decreases the risks of child death by a factor of 65 percent ($p < 0.05$) relative to living in Manicaland province. Likewise, living in Midlands province decreases the risks of child death by a factor of 54 percent ($p < 0.05$) relative to living in Manicaland province. Bulawayo is associated with higher child survival prospects as compared to Harare. Living in Bulawayo significantly reduces the risks of infant death ($RR = 0.53$) and child death ($RR = 0.38$) relative to living in Manicaland province ($p < 0.05$). A similar pattern is observed for Harare province. The increase in child survival is enhanced during the childhood period as compared to the infancy period, but is not statistically significant.

5.3.3 Impact of Environmental Covariates on Infant and Child Mortality

Table 5.7 presents data on the impact of environmental variables on infant and child mortality. Similar to socioeconomic variables, the impact of environmental contamination variables is larger during the childhood age than during the infancy period.

The effects of piped drinking water on infant and child mortality are in the expected direction, although they are not significant. Relative to children born in households without piped drinking water, the relative risks of infant and child death for children born to households with piped drinking water are reduced by a factor of 5 percent and 10 percent, respectively. The presence of a flush toilet in the household reduces infant mortality by 12 percent relative to households without flush toilets. It decreases the odds of child mortality by 34 percent compared to households without flush toilets.

5.3.4 Impact of Personal Illness Control Covariates on Infant and Child Mortality

Finally, Table 5.8 presents data on the impact of personal illness control variables on infant and child mortality. The two variables analysed in this category are antenatal care and place of delivery of the child.

Information on antenatal care is of great value in identifying subgroups of women who do not utilise such services and is useful in planning improvements in the services. The data in Table 5.8 indicates that antenatal care significantly elevates infant survival. Children whose mothers undertook at least one antenatal care visit are 0.59 times less likely to die in infancy than those whose mothers did not use any antenatal care ($p < 0.05$).

Proper medical attention and hygienic conditions during delivery can reduce the risks of complications and infections that cause morbidity and mortality to either the mother or the baby. Table 5.8 also presents the relative risks associated with place of delivery of the child. Giving birth at a health facility reduces the likelihood of infant and child mortality by factors of 13 percent and 30 percent ($p < 0.05$), respectively.

5.4 Comparison of 2005-06 ZDHS with Two Other ZDHS surveys

In this section we compare the results of the impact of birth order, maternal age and education from the 2005-06 ZDHS survey with results from the 1994 and 1999 surveys. These results are presented in Table 5.9. We do this in order to show the relative change in the impact of these variables on under-five mortality from the period 1990-1994 to the period 2001-2005. The relationship between birth order and under-five mortality is U-shaped indicating higher mortality for first births and higher order births during 1990-1994 and 1995-1999. During 2001-2005 the relationship between birth order and under-five mortality is linear indicating the diminished impact of birth order on under-five mortality. We note that the changes in the relative risks of dying in under-five age are not substantial between 1990-1994 and 2001-2005.

The relationships between maternal age and under-five mortality during 1990-1994 and 1995-1999 are U-shaped. However the U-shaped relationship diminishes and is almost flattened in the 2005-06 survey. For instance, in the 1994 survey the children born to mothers aged less than 20 years experienced 34 percent higher mortality relative to children born to women aged 30-39 years. In the 1999 survey they experienced 21 percent higher mortality, and in the 2005-06 survey the effect of maternal age on under-five mortality is no longer discernible. A similar observation is obtained for the mortality situation of children born to older mothers, that is, those aged 40-49 years. Children born to mothers aged 40-49 years experienced 79 percent higher mortality in the 1994 survey, 61 percent higher mortality in the 1999 survey and 7 percent higher mortality in the 2005-06 survey relative to children born to mothers aged 30-39 years.

Further evidence of the diminishing impact of independent variables on under-five mortality is shown by the changes in the impact of maternal

education on under-five mortality from the 1994 survey to the 2005-06 survey. In the 1994 survey, children born to mothers who had completed secondary and above education experienced 39 percent lower mortality, in the 1999 survey they experienced 57 percent lower mortality and in the 2005-06 survey they experienced 9 percent lower mortality relative to children born to mothers with no education.

5.5 Impact of HIV/AIDS on Infant and Child Mortality

In this section the results of the impact of HIV/AIDS on infant and child mortality are presented. This is done by studying the results from the bivariate Cox regression model that consists of HIV prevalence as the independent variable and mortality as the dependent variable. The results are displayed in Table 5.10. These results indicate that a unit increase in HIV prevalence in Zimbabwe significantly elevates the risk of infant and child death by 10 percent and 50 percent, respectively ($p < 0.001$). The results show an association between HIV/AIDS and mortality but not a causal relationship. These results suggest, however, that it is likely that HIV/AIDS has in Zimbabwe influenced the rate of infant and child death directly or indirectly. The association between HIV/AIDS and infant and child mortality in the presence of maternal, socioeconomic and environmental contamination variables in the multivariate analysis will be explored further in Chapter 6.

5.6 Concluding Remarks

The results presented in this chapter deal with the impact of the relationships between maternal, socioeconomic, environmental contamination, personal illness covariates and HIV/AIDS on infant and child mortality. It has been observed that the endogenous or maternal variables are important during the infancy period while exogenous or socioeconomic and environmental contamination variables are central during the childhood stage. Relationships reached statistical significance

for a few of the variables, but not for many others. Relationships of independent variables with dependent variables in the 2005-06 ZDHS survey are often smaller than in the two previous ZDHS surveys, namely the 1994 and the 1999 surveys.

For example, the 1994 and 1999 surveys show a U-shaped relationship between birth order and under-five mortality. But in the 2005-06 survey this U-shaped relationship is flattened. This is a deviation from the expected pattern. The 1994 and 1999 ZDHS surveys also show a larger impact of maternal education on under-five mortality than in the 2005-06 survey. The impact of the education of the mother on under-five mortality completely disappears in 2005-06 in Zimbabwe. These results are rather unexpected and are not in line with observations from other surveys conducted in neighbouring countries such as South Africa.

It could be that these unexpected results are explained by the hypothesis mentioned in Chapter 4 that certain high risk mothers and subsequently their high risk births were missing in the 2005-06 ZDHS survey having died between the time of the 1999 and 2005-06 surveys. It is therefore these “missing mothers” which could explain these observed, unexpected results dealing with the lack of expected relationships between the independent variables and infant and child mortality in the 2005-06 ZDHS survey.

For instance, it could be that there is a group of HIV positive women who are older (30 years and older) and who died and who had children under the age of five years with higher than average mortality. This group could be missing in the 2005-06 ZDHS survey and could not be interviewed. This means that the observed infant and child mortality rates among women 30 years and older are actually too low. These

rates would have been higher if these missing women could have been interviewed.

An argument against this hypothesis is that there is no discernible change in the distribution of women interviewed in the 2005-06 ZDHS in comparison with the previous surveys (see Figure 3.2). It was also found that HIV/AIDS significantly elevates infant and child mortality in Zimbabwe. However, it must be noted that these results suggest a causal relationship; such a causal relationship was not proven. This relationship will be explored further in the multivariate analysis presented in Chapter 6.

The findings presented in this chapter should shed more light on the mortality situation of under-five children in Zimbabwe. The findings are therefore important for appropriate child health targeting and programming that is aimed at improving the survival prospects of under-five children. Chapter 6 presents the results from fitting the multivariate Cox proportional hazard models on infant and child mortality data.

Table 5.1: Absolute and Percent Distribution of Births and Under-five Deaths for Maternal Covariates, 1996-2005, (2005-06 ZDHS)

Maternal Covariate	Number of Live Births	%	Number of Deaths	%	Rate per 1,000 Live Births¹
<i>Birth order & preceding birth interval</i>					
First births	3,046	32.1	185	30.6	60.7
2-5 and short	239	2.5	43	7.1	179.9
2-5 and medium	333	3.5	28	4.6	84.1
2-5 and long	4,900	51.6	271	44.9	55.3
6+ and short	61	0.6	15	2.4	245.9
6+ and medium	74	0.8	12	2.0	162.2
6+ and long	836	8.8	51	8.4	61.0
<i>Maternal age</i>					
<20 years	2,018	21.3	131	21.7	64.9
20-29 years	5,266	55.5	318	52.8	60.4
30-39 years	1,953	20.6	135	22.4	69.1
40-49 years	254	2.7	19	3.1	74.8
<i>Sex of child</i>					
Female	4,619	48.7	286	47.4	61.9
Male	4,872	51.3	317	52.6	65.1
<i>Type of birth</i>					
Multiple	277	2.9	51	8.5	184.1
Singleton	9,213	97.1	552	91.5	59.9
<i>Birth size²</i>					
Small/ very small	759	14.7	71	20.5	93.5
Average or larger	4,405	85.3	277	79.5	62.9
<i>Total</i>	<i>5,164</i>	<i>100.0</i>	<i>348</i>	<i>100.0</i>	<i>67.4</i>
Total	9,491	100.0	603	100.0	63.5

¹ These are crude unadjusted mortality rates and they are not calculated with the life table method.

² The 2005-06 ZDHS survey collected information on birth size for under-five children in the period five years before the survey. The total number of under-five births was 5,474. The difference between 5,474 and 5,164 is due to missing values.

Table 5.2: Absolute and Percent Distribution of Births and Under-five Deaths for Socioeconomic Covariates, 1996-2005, (2005-06 ZDHS)

Socioeconomic Covariate	Number of Live Births	%	Number of Deaths	%	Rate per 1,000 Live Births
<i>Residence</i>					
Rural	6,720	70.8	440	72.9	65.5
Urban	2,770	29.2	163	27.1	58.8
<i>Maternal education</i>					
No education	500	5.3	29	4.8	58.0
Primary	3,689	38.9	247	40.9	67.0
Secondary and higher	5,301	55.9	328	54.3	61.9
<i>Paternal education</i>					
No education	798	8.4	60	10.0	75.2
Primary	2,754	29.0	168	27.9	61.0
Secondary and higher	5,938	62.6	374	62.1	63.0
<i>Wealth status</i>					
Poor	4,292	45.2	285	47.3	66.4
Medium	1,651	17.4	110	18.2	66.6
Rich	3,547	37.4	208	34.5	58.6
<i>Province</i>					
Manicaland	1,185	12.5	114	18.8	96.2
Mashonaland Central	1,018	10.7	62	10.3	60.9
Mashonaland East	766	8.1	50	8.2	65.3
Mashonaland West	977	10.3	67	11.1	68.6
Matabeleland North	612	6.4	37	6.1	60.5
Matabeleland South	452	4.8	18	3.0	39.8
Midlands	1,384	14.6	85	14.0	61.4
Masvingo	1,416	14.9	78	12.9	55.1
Harare	1,211	12.8	73	12.1	60.3
Bulawayo	470	5.0	21	3.4	44.7
Total	9,491	100.0	603	100.0	63.6

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

Table 5.3: Absolute and Percent Distribution of Births and Under-five Deaths for Environmental Covariates, 1996-2005, (2005-06 ZDHS)

Environmental Contamination Covariate	Number of births	%	Number of deaths	%	Rate per 1,000 Live Births
<i>Piped drinking water</i>					
Yes	3,182	33.5	194	32.1	61.0
No	6,309	66.5	409	67.9	64.8
<i>Flush toilet</i>					
Yes	2,689	28.3	155	25.7	57.6
No	6,801	71.7	448	74.3	65.9
Total	9,491	100.0	603	100.0	63.5

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

Table 5.4: Absolute and Percent Distribution of Births and Under-five Deaths for Personal Illness Control Covariates, 2001-2005, (2005-06 ZDHS)

Personal Illness Control Covariate ¹	Number of births	%	Number of deaths	%	Rate per 1,000 Live Births
<i>Antenatal visits</i>					
None	206	5.1	19	9.5	92.2
At least one visit	3,846	94.9	179	90.5	46.5
<i>Total</i>	<i>4,052</i>	<i>100.0</i>	<i>198</i>	<i>100.0</i>	<i>48.9</i>
<i>Place of delivery</i>					
Home	1,627	31.4	135	38.7	83.0
Hospital/ clinic	3,551	68.6	214	61.3	60.3
<i>Total</i>	<i>5,178</i>	<i>100.0</i>	<i>349</i>	<i>100.0</i>	<i>67.4</i>
Total	5,474	100.0	371	100.0	67.8

¹ The 2005-06 ZDHS survey collected information on antenatal visits and place of delivery for under-five children born in the period five years before the survey. The total number of under-five births was 5,474.

The difference between 5,474 and the totals for antenatal visits and place of delivery is due to missing values. There were 371 deaths to under-five children born in the period five years before the 2005-06 ZDHS survey.

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

Table 5.5: Impact of Maternal Variables on Infant and Child Mortality, Bivariate Analysis, 1996-2005, (2005-06 ZDHS)

Maternal Covariate	Infant Mortality		Child Mortality	
	Relative Risk	Confidence Interval	Relative Risk	Confidence Interval
<i>Birth order and preceding birth interval</i>				
First births	1.143	0.925-1.412	0.700	0.472-1.038
2-5 and short	1.409	0.994-1.996	1.384	0.562-3.412
2-5 and medium	1.474	0.957-2.271	0.857	0.348-2.113
2-5 and long	1.000	-----	1.000	-----
6+ and short	2.561***	1.490-4.403	1.113	0.155-7.995
6+ and medium	1.003	0.530-1.897	0.672	0.094-4.829
6+ and long	1.246	0.910-1.706	1.024	0.591-1.773
<i>Maternal age</i>				
<20 years	1.120	0.849-1.477	0.893	0.562-1.419
20-29 years	1.032	0.822-1.295	0.748	0.505-1.107
30-39 years	1.000	-----	1.000	-----
40-49 years	1.181	0.724-1.926	0.318	0.077-1.320
<i>Sex of Child</i>				
Female	0.973	0.815-1.163	1.010	0.731-1.395
Male	1.000	-----	1.000	-----
<i>Type of birth</i>				
Multiple	2.068***	1.557-2.748	1.501	0.663-3.399
Singleton	1.000	-----	1.000	-----
<i>Birth size¹</i>				
Small/very small	1.000	-----	1.000	-----
Average or larger	0.630***	0.476-0.834	0.821	0.440-1.533

* $p < 0.05$, ** $p < 0.01$, *** $P < 0.001$

¹ Refers to the five-year period preceding the 2005-06 ZDHS survey.

Table 5.6: Impact of Socioeconomic Variables on Infant and Child Mortality, Bivariate Analysis, 1996-2005, (2005-06 ZDHS)

Socioeconomic Covariate	Infant Mortality		Child Mortality	
	Relative Risk	Confidence Interval	Relative Risk	Confidence Interval
<i>Residence</i>				
Rural	1.080	0.871-1.341	1.326	0.892-1.971
Urban	1.000	-----	1.000	-----
<i>Maternal education</i>				
No education	1.000	-----	1.000	-----
Primary	1.023	0.680-1.539	0.792	0.407-1.541
Secondary and higher	1.008	0.672-1.511	0.587	0.303-1.138
<i>Paternal education</i>				
No education	1.000	-----	1.000	-----
Primary	1.003	0.723-1.393	0.680	0.387-1.195
Secondary and higher	0.938	0.689-1.277	0.636	0.379-1.070
<i>Wealth status</i>				
Poor	1.000	-----	1.000	-----
Middle	1.101	0.869-1.395	1.188	0.783-1.802
Rich	0.972	0.791-1.194	0.830	0.569-1.211
<i>Province</i>				
Manicaland	1.000	-----	1.000	-----
Mashonaland Central	0.815	0.572-1.160	0.600	0.324-1.111
Mashonaland East	0.927	0.632-1.359	0.748	0.384-1.457
Mashonaland West	0.894	0.640-1.248	0.621	0.330-1.166
Matabeleland North	0.563**	0.378-0.838	0.617	0.317-1.202
Matabeleland South	0.678	0.431-1.067	0.349*	0.145-0.836
Midlands	1.136	0.835-1.546	0.461*	0.252-0.843
Masvingo	0.903	0.650-1.255	0.665	0.375-1.177
Harare	0.796	0.553-1.145	0.591	0.327-1.069
Bulawayo	0.533*	0.316-0.898	0.379*	0.148-0.976

* $p < 0.05$, ** $p < 0.01$, *** $P < 0.001$

Table 5.7: Impact of Environmental Contamination Variables on Infant and Child Mortality, Bivariate Analysis, 1996-2005, (2005-06 ZDHS)

Environmental Contamination Covariate	Infant Mortality		Child Mortality	
	Relative Risk	Confidence Interval	Relative Risk	Confidence Interval
<i>Piped drinking water</i>				
Yes	0.965	0.791-1.178	0.899	0.629-1.286
No	1.000	-----	1.000	-----
<i>Flush toilet</i>				
Yes	0.876	0.707-1.086	0.663	0.437-1.007
No	1.000	-----	1.000	-----

* $p < 0.05$, ** $p < 0.01$, *** $P < 0.001$

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

Table 5.8: Impact of Personal Illness Control Variables on Infant and Child Mortality, Bivariate Analysis, 2001-2005, (2005-06 ZDHS)

Personal Illness Control Covariate ¹	Infant Mortality		Child Mortality	
	Relative Risk	Confidence Interval	Relative Risk	Confidence Interval
<i>Antenatal visits</i>				
None	1.000	-----	n/a ²	n/a
At least one visit	0.588*	0.372-0.931	n/a	n/a
<i>Place of delivery</i>				
Home	1.000	-----	1.000	-----
Hospital/ clinic	0.867	0.685-1.096	0.599*	0.370-0.968

* $p < 0.05$, ** $p < 0.01$, *** $P < 0.001$

¹ Relative risks for the five-year period before the 2005-06 ZDHS survey.

² Not computed due to relatively smaller numbers available for analysis.

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

Table 5.9: Changes in the Impact of Birth Order, Maternal Age Age and Maternal Education on Under-five Mortality, 1985-1994 (1994 ZDHS), 1990-1999 (1999 ZDHS) and 1996-2005 (2005-06 ZDHS)

Variable	1985-1994	1990-1999	1996-2005
Birth Order	Relative Risk		
1	1.068	0.993	0.892
2-3	0.997	0.955	0.919
4-6	1.000	1.000	1.000
7+	1.084	1.223	1.081
Maternal age			
<20	1.343	1.207	0.972
20-29	1.214	1.122	0.944
30-39	1.000	1.000	1.000
40-49	1.794	1.605	1.069
Maternal education			
No education	1.000	1.000	1.000
Primary	0.845	0.790	1.029
Secondary+	0.608	0.434	0.906

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

Table 5.10: Impact of HIV/AIDS on Infant and Child Mortality, Bivariate Analysis, 1996-2005, Zimbabwe

Variable	Infant Mortality		Child Mortality	
	Relative Risk	Confidence Interval	Relative Risk	Confidence Interval
HIV prevalence in rural/ urban area as at time of birth of child	1.100***	1.080-1.121	1.505***	1.429-1.585

* $p < 0.05$, ** $p < 0.01$, *** $P < 0.001$

CHAPTER 6

DETERMINANTS OF INFANT AND CHILD MORTALITY: RESULTS OF MULTIVARIATE HAZARD ANALYSIS

6.1 Introduction

This chapter presents the analysis of the multivariate proportional hazards models on the impact of maternal, socioeconomic and environmental contamination variables on infant mortality (0-11 months) and child mortality (12- 59 months). Personal illness control variables presented in Chapter 5 have been omitted from the multivariate analysis in this chapter because they refer to the five years preceding the 2005-06 ZDHS survey. The analysis of two dependent variables, that is, infant and child mortality, is needed because of the differential impact of maternal, socioeconomic and environmental contamination variables on mortality in infancy and childhood.^{27,33}

Sections 6.2 and 6.3 present the results from fitting the Cox proportional hazards models on infant and child mortality data from the 2005-06 ZDHS survey, respectively. Finally, section 6.4 presents some concluding remarks. These results offer an in-depth analysis of the 2005-06 ZDHS data and will be of interest to people working with public health and epidemiological studies of Zimbabwe with respect to infant and child mortality risk. In addition to the maternal, socioeconomic and environmental contamination variables, an estimate of the HIV prevalence as at the year of birth of child was included in the final models. The inclusion of HIV prevalence in the multivariate models should give an indication of the impact of HIV/AIDS on infant and child mortality in Zimbabwe. The results presented in the multivariate models in this chapter should be useful for the formulation of child health policies and child health programming in Zimbabwe. They should also

be useful in determining the direct and/or indirect impact of HIV/AIDS on infant and child mortality.

6.2 Infant Mortality

6.2.1 Impact of Maternal Variables on Infant Mortality

Model I presented in Table 6.1 shows whether introducing maternal age changes the relationship between the birth order and preceding birth interval variable and infant mortality. Comparison with Table 5.5 shows that introducing a control for maternal age decreases the relative risks associated with first births, order 2-5 and short preceding interval group and order 2-5 and medium preceding interval relative to order 2-5 and long preceding interval group. Introducing the same control increases the relative risks associated with order 6+ and short preceding interval, 6+ and medium preceding interval and 6+ and long preceding interval groups relative to infants in the order 2-5 and long preceding interval group. The high significance level ($p < 0.001$) of order 6+ and short preceding interval is unaffected in the presence of maternal age. This underlines the importance of birth spacing in enhancing child survival prospects.

Model II, presented in Table 6.1, shows the impact of birth order and preceding birth interval and type of birth on infant mortality. Comparison is drawn again with data in Table 5.5. The impact of the type of birth on infant mortality marginally increases when we control for birth order and preceding birth interval from odds of 2.07 ($p < 0.001$) in the absence of maternal age to odds of 2.09 ($p < 0.001$) in the presence of any control. The odds of infant death for order 6+ and long preceding birth interval are marginally increased in the presence of type of birth.

Table 6.2 presents results on the impact of birth order and preceding birth interval, maternal age, sex of child and type of birth. In model I

results of three of these maternal reproductive variables and mortality are in the expected direction. The risks of dying are much higher among infants of higher order births and closely spaced. Relative to infants in the order 2-5 and long preceding birth interval group, the relative risk of infant deaths for infants in birth order 6+ and short preceding interval is 2.77 times higher ($p < 0.001$). This model that is, model I in Table 6.2, is an extension of model I presented in Table 6.1. This is achieved through the addition of a control for sex of child. When we compare these results with those of Table 5.5 we observe that this control does not introduce any changes in the values nor pattern of the relative risks for birth order and preceding interval and maternal age. The presence of other maternal variables in model I elevates the impact of maternal age on infant mortality. This suggests that maternal age is an important determinant of infant mortality. Controlling for maternal reproductive variables in model I does not alter the U-shaped distribution of the impact of maternal age on infant mortality observed in the bivariate analysis (see Tables 5.5 and 6.2). Infants born to mothers aged less than 20 years and 20-29 years have an elevated mortality risk of 1.18 and 1.13 times, respectively, relative to infants born to mothers aged 30-39 years. These results were not statistically significant.

Model II in Table 6.2 adds the type of birth as a control variable. The odds of dying in infancy associated with birth order and preceding interval are reduced somewhat with the addition of the impact of the type of birth. The odds for sex of child and mortality remain largely unchanged. The U-shaped relationship of maternal age and infant mortality, indicating that younger (< 20 years) and older (40-49 years) mothers are associated with higher infant mortality relative to mothers aged 30-39 years, is not altered in the presence of all other maternal variables.

6.2.2 *Impact of Socioeconomic Variables on Infant Mortality*

Table 6.3 shows the estimated coefficients from fitting two hazard models on socioeconomic variables and infant mortality. The variables included in model I are type of residence and maternal and paternal education. Model II is extended to include controls for wealth index. In this analysis comparisons are drawn with data in Table 5.6. The impact of type residence and maternal and paternal education on infant mortality remain largely unchanged when these variables control for each other.

Cleland and van Ginneken²⁴ observed that education of the mother is associated with infant mortality. It is interesting to note that the results in Table 6.3 do not show any discernible impact of maternal education on infant mortality in Zimbabwe during 1995-2006. These results are consistent with those presented in Table 8.3 (p. 112) in the 2005-06 ZDHS survey report which also show lack of the impact of maternal education on infant mortality.²¹ We further observe that the addition of wealth status in model II does not change the impact of the socioeconomic variables in model I on infant mortality.

Paternal education appears to have a favourable effect on infant mortality (see model I). Children born to fathers with secondary and higher education were 0.93 times less likely to die in infancy than those born to fathers with no education. The addition of controls for wealth index in model II generally decreases the estimated coefficients for the socioeconomic variables in model I. The small impact of wealth status as observed in Table 5.6 has disappeared in the presence of other socioeconomic variables (see Table 6.3). There is hardly any relationship between wealth status and infant mortality. One would expect infants born to mothers in wealthier households to experience

higher survival prospects than those born to mothers in poor households.

6.2.3 Impact of Environmental Contamination Variables on Infant Mortality

Model I presented in Table 6.4 shows environmental contamination indicators and infant mortality. The variables controlling for each other, included in model I are piped drinking water and flush toilet facility. As previously observed in Table 5.7, the availability of piped drinking water in the household decreases the odds of children dying in infancy by a factor of 4 percent. In the presence of a control for access to a flush toilet, the odds of children dying in infancy are reduced by a factor of 20 percent relative to infants born in households without piped drinking water. We further previously observed in Table 5.7 that access to a flush toilet decreases the odds of dying in infancy by a factor of 12 percent. In the presence of a control for piped drinking water observed in Table 6.4, this impact on infant mortality more than doubles to a factor of 28 percent. The risk ratios depicting the impact of piped drinking water and flush toilet on infant mortality are in the expected direction but are not statistically significant.

6.2.4 Impact of Maternal, Socioeconomic, Environmental Contamination Variables and HIV/AIDS on Infant Mortality

The model consisting of all maternal, socioeconomic, environmental contamination and HIV prevalence variables is presented in Table 6.5. Model I consists of maternal reproductive variables only while model II is an addition of socioeconomic variables to the maternal reproductive variables. Finally, model III adds the environmental contamination variables.

In model I the risk ratios for birth order and preceding birth interval and mortality are in the expected direction. Births of order 6 and more and

short preceding interval have the highest mortality risk. Infants with these characteristics are significantly more likely (2.75 times) to die in infancy relative to births of order 2-5 and long preceding birth interval ($p < 0.001$). Infants of order 2-5 and short preceding interval experience 30 percent higher mortality than infants of order 2-5 and long preceding interval. These results underline the importance of parity and birth spacing in determining infant survival. High parity (birth order of 6+) and short preceding birth intervals (intervals of less than or equal to 18 months) predispose children to the risk of dying in infancy. Results in model I further show that the effect of giving birth at less than 20 years of age increases the risk of children dying in infancy by 15 percent relative to giving birth at age 30-39 years. Infants born to women aged 40-49 years experience 3 percent higher mortality risk relative those born to women aged 30-39 years. Giving birth at younger (less than 20 years) and older (40-49 years) maternal ages predisposes children to elevated mortality risks during infancy. Multiple births are associated with an elevated mortality risk. The infant mortality risk associated with multiple births is 2.08 times more relative to singleton births ($p < 0.001$).

Model II is an extension of model I by the addition of socioeconomic controls that include place of residence, maternal education, paternal education and wealth index (see Table 6.5). Infants of order 6 and more and short preceding interval continue to exhibit the highest risk to death. The probability of such infants dying in infancy is 2.89 times more relative to infants of order 2-5 and long preceding interval. The U-shaped relationship of maternal age and infant mortality is not altered in the presence of maternal and socioeconomic variables. Model II presented in Table 6.5 also shows the impact of socioeconomic variables after controlling for maternal reproductive variables. We observe that socioeconomic variables do not have a distinct impact on infant mortality.

Model III adds controls for two household amenities namely the presence of piped drinking water and flush toilet. The bivariate analysis results (see Table 5.7) show that the presence of piped drinking water in the dwelling is associated with 3 percent less risk of dying in infancy compared to the reference category. The presence of a flush toilet is associated with 12 percent less risk of dying in infancy relative to the reference category. In the presence of maternal and socioeconomic variables the odds of dying for infants born to mothers in households with access to piped drinking water are reduced by 12 percent relative to infants born to mothers in households without access to piped drinking water. Again, in the presence of maternal and socio-economic variables, infants born to mothers in households with access to a flush toilet are associated with 38 percent less risk of dying in infancy compared to those born to mothers in households without access to a flush toilet. We further observe that although the odds ratios for piped drinking water and flush toilet are in the expected direction they are both not statistically significant.

Model IV is an extension of Model III with the addition of HIV prevalence as at the year of the birth of the child. We observe that one unit change in HIV prevalence significantly increases the hazard of infant death by 10 percent ($p < 0.001$) in the presence of maternal, socioeconomic and environmental contamination variables. Introducing HIV prevalence in Model IV also alters, through a downward effect, the size of the impact of maternal, socioeconomic and environmental contamination variables on infant mortality. While association does not necessarily mean causation, the results in Model IV nevertheless suggest that HIV/AIDS influences the level of infant mortality in Zimbabwe either directly and/or indirectly. According to Hill, Bicego and May, the direct effects of HIV/AIDS on infant mortality occur when, for instance, seropositive children die at a higher rate than their seronegative counterparts.⁵

Indirect effects would occur when, for instance, parental care is incapacitated due to ill health due to HIV/AIDS or when the level of opportunistic infections such as tuberculosis is higher in areas with higher HIV prevalence than those with lower HIV prevalence. This would predispose children, both seropositive and seronegative, to the risk of contracting various infectious diseases.⁵

6.3 Child Mortality

6.3.1 Impact of Maternal Variables on Child Mortality

The results for the multivariate analysis for selected maternal variables for child mortality are presented in Table 6.6. Model I demonstrates that parity (with the exception of first births), maternal age and type of birth do not have a significant positive effect on child mortality as was also found with respect to infant mortality. Children of birth order 2-5 and short preceding interval are associated with a mortality risk of 1.29 times more relative to children of birth order 2-5 and long preceding interval. Only first births have a significant impact on child mortality. The odds of dying in child age for first births is 0.55 times less relative to children of order 2-5 and long preceding birth interval ($p < 0.05$). The relationship of birth order and preceding interval and child mortality does not follow the expected U-shaped curve. A similar observation is drawn from the relationship between maternal age and child mortality. Children born to younger mothers that are those aged less than 20 years experienced 46 percent higher odds of dying in child age than those born to older mothers aged 30-39 years. Model II shows birth order and birth interval controlled by type of birth. Relationships with mortality are very similar to those of model I, except that the mortality of first-born children is now non-significant.

Model I presented in Table 6.7 shows that the addition of a control for sex of child does not alter the relationship among birth order and

preceding birth interval, maternal age and child mortality. Children of first birth order are significantly associated with 45 percent lower mortality risk ($p < 0.05$) than children of birth order 2-5 and long preceding interval. The mortality risks associated with female and male children are nearly similar. The addition of a control for type of birth in model II in Table 6.7 does not also alter the relationship among the other maternal variables and child mortality. It is worthy commenting that being of a multiple births are associated with an elevated risk of child death than being singleton births. Although not significant, children who were of multiple births experienced 43 percent higher risk of child death than those who were singleton births (see Table 6.7).

6.3.2 Impact of Socioeconomic Variables on Child Mortality

Model I of Table 6.8 presents the multivariate analysis of place of residence, maternal and paternal education and wealth status and child mortality. Model II adds a control for wealth status. The results in model II follow a similar pattern to those in model I. We will discuss the results together. An association between residence and child mortality in the expected direction continues to exist in the presence of maternal and paternal education levels and wealth index. Living in rural areas increases the risk of child mortality by 18 percent relative to living in urban areas although the coefficients are not statistically significant. The risk ratios for maternal education imply declining child mortality with an increase in schooling. The impact of maternal and paternal education on child mortality is in the expected direction and is considerably stronger than that observed for infant mortality. Children whose mothers attained secondary and higher education are 36 percent less likely to die in child age relative to children whose mothers had no education (model II). These results are consistent with those observed in Table 8.3 (p. 112) in the 2005-06 ZDHS survey report.²¹

Father's education also has a substantial impact on child mortality; this is also different from results found in the infant period. Attaining secondary and higher education decreases the risks of child deaths by 30 percent relative to having no education (model II). Results of model II show that wealth status appears to have no discernible impact on child mortality in the presence of type of residence, maternal and paternal education.

6.3.3 Impact of Environmental Contamination Variables on Child Mortality

Model I in Table 6.9 shows that, as expected, the availability of piped drinking water and a flush toilet has a substantial impact on child mortality. The availability of piped drinking water in the dwelling significantly decreases the risks of child death by 43 percent ($p < 0.05$). The availability of a flush toilet in the dwelling significantly decreases the risk of child mortality by 60 percent ($p < 0.01$). The impact of environmental contamination variables is considerably stronger on child mortality than on infant mortality. These findings are of fundamental importance for child health programming in Zimbabwe where only 30 and 40 percent of households have access to piped drinking water and flush toilet facilities, respectively.

6.3.4 Impact of Maternal, Socioeconomic and Environmental Variables and HIV/AIDS on Child Mortality

The results of the impact of all independent variables (maternal, socioeconomic, environmental contamination and HIV prevalence) on child mortality are presented in Table 6.10. It is immediately clear that determinants of child mortality are different in relative importance from those of infant mortality. The results in model I (Table 6.10) are similar to those presented in model I (Table 6.7). Again, the results in model II of Table 6.10 as far as the maternal variables are concerned, are nearly similar to those of model I in the same table. Model III is an extension of

model II by the addition of environmental contamination variables. This does not substantially change the impact of maternal and socioeconomic variables as observed in model II. The results presented in the full model (model III) demonstrate that children who are the first-born have lower mortality than children of other birth orders. Children who are first-born are 0.57 times less likely to die in child age relative to children of birth order 2-5 that follow a long preceding interval. Furthermore, in the full model, order 6 and more and short preceding interval and type of birth do not have any significant effects on child mortality. There was such an impact with respect to infant mortality (see Table 6.5).

There continues to be an association between residence and child mortality in the presence of maternal and environmental contamination variables. Living in rural areas increases the risks of child death by 26 percent relative to children living in urban areas. This was also found in the tables dealing with infant mortality (see Table 6.5). The coefficients depicting the impact of type of residence on infant and child mortality are in both cases not statistically significant.

The effect of maternal education, though not significant, implies a decline in child mortality with increasing maternal schooling. Relative to children whose mothers had no education, the relative risks of child death for children whose mothers completed primary and secondary and higher education are reduced by 24 percent and .41 percent, respectively. Father's education has a substantial effect on child mortality unlike in the infant period. Attaining secondary and higher education reduces the relative risks of child death by 33 percent relative to fathers with no education.

Model III further confirms that environmental contamination variables are more important during the child age than during the infant age. The effect of the availability of piped drinking water in the dwelling is in the expected negative direction even though it is non-significant. The odds of dying in child age for children born in households with access to piped drinking water are reduced by 39 percent relative to those born in households without access to piped drinking water. The effect of the availability of a flush toilet on child mortality is also in the expected negative direction and is significant. Relative to children born in households with no access to a flush toilet, the relative risks of death for children born in households with access to a flush toilet are reduced by 60 percent ($p < 0.01$). This underlines the importance of good quality sanitation in preventing diseases such as cholera, diarrhoea and dysentery. Flush toilets ensure the proper disposal of faeces, which is important in preventing the spread of these diseases.

Model IV shows the addition of HIV prevalence to maternal, socioeconomic and environmental contamination variables presented in Model III. HIV prevalence does have a significant impact on child mortality in Zimbabwe. One unit change in HIV prevalence significantly increases the hazard of child mortality in Zimbabwe by 63 percent ($p < 0.001$) in the presence of maternal, socioeconomic and environmental contamination variables. However, as previously noted, these results should be treated with caution since association does not necessarily imply causation. What these observations suggest, however, is that HIV/AIDS either directly or indirectly influences the level of child mortality in Zimbabwe. The possible direct and indirect effects have been discussed in section 6.2.4.

6.4 Concluding Remarks

The results of the multivariate analysis presented in this chapter are in broad agreement with those of Chapter 5. In general the strengths of the relationships of the independent (maternal, socioeconomic and environmental contamination) variables with the dependent variables (infant and child mortality) remain much smaller in the 2005-06 ZDHS survey than in the other ZDHS surveys. For instance, the results from the 1994 and 1999 ZDHS surveys show a larger impact of maternal education on infant mortality than in the 2005-06 survey. The impact of the education of the mother on infant mortality completely disappears in 2005-06 in Zimbabwe. These results are rather unexpected and are not in line with observations from other surveys conducted in neighbouring countries such as South Africa. We already commented on these results in the final section of Chapter 5.

The multivariate analysis produced only relatively small changes in the strengths of the relationships between independent and dependent variables compared to the bivariate analysis. In the multivariate analysis we found again a lack of a U-shaped relationship between birth order and mortality and maternal age and mortality both in the bivariate and multivariate analysis.

We expect that children born to young mothers (aged less than 20 years) and those born to older mothers (aged 40-49 years) should have higher mortality than those born to mothers aged 20-39 years. The lower risks to child death among children who are first born and those born to mothers aged 40-49 years found in this chapter are deviations from the expected mortality pattern and require further investigation.

The findings further suggest the following: birth order and preceding birth intervals, maternal age and type of birth are dominant determinants

of infant mortality, but they are less pronounced in child mortality. Maternal schooling has a marginal impact on infant mortality. Both maternal and paternal education affects child mortality.

On sanitation, the findings indicated that the provision of piped drinking water and flush toilets to the households has a stronger impact on child mortality than infant mortality. The findings support the thesis that endogenous factors are dominant during infancy while exogenous factors are dominant during the childhood age. The results on the impact of HIV/AIDS on mortality showed that HIV/AIDS significantly increases the risk of dying during infancy and childhood age in Zimbabwe. These results are consistent with observations made in Kenya by Hill, Bicego and May.⁵ Furthermore, the results are important in shaping appropriate strategies for the reduction of infant and child mortality and the control of the spread of the HIV/AIDS epidemic.

We conclude that the findings presented in this chapter provide further evidence on the importance of practicing child spacing methods. Women and men living in urban areas or with higher educational levels are more likely to use a family planning method.^{14,21} Thus family and health planning in Zimbabwe should be directed at educating men and women with low educational levels and those in rural areas about the benefits of long birth spacing and encouraging them to use birth spacing methods. Such policies may be expected in the long run to reduce childhood mortality and possibly socioeconomic variations in mortality as well.

Frailty proportional hazard models are presented in Chapter 7. They are extensions of Chapter 6 and allow for the estimation of the effect of unmeasured and immeasurable factors on the risk of infant and child death.

Table 6.1: Impact of Selected Maternal Variables on Infant Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I		Model II	
	Relative Risk	Confidence Interval	Relative Risk	Confidence interval
<i>Birth order and preceding birth interval¹</i>				
First births	1.093	0.854-1.398	1.149	0.930-1.420
2-5 and short	1.363	0.951-1.954	1.409	0.994-1.996
2-5 and medium	1.423	0.918-2.206	1.519	0.986-2.340
2-5 and long	1.000	-----	1.000	-----
6+ and short	2.772***	1.563-4.916	2.604***	1.515-4.477
6+ and medium	1.081	0.558-2.093	1.065	0.562-2.017
6+ and long	1.345	0.916-1.976	1.251	0.914-1.712
<i>Maternal age</i>				
<20 years	1.178	0.819-1.695	-	-
20-29 years	1.138	0.861-1.503	-	-
30-39 years	1.000	-----	-	-
40-49 years	1.044	0.624-1.746	-	-
<i>Type of birth</i>				
Multiple			2.092***	1.574-2.782
Singleton			1.000	-----

*p<0.05, **p<0.01, ***p<0.001

¹ Preceding birth interval: short <= 18 months, medium 19-23 months, long 24+ months.

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

Table 6.2: Impact of All Maternal Variables on Infant Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I		Model II	
	Relative Risk	Confidence Interval	Relative Risk	Confidence interval
<i>Birth order and preceding birth interval¹</i>				
First births	1.092	0.854-1.397	1.101	0.859-1.411
2-5 and short	1.366	0.953-1.959	1.369	0.955-1.962
2-5 and medium	1.420	0.916-2.202	1.474	0.950-2.286
2-5 and long	1.000	-----	1.000	-----
6+ and short	2.771***	1.562-4.914	2.747***	1.544-4.884
6+ and medium	1.081	0.558-2.093	1.121	0.578-2.172
6+ and long	1.341	0.912-1.971	1.316	0.898-1.929
<i>Maternal age</i>				
<20 years	1.176	0.817-1.692	1.147	0.796-1.653
20-29 years	1.134	0.857-1.500	1.090	0.824-1.443
30-39 years	1.000	-----	1.000	-----
40-49 years	1.043	0.623-1.744	1.032	0.618-1.725
<i>Sex of child</i>				
Female	0.977	0.816-1.170	0.992	0.829-1.187
Male	1.000	-----	1.000	-----
<i>Type of birth</i>				
Multiple			2.080***	1.562-2.768
Singleton			1.000	-----

*p<0.05, **p<0.01, ***p<0.001

¹ Preceding birth interval: short <= 18 months, medium 19-23 months, long 24+ months.

Table 6.3: Impact of Socioeconomic Variables on Infant Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I		Model II	
	Relative Risk	Confidence Interval	Relative Risk	Confidence interval
<i>Residence</i>				
Rural	1.082	0.860-1.362	1.095	0.765-1.568
Urban	1.000	-----	1.000	-----
<i>Maternal education</i>				
No education	1.000	-----	1.000	-----
Primary	1.041	0.691-1.569	1.024	0.678-1.546
Secondary and higher	1.071	0.702-1.634	1.037	0.673-1.598
<i>Paternal education</i>				
No education	1.000	-----	1.000	-----
Primary	1.001	0.721-1.389	1.002	0.722-1.391
Secondary and higher	0.935	0.681-1.283	0.934	0.680-1.283
<i>Wealth status</i>				
Poor			1.000	-----
Middle			1.103	0.866-1.406
Rich			1.048	0.745-1.475

*p<0.05, **p<0.01, ***p<0.001

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

Table 6.4: Impact of Environmental Contamination Variables on Infant Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I	
	Relative Risk	Confidence interval
<i>Piped drinking water</i>		
Yes	0.805	0.571-1.134
No	1.000	-----
<i>Flush toilet</i>		
Yes	0.723	0.499-1.047
No	1.000	-----

*p<0.05, **p<0.01, ***p<0.001

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

Table 6.5: Impact of All Independent Variables on Infant Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-05 ZDHS)

Covariate	Model I		Model II	
	Relative Risk	Confidence Interval	Relative Risk	Confidence interval
<i>Birth order and preceding birth interval</i>				
First births	1.101	0.859-1.411	1.098	0.852-1.416
2-5 and short	1.369	0.955-1.962	1.387	0.958-2.007
2-5 and medium	1.474	0.950-2.286	1.481	0.950-2.310
2-5 and long	1.000	-----	1.000	-----
6+ and short	2.747***	1.544-4.884	2.887***	1.598-5.216
6+ and medium	1.121	0.578-2.172	1.146	0.584-2.250
6+ and long	1.316	0.898-1.929	1.333	0.903-1.968
<i>Maternal age</i>				
<20 years	1.147	0.796-1.653	1.150	0.788-1.678
20-29 years	1.090	0.824-1.443	1.092	0.816-1.461
30-39 years	1.000	-----	1.000	-----
40-49 years	1.032	0.618-1.725	1.080	0.616-1.892
<i>Sex of child</i>				
Female	0.992	0.829-1.187	0.987	0.823-1.185
Male	1.000	-----	1.000	-----
<i>Type of birth</i>				
Multiple	2.080***	1.562-2.768	2.086***	1.563-2.785
Singleton	1.000	-----	1.000	-----
<i>Residence</i>				
Rural			1.020	0.708-1.470
Urban			1.000	-----
<i>Maternal education</i>				
No education			1.000	-----
Primary			1.071	0.658-1.742
Secondary and higher			1.039	0.619-1.742
<i>Paternal education</i>				
No education			1.000	-----
Primary			1.109	0.791-1.556
Secondary and higher			1.117	0.800-1.559
<i>Wealth status</i>				
Poor			1.000	-----
Middle			1.096	0.857-1.402
Rich			1.022	0.723-1.444

Table 6.5 (Continued)

Covariate	Model III		Model IV	
	Relative Risk	Confidence interval	Relative Risk	Confidence interval
<i>Birth order and preceding birth interval¹</i>				
First births	1.098	0.851-1.416	0.997	0.775-1.282
2-5 and short	1.398	0.966-2.025	1.183	0.812-1.724
2-5 and medium	1.477	0.945-2.308	1.347	0.862-2.105
2-5 and long	1.000	-----	1.000	-----
6+ and short	2.915***	1.613-5.265	2.692**	1.490-4.863
6+ and medium	1.149	0.585-2.256	0.962	0.483-1.919
6+ and long	1.337	0.906-1.975	1.198	0.808-1.778
<i>Maternal age</i>				
<20 years	1.132	0.775-1.653	1.104	0.756-1.614
20-29 years	1.090	0.815-1.459	1.026	0.764-1.378
30-39 years	1.000	-----	1.000	-----
40-49 years	1.081	0.617-1.894	1.172	0.683-2.011
<i>Sex of child</i>				
Female	0.979	0.816-1.176	0.957	0.798-1.149
Male	1.000	-----	1.000	-----
<i>Type of birth</i>				
Multiple	2.060***	1.541-2.754	1.825***	1.362-2.444
Singleton	1.000	-----	1.000	-----
<i>Residence</i>				
Rural	1.323	0.765-2.289	1.065	0.622-1.824
Urban	1.000	-----	1.000	-----
<i>Maternal education</i>				
No education	1.000	-----	1.000	-----
Primary	1.074	0.660-1.748	1.044	0.650-1.676
Secondary and higher	1.055	0.628-1.770	1.142	0.686-1.900
<i>Paternal education</i>				
No education	1.000	-----	1.000	-----
Primary	1.116	0.796-1.566	1.086	0.774-1.524
Secondary and higher	1.121	0.803-1.565	1.111	0.796-1.553
<i>Wealth status</i>				
Poor	1.000	-----	1.000	-----
Middle	1.082	0.845-1.386	1.044	0.815-1.337
Rich	1.086	0.722-1.633	1.080	0.711-1.641

¹ Preceding birth interval: short <= 18 months, medium 19-23 months, long 24+ months.

Table 6.5 (Continued)

Covariate	Model III		Model IV	
	Relative Risk	Confidence interval	Relative Risk	Confidence interval
<i>Piped drinking water</i>				
Yes	0.885	0.597-1.311	0.900	0.597-1.357
No	1.000	-----	1.000	-----
<i>Flush toilet</i>				
Yes	0.629	0.348-1.136	0.618	0.349-1.094
No	1.000	-----	1.000	-----
HIV prevalence in rural/ urban area as at birth of child			1.102***	1.081-1.123

*p<0.05, **p<0.01, ***p<0.001

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

Table 6.6: Impact of Selected Maternal Variables on Child Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I		Model II	
	Relative Risk	Confidence Interval	Relative Risk	Confidence interval
<i>Birth order and preceding birth interval¹</i>				
First births	0.547*	0.337-0.885	0.705	0.475-1.045
2-5 and short	1.290	0.521-3.193	1.391	0.564-3.428
2-5 and medium	0.806	0.325-1.998	0.868	0.352-2.140
2-5 and long	1.000	-----	1.000	-----
6+ and short	1.069	0.146-7.834	1.114	0.155-8.000
6+ and medium	0.788	0.108-5.741	0.681	0.095-4.892
6+ and long	1.198	0.631-2.276	1.003	0.578-1.742
<i>Maternal age</i>				
<20 years	1.462	0.795-2.688	-	
20-29 years	0.881	0.559-1.390	-	
30-39 years	1.000	-----	-	
40-49 years	0.295	0.069-1.256	-	
<i>Type of birth</i>				
Multiple			1.418	0.622-3.234
Singleton			1.000	-----

*p<0.05, **p<0.01, ***p<0.001

¹ Preceding birth interval: short <= 18 months, medium 19-23 months, long 24+ months.

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

Table 6.7: Impact of Maternal Variables on Child Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I		Model II	
	Relative Risk	Confidence Interval	Relative Risk	Confidence interval
<i>Birth order and preceding birth interval¹</i>				
First births	0.546*	0.337-0.885	0.549*	0.339-0.890
2-5 and short	1.288	0.520-3.192	1.295	0.523-3.207
2-5 and medium	0.806	0.325-1.998	0.816	0.329-2.022
2-5 and long	1.000	-----	1.000	-----
6+ and short	1.066	0.145-7.825	1.071	0.146-7.858
6+ and medium	0.787	0.108-5.739	0.800	0.110-5.830
6+ and long	1.198	0.631-2.277	1.177	0.619-2.239
<i>Maternal age</i>				
<20 years	1.462	0.796-2.688	1.471	0.800-2.704
20-29 years	0.881	0.559-1.390	0.886	0.561-1.398
30-39 years	1.000	-----	1.000	-----
40-49 years	0.295	0.069-1.256	0.294	0.069-1.253
<i>Sex of child</i>				
Female	1.011	0.732-1.398	1.011	0.732-1.398
Male	1.000	-----	1.000	-----
<i>Type of birth</i>				
Multiple			1.428	0.625-3.259
Singleton			1.000	-----

*p<0.05, **p<0.01, ***p<0.001

¹ Preceding birth interval: short <= 18 months, medium 19-23 months, long 24+ months.

Table 6.8: Impact of Socioeconomic Variables on Child Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I		Model II	
	Relative Risk	Confidence Interval	Relative Risk	Confidence interval
<i>Residence</i>				
Rural	1.185	0.768-1.828	1.177	0.621-2.234
Urban	1.000	-----	1.000	-----
<i>Maternal education</i>				
No education	1.000	-----	1.000	-----
Primary	0.860	0.434-1.703	0.864	0.437-1.710
Secondary and higher	0.655	0.321-1.337	0.641	0.313-1.313
<i>Paternal education</i>				
No education	1.000	-----	1.000	-----
Primary	0.646	0.364-1.147	0.649	0.366-1.151
Secondary and higher	0.717	0.417-1.233	0.705	0.410-1.212
<i>Wealth status</i>				
Poor			1.000	-----
Middle			1.266	0.828-1.937
Rich			1.078	0.593-1.961

*p<0.05, **p<0.01, ***p<0.001

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

Table 6.9: Impact of Environmental Contamination Variables on Child Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I	
	Relative Risk	Confidence interval
<i>Piped drinking water</i>		
Yes	0.573*	0.335-0.978
No	1.000	-----
<i>Flush toilet</i>		
Yes	0.403**	0.216-0.753
No	1.000	-----

*p<0.05, **p<0.01, ***p<0.001

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

Table 6.10: Impact of All Independent Variables on Child Mortality, Hazard Model Estimates of Relative Risks (RR), 1996-2005 (2005-06 ZDHS)

Covariate	Model I		Model II	
	Relative Risk	Confidence Interval	Relative Risk	Confidence interval
<i>Birth order and preceding birth interval</i>				
First births	0.549*	0.339-0.890	0.566*	0.345-0.928
2-5 and short	1.295	0.523-3.207	1.317	0.530-3.270
2-5 and medium	0.816	0.329-2.022	0.821	0.331-2.038
2-5 and long	1.000	-----	1.000	-----
6+ and short	1.071	0.146-7.858	0.895	0.121- 6.624
6+ and medium	0.800	0.110-5.830	0.692	0.094- 5.093
6+ and long	1.177	0.619-2.239	0.966	0.496- 1.881
<i>Maternal age</i>				
<20 years	1.471	0.800-2.704	1.461	0.788-2.710
20-29 years	0.886	0.561-1.398	0.905	0.571-1.434
30-39 years	1.000	-----	1.000	-----
40-49 years	0.294	0.069-1.253	0.270	0.063-1.158
<i>Sex of child</i>				
Female	1.011	0.732-1.398	1.019	0.737-1.409
Male	1.000	-----	1.000	-----
<i>Type of birth</i>				
Multiple	1.428	0.625-3.259	1.510	0.660-3.457
Singleton	1.000	-----	1.000	-----
<i>Residence</i>				
Rural			1.135	0.598-2.153
Urban			1.000	-----
<i>Maternal education</i>				
No education			1.000	-----
Primary			0.746	0.364-1.529
Secondary and higher			0.567	0.264-1.218
<i>Paternal education</i>				
No education			1.000	-----
Primary			0.618	0.347-1.099
Secondary and higher			0.675	0.390-1.168
<i>Wealth status</i>				
Poor			1.000	-----
Middle			1.297	0.845-1.989
Rich			1.099	0.603-2.001

Table 6.10 (Continued)

Covariate	Model III		Model IV	
	Relative Risk	Confidence interval	Relative Risk	Confidence interval
<i>Birth order and preceding birth interval¹</i>				
First births	0.570*	0.347-0.937	0.683	0.416-1.120
2-5 and short	1.307	0.525-3.252	1.611	0.648-4.006
2-5 and medium	0.822	0.331-2.039	0.867	0.348-2.161
2-5 and long	1.000	-----	1.000	-----
6+ and short	0.902	0.122-6.680	1.047	0.140-7.815
6+ and medium	0.719	0.098-5.293	0.195	0.024-1.597
6+ and long	0.977	0.502-1.900	0.960	0.490-1.880
<i>Maternal age</i>				
<20 years	1.416	0.761-2.636	1.076	0.572-2.023
20-29 years	0.889	0.560-1.410	0.750	0.465-1.211
30-39 years	1.000	-----	1.000	-----
40-49 years	0.262	0.061-1.121	0.406	0.094-1.750
<i>Sex of child</i>				
Female	1.021	0.738-1.412	0.958	0.688-1.335
Male	1.000	-----	1.000	-----
<i>Type of birth</i>				
Multiple	1.492	0.651-3.419	1.560	0.675-3.605
Singleton	1.000	-----	1.000	-----
<i>Residence</i>				
Rural	1.260	0.545-2.912	1.371	0.742-3.162
Urban	1.000	-----	1.000	-----
<i>Maternal education</i>				
No education	1.000	-----	1.000	-----
Primary	0.764	0.373-1.564	1.006	0.485-2.083
Secondary and higher	0.594	0.276-1.276	0.857	0.395-1.860
<i>Paternal education</i>				
No education	1.000	-----	1.000	-----
Primary	0.614	0.345-1.091	0.708	0.394-1.270
Secondary and higher	0.670	0.387-1.159	0.851	0.483-1.500
<i>Wealth status</i>				
Poor	1.000	-----	1.000	-----
Middle	1.240	0.806-1.907	1.082	0.692-1.693
Rich	1.064	0.558-2.029	1.098	0.546-2.206

¹ Preceding birth interval: short <= 18 months, medium 19-23 months, long 24+ months.

Table 6.10 (Continued)

Covariate	Model III		Model IV	
	Relative Risk	Confidence interval	Relative Risk	Confidence interval
<i>Piped drinking water</i>				
Yes	0.606	0.330-1.116	0.691	0.352-1.357
No	1.000	-----	1.000	-----
<i>Flush toilet</i>				
Yes	0.401**	0.171 0.940	0.743	0.334-1.651
No	1.000	-----	1.000	-----
HIV prevalence in rural/ urban area as at birth of child			1.629***	1.542-1.721

*p<0.05, **p<0.01, ***p<0.001

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