THE FACTORS ASSOCIATED WITH UNDER-FIVE MORTALITY IN ZAMBIA

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ABSTRACT

Zambia's under-five mortality rate is among the highest in the world. In 1996 it stood at 197 per 1,000 live births (Zambia Central Statistics Office 1997). The study aims to establish the factors that are associated with under-five mortality in Zambia by using the 1996 Zambia Demographic and Health Survey. Results are compared to an earlier investigation by Nsemukila (1996) that used the 1992 survey and an adapted Mosley-Chen analytical framework. The construction of variables and analytical techniques are aimed at producing comparable results. As in the previous study, the inclusion of behavioural and proximate variables fails to explain the impact of socio-economic and cultural factors on neonatal mortality but has a greater influence at later periods in a child's life. Another similarity to the previous work is that maternal education only plays an important role in reducing under-five mortality at the childhood stage. Differences arise in the significance of individual variables, to a lesser extent at the neonatal and post-neonatal stage but more so at the level of childhood mortality. Whereas the present study finds that individual proximate variables have little influence on childhood mortality, the earlier research found many of these variables to be highly significant.

A key finding from this research is in the performance of the community level socio-economic variables. In particular, the presence of electricity in a household, which is indicative of urban dwelling, consistently results in a significant increased risk of mortality. This result might suggest that economic structural reforms and the resultant introduction of user fees in hospitals have had a severe effect on the urban poor. The outcome may also be due to the higher prevalence of HIV/AIDS in urban areas. The high provincial levels of under-five mortality in the Western, North Western and Southern provinces are confirmation of the acute poverty in these regions of the country. One unusual finding that warrants further investigation is the decrease in child mortality as the number of children in the household increases since it is possible that this result is being confounded by the age of mother. Also, the violation of the assumption of proportional hazards suggests that a different model should be used in further analysis.

The study recommends an improvement in access and quality of health care throughout the country as well as concerted efforts to redress the acute impact of urban poverty. Furthermore, poverty reduction schemes should aim at reducing regional variations in under-five mortality. Strategies that provide women with practical and affordable options for birth spacing should be promoted given the reduced risk of post-neonatal mortality associated with longer subsequent birth intervals Finally, efforts at increasing female enrolment rates in secondary schools and in tertiary institutions should be encouraged since this has been shown to be a significant factor in improving child survival.

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"Trust in the Lord with all your heart and lean not on your own understanding; in all your ways acknowledge him and he will make your paths straight." (Proverbs 3:5-6)

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INTRODUCTION

1.1 Purpose of the Study

Zambia is one of the countries in sub-Saharan Africa that experienced an increase in under-five mortality during the 1980s and 1990s. According to the 1996 Zambia Demographic and Health Survey, Zambia's under-five mortality rate was 197 per 1,000 live births, a figure that ranks within the top ten in the world. The importance of understanding this trend extends beyond humanitarian grounds. The health status of infants and children is a useful indicator of a country's overall well being. Although children under the age of five are not part of the economically active sector of the population, a healthier society as a whole can make a more meaningful contribution to national productivity. Therefore understanding under-five mortality is central to formulating strategies for poverty reduction (Romani and Anderson 2002).

It is becoming more widely accepted that knowledge of mortality in general contributes to more in-depth economic analysis because of the economic variables that are associated with mortality (Sen 1995). The potential long run effects include an increase in life expectancy with a resultant stimulation of investment in human capital and a subsequent rise in economic growth (Birdsall and Sinding 2001). This important relationship will be discussed further in the literature review later in this chapter.

1.2 Aims of Study

The purpose of this study is to investigate the factors that are associated with under-five mortality[1] in Zambia, and how these factors interact with each other.

Specifically, it aims to add knowledge to previous national studies of under-five mortality. The results are compared to those obtained by Nsemukila's 1996 thesis (Nsemukila 1996). Whereas the 1992 Zambia Demographic and Health Survey

[1] Neonatal mortality is the probability of dying within the first month of life (specifically up to and including day 27 of life). Post-neonatal mortality includes deaths that occur from day 28 through day 364 after birth. Infant mortality is the probability of dying before the first birthday. Child mortality is the probability of dying between first and fifth birthday. Under –five mortality is the probability of dying between birth and the fifth birthday.

(ZDHS) data were used earlier, this study employs the more recent 1996 data[2]. One of the objectives spelled out in the National Population Policy (Government of Zambia 2000) is the reduction of infant and child mortality rates. This study contributes to the interpretation of this goal. In addition, the health sector reforms in Zambia that began in 1994 have included initiatives for revising existing standards of service provision in order to slow down the accelerating case fatality rates, especially among mothers and their children. The emergence of chloroquine resistant malaria and HIV has increased the urgency of this campaign. By examining the factors that are associated with under-five deaths, this paper improves on the awareness of appropriate health interventions.

1.3 Background on Zambia

Zambia is a landlocked country located in Southern Africa. It is situated between 8 and 18 degrees South latitude and 20 and 35 degrees east longitude. It is bordered by Tanzania and Zaire in the North, Zimbabwe and Botswana to the South, Malawi and Mozambique to the East, Angola to the West and Namibia to the South West. There are nine provinces in Zambia, namely Central, Copperbelt, Eastern, Luapula, Lusaka, Northern, North Western, South, and Western. The country is further subdivided into 67 districts.

The Constitutional head of state is the President, who holds executive power. Legislative power is in the hands of a 150 member national assembly. The Vice-President and cabinet are appointed by the President, and are selected from the national assembly. There is a Minister for each of the 9 provinces and a 27 member House of Chiefs who represent traditional authority.

1.3.1 Economy

At the time of independence in 1964, Zambia enjoyed a strong, mining-based economy. An estimated 90 per cent of export earnings and 40 per cent of GDP came from this industry (Nsemukila 1994). This is compared to only 6 per cent of GDP from manufacturing and 14 per cent of GDP from agriculture. The onset of the downturn began in 1970, when copper output fell by 23 per cent. The oil shocks of the mid-1970s, coupled with a global decline in copper prices worsened the

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[2] The DHS programme recommends that data not be released until the submission of the final report. At the

situation. The terms of trade in 1975 were 54 per cent of the previous year (Nsemukila 1994). Government's response was to increase foreign borrowing. Attempts were also made at industrialisation. These efforts failed because of the country's poor export capacity and the presence of more competitive consumer imports (IMF 2002).

In the 1980s, the initial phases of a Structural Adjustment Programme (SAP) were introduced. The negative impact on the poorer sections of the population was severe (Kanji 2001). Thus, after widespread food riots in 1987, the New Economic Reform Programme (NERP) replaced SAP, which essentially translated to a return to the earlier price controls of the 1970s. Although there was a slight improvement in the terms of trade, mounting pressure from the IMF resulted in a new deal in 1989. The newly elected Movement for Multi-Party Democracy (MMD) government eventually brokered an agreement with the World Bank in 1992. Between 1991 and 1998, poverty levels had increased from 63 per cent to 73 per cent[3]. Nsemukila (2001, p.3) emphasised, that the urban poor particularly felt the impact of the worsening economic situation, '...given their dependence on wage employment for income, on the market for food supplies, and on the government food subsidy which was completely discontinued after 1992.'

Nsemukila also noted that the damage to child health and welfare as a result of the economic roller coaster was extensive. He made three noteworthy criticisms of the nature with which the government has embraced SAP. First, the government failed to estimate how realistic the programmes were at ground level and prioritise accordingly. For example, in spite of the vast potential for agricultural development to reduce poverty, very few resources were directed towards this sector. Second, repeated changes in policy worsened an already bad situation and no attempt was made to plan a gradual transition into new projects. Privatisation of state-run enterprises was at best, hesitant and sluggish. Finally, there was a complete absence of protection for vulnerable groups.

time of this study, the final results of the 2000/1 ZDHS were not available.

[3] The 1998 Zambian Living Conditions Monitoring Survey classifies households and individuals as poor based on their ability to purchase a 'basket' of goods that contains a required number of calories as well as a selection of non-food items. The 1998 poverty lines are set at K32, 861 per adult equivalent unit month for 'extreme' poverty and K47, 188 for 'moderate' poverty.

1.3.2 Education

According to the International Monetary Fund's Poverty Reduction Strategy Paper on Zambia (2002), there is a critical shortage of physical spaces in Zambian schools, especially in the rural areas. This is a result of lack of classrooms, poor salaries for teachers, and insufficient learning materials. In 1990, real per capita expenditure on education was a mere one-third of its level in 1970 (Nsemukila 2001). The fall in the number of teachers has been exacerbated by the HIV/AIDS pandemic. The pupil-to-teacher ratio has increased from 37 in 1996 to 47 in 1999 and is worse in urban areas than in rural areas (IMF 2002). The situation is aggravated by the growth in young household heads, long distances commuted to schools, early marriages and early entry into the labour market. Young learners begin to drop out as early as Grade 2. Access to education facilities for female learners has been more severely affected by resource constraints within households since preference is usually given to educating male children (Kanji 2001). In 2000, the net enrolment rate was a mere 66 per cent of potential primary school learners (IMF 2002).

The picture is equally bleak at the secondary level. Less than 50 per cent of primary school leavers enter high school. The capacity of the University of Zambia (UNZA) is less than 5, 000 students and changes in the government bursary system have meant that even able students, who succeed in spite of the dilapidated early school system, may not afford University fees. The majority of vocational and technical centres house outdated equipment and curricula. Very few of these exist in the rural areas.

1.3.3 Population Issues

Since independence, four censuses have been conducted (1969, 1980, 1990 and 2000) together with three demographic and health surveys (1992, 1996, 2001). According to the October 2000 census, the population of Zambia stood at 10, 285, 631 persons, an increase of 33 per cent from the figure of 7, 759, 167 in August 1990 (Zambia Central Statistics Office 2001).

In terms of fertility, the Total Fertility Rate (TFR) has fallen, albeit slowly from 6.5 births per woman by the end of her reproductive career in 1992, to 6.1 in 1996 and more recently to 5.9 births in 2001/2.

According to preliminary findings of the most recent ZDHS (Zambia Central Statistics Office 2003), the level of infant mortality in 2001/2 was estimated at 98 per

1, 000 live births (compared to 107 and 109 in 1992 and 1996 respectively). Under-five mortality was estimated to be 168 deaths per 1, 000 (compared to 191 and 197 in 1992 and 1996 respectively). Most of the improvement in under-five mortality would appear to be a consequence of rapid improvements in child mortality.

In the years immediately following independence, the growth in the country's population was not a national priority (Zambia Central Statistics Office 1997). However, the persistent increase in population size, coupled with a decline in GDP, led to the introduction of the first National Population Policy in May 1989 and the launch of the Family Planning Programme in 1992. Whereas the initial policy document was aimed at meeting demographic targets, new issues came to the fore as a result of the 1994 International Conference on Population and Development (ICPD). In January 2000, a revision of the National Population Policy was presented. Among its goals were the reduction of maternal, infant and child mortality rates, a drop in HIV/AIDS infection rates, the improvement of the sexual and reproductive health status of the population, the promotion of sustainable use of resources and the increase in the enrolment and retention of school going pupils (Government and Zambia 2000).

1.4 Mortality and Economic Analysis

Whereas the 'traditionalist' perspective of population increase being a mitigating factor to per capita economic growth dominated literature in the 1960s and 1970s, during the 1980s, the more tempered views of the 'revisionist' economists have gained recognition (Kelley 2001). Although most revisionists would agree that developing countries could benefit from lower fertility rates, they consider the association between population growth and economic development in the context of other equally important factors. They also encompass both intermediate and long run effects into their analysis. The question of reverse causality – whether indeed fertility and mortality decline may be either outcomes or causes of economic growth – continues to be debated. Lesthaeghe and Jolly (1995) presented evidence of sub-Saharan countries that experienced fertility decline, in spite of socio-economic hindrances. Cleland (1994) gave the example of how a more developed South Korea underwent earlier declines in fertility than its poorer Northern neighbour. He did, however, cite evidence of a contrary trend in South America and the Middle East, where more wealthy countries were slower to show signs of declining fertility than poorer ones. This section looks at the underlying link between the traditional demographic theme of mortality and its application to economic analyses, the benefits of using mortality indices as economic measures, and the relation between under-five mortality and Zambia's economic history.

1.4.1 Mortality and Economic Performance

At the core of a need to examine mortality statistics is the link between factors that influence mortality and the economic and social causes at work in the background. Sen (1994) pointed out that the connection runs through the potential of a government to invest the fruits of economic growth into public expenditure and health care. He contrasted South Korea and Hong Kong, which have both managed to make great strides in raising life expectancy because of the 'employment-oriented nature of the growth and through the resource generated to expand health care' with Brazil whose rapid rates of economic growth have not translated into significant improvements in life expectancy (Sen 1994, p.4).

Mosley and Chen (1984, p.37) would add that there are specific income effects at a household level that connect wealth to child mortality. One example is the quantity and quality of food, and the environment in which it is prepared, since these variables are all linked to a household's income level. They noted that in poor societies, a household may spend '80 per cent or more of their disposable income on food; thus variations in income or food prices may be directly translated into rising rates of mortality and malnutrition.'

An important issue when considering mortality indices within the framework of economics is its advantage over other statistics. Morbidity is one alternative measure of survival. Indices such as Disability Adjusted Life Years (DALYs) adjust life expectancy to account for the number of healthy years of life lost due to disability and death. Quality Adjusted Life Years (QALYs) assign a weight to account for the health related quality of life in each time interval of life. Yet DALYs and QALYs are influenced by the interpretation of the severity of a disease. A society's perception of illness depends to a large extent, on medical knowledge and the availability of medical care (Sen 1994). Communities where both are plentiful would have a much broader perception of illness than areas where these resources are lacking.

Critics of mortality statistics would argue that it is flawed by its sluggishness, a factor that erodes its value in economic evaluation. Sen (1994) countered this argument by pointing out that mortality rates can shift very rapidly in an upward direction during times of economic crisis, for example when famines occur.

To what extent can upward trends in under-five mortality in Africa be attributed to the adoption of IMF-sponsored structural adjustment programmes? These programmes reduce government spending on social services, such as education, health care and sanitation services. Moreover, they raise food prices by requiring the removal of price support systems. Often, they result in a drastic fall in exchange rates. Yet, Hill and Pebley (1989) have pointed out that the sample of countries adopting structural adjustment packages is often already experiencing economic crises. It is difficult, therefore, to identify whether mortality changes are due to previous economic difficulties or are attributable to the new economic performance systems. They further noted that a fall in wages and a rise in commodity prices should benefit rural producers, resulting in lower mortality in rural areas. Evidence of this tendency is found in Zambia where, although rural to urban poverty disparities still exist, the gap has narrowed between 1991 and 1998 because of the decrease in rural poverty and the rapid increase urban poverty (IMF 2002). It would appear that Zambia is a classic example of a country whose economic crisis was rapidly deepened by structural reforms.

Recent studies in Sub-Saharan Africa, such as the 1993 Working Group on the Demographic Effects of Economic and Social Reversal supported the opinion that economic reversals contribute to rapid increases in childhood mortality. Nsemukila (1994) observed that the hypotheses tested in this study bore great relevance to the Zambian situation. Since there were demographic impacts associated with economic downturns, these would be reflected in trends of child mortality. The impact of economic collapse would vary between urban and rural areas. Because public expenditures were generally concentrated in urban areas, the more visible impact of the economic change would be seen in urban areas. Recent setbacks in the Zambian mining and manufacturing sectors have resulted in increased urban unemployment. Finally, economies that were dominated by single commodities (such as copper in Zambia's case) would suffer a heightened impact of exogenous shocks.

1.5 Under-Five Mortality in Africa

Prior to the introduction of special purpose surveys in the 1970s, lack of quality data hampered the study of under-five mortality on the African continent (Hill and Pebley 1989; Kizito 1998). With the launch of census exercises, World Fertility Surveys, and Demographic and Health Surveys, it has become easier to estimate these trends. What is apparent is that rates of child mortality decline have been slower in Africa than in the Middle East and Asia. It is also clear that medical advantages following the second world war and improvements in standards of living, greatly benefited African countries. Hill and Pebley (1989, p.657) observed that '...these declines, once substantiated, generated widespread optimism in the 1960s and 1970s about prospects for bringing about a child survival revolution.'

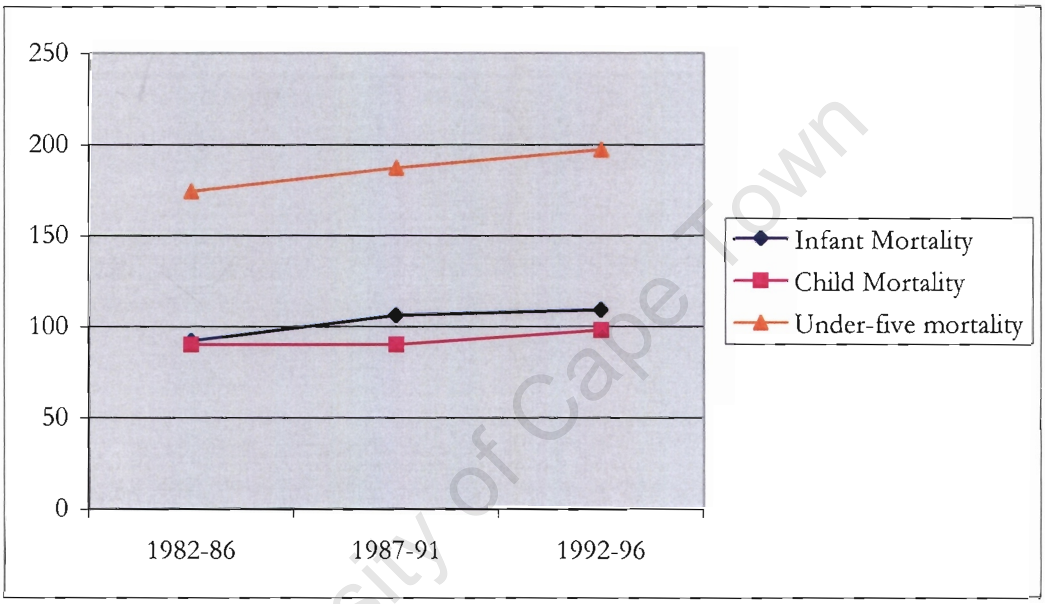
They suggested that a key factor contributing to the rise in child mortality rates is the concentration on narrow health interventions, such as oral rehydration therapy and the eradication of immunisable diseases rather than focusing on the improvement of community health. A possible outcome of this tendency, they argued, is a substitution effect in morbidity and mortality, since children who would have succumbed to immunisable diseases would instead die later from other causes. Yet, empirical evidence (Foster 1984) seems to indicate that immunisation campaigns have advantages for children under 5 that go beyond the prevention of the actual disease. For example, measles immunisations appear to be beneficial against other infections, as do malaria campaigns.

There are, however, wide variations in mortality trends among African countries. According to Kizito (1998), data from 19 African countries showed variations in under-five mortality that ranged from 160 per 1,000 in Zimbabwe to 400 per 1,000 in Sierra Leone. Within Zambia, an examination of the trends in under -five mortality produces some interesting results, which are relevant for the rest of this study.

1.5.1 Trends in Under-Five Mortality in Zambia

Based on census exercises, together with the 1992 Demographic and Health Survey, Nsemukila (1994) found that under-five mortality levels had declined from 25 per cent between the mid 1960s to approximately 16 per cent in the early 1980s. By the mid-1980s, however, a marked increase was observed, which was more pronounced in the infant and early childhood phases and less so in late childhood, where a further decline of 40 per cent was observed. According to Simms, Milimo et al. (1998), the increase in under-five mortality can be traced as far back as the mid-1970s. They added that under-five mortality increased from 15 to 19 per cent between 1980 and 1991. This exceeds the increases that were experienced in other African countries in the same period. Figure 1.1 illustrates trends in child survival in Zambia between 1982 and 1996. It clearly shows that the pace of increase in infant mortality far outstripped childhood mortality, particularly between 1987 and 1991.

Figure 1. 1:
Trends in Infant and Child Mortality Zambia, 1982-1986 to 1992-1996



Source: Zambia Central Statistics Office 1997, page 94.

1.6 Factors Affecting Under-Five Mortality

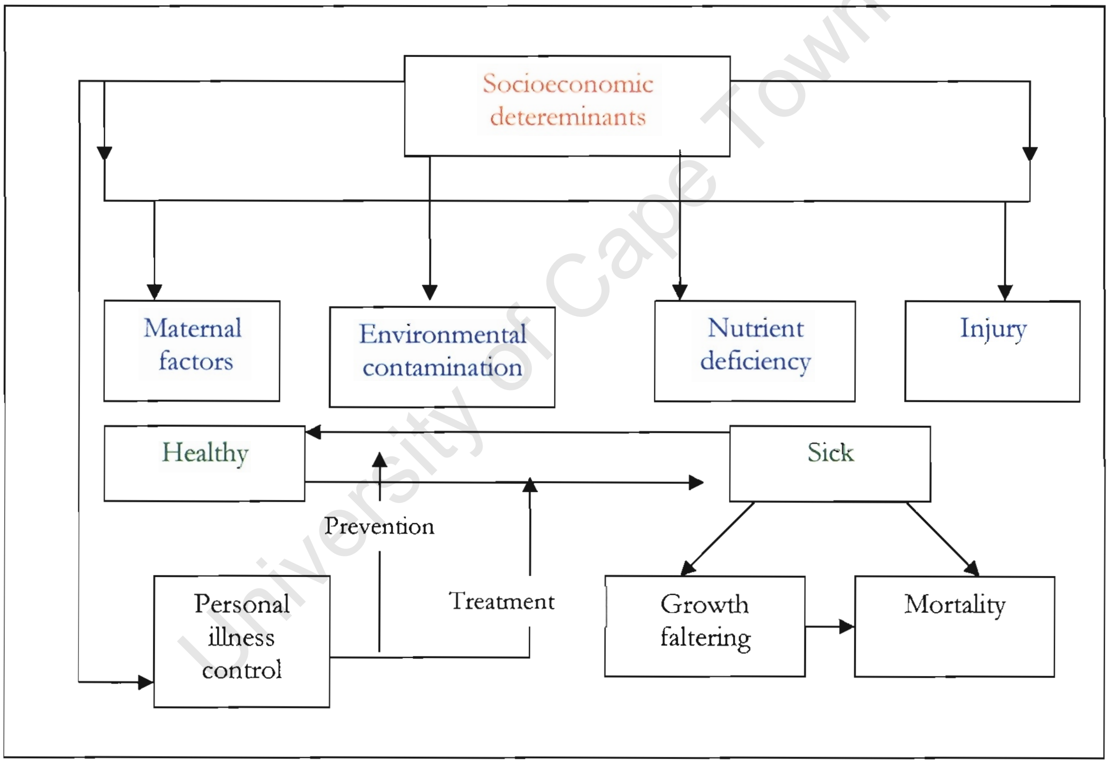
In their review of infant and child mortality in Sri Lanka, Trussel and Hammerslough (1983, p.13) concluded that the factors most strongly associated with mortality for these age groups were: mother and father's education, time period of birth, urban/rural/estate residence, ethnicity, sex of child, birth order, age of mother at birth and type of toilet facility. They worked on the premise that socio-economic covariates would affect mortality at later ages. When selecting the place of residence, they opted for the mother's current place of residence, rather than her childhood place of residence, since this was most likely where the child was exposed to the risk of dying. They imposed the assumption that the mother's education was complete by the time of the survey, and that the education of the husband corresponded to the education of the biological father. They encouraged caution in interpreting mortality associated with modern toilet facility and water supplies, since it might be biased upwards 'because some of the children classified as having modern facilities actually grew up in a less healthy environment lacking them.' Rutstein (2000) categorised environmental health factors according to the exposure of a child to contaminants. Thus, source of drinking water was broadly categorised into either women who have access to piped water, whether within the dwelling or elsewhere, and those women who obtain their drinking water from a surface source, such as a well or a stream.

In another study (Curtis, Diamond et al. 1993), preceding birth intervals were found to have a highly significant effect on post-neonatal mortality. The same study discovered an important association between maternal education and infant mortality. The authors used this variable as a proxy for socio-economic status and knowledge of health issues. Hobcraft, McDonald, and Rutstein (1985) have presented evidence of the importance of birth intervals in infant and early childhood mortality. They estimated that in 24 countries studied, there was a 50 per cent increase in mortality risk if the mother was pregnant before an index child's first birthday. The study (Hobcraft, McDonald and Rutstein 1985, p.374) went on to reaffirm the importance of education in reducing under-five mortality since it resulted in 'clear cut reductions in risks for all survival intervals and confirms the general increasing importance of socio-economic variables with age of the child.' Rutstein's study (2000) examined these factors as well as birth order and found that an increase in first birth order was associated with higher post-neonatal and early childhood mortality.

Other reports (Foster 1984; Mosley and Chen 1984; Kizito 1998) have cited immunisation, duration of breast-feeding, partner's occupation and nutrition as important factors. Increasingly, the HIV/AIDS epidemic has been related to child deaths, although often indirectly through increasing the number of orphans and reducing quality of childcare. Results of different analyses often vary because of different modelling approaches. For example, research that is interested in socio-economic factors often does not control for changes in health care whereas investigations into health care, overlook the effect of changes in socio-economic factors (Hanmer and White 1999).

The analytical framework used in the Nsemukila study drew heavily on the Mosley-Chen study of child survival in developing countries (1984). This model identified five groups of proximate determinants or intermediate variables that act as a bridge between socio-economic determinants and child survival. The proximate determinants are: *Maternal factors*: age; parity; birth interval; *Environmental contamination*: through air; food/water/fingers (when eating); skin (through absorption)/soil/inanimate objects; insect vectors; *Nutrient deficiency*: calories; protein; micronutrients (vitamins and minerals); *Injury*: accidental; intentional; *Personal illness control*: personal preventive measures; medical treatment. Figure 1.2 illustrates the chain of events in the Mosley-Chen system.

Figure 1. 2:
The Mosley Chain Analytical Framework



Source: Mosley and Chen 1984, page 26.

Not all the factors that are illustrated in the Mosley-Chen framework have corresponding data in the ZDHS. This is because the DHS focuses on factors that are important to public policy and where remedial measures can be easily implemented (Rutstein 2000).

Nsemukila (1996, p.18) emphasised cultural factors at the socio-economic level, in order to highlight the important role these variables play on household lifestyles and attitudes towards health interventions. He incorporated an intermediate behavioural mechanism (including variables such as child care by household members, breastfeeding, food supplementation, contraception and family planning, delivery method and use of health services) between the socio-economic and proximate determinants 'whereas the Mosley-Chen model includes these in the socio-economic block as independent variables'. Other modifications were an addition of a malnutrition/infection effect among proximate determinants, the accommodation of age variation of children and the removal of the injury block from the intermediate variables (because of lack of data on injuries in the DHS).

The Nsemukila study used this modified framework to examine factors influencing both under-five mortality and childhood health. His results revealed an insignificant influence of the selected socio-economic factors on neonatal mortality whereas their importance increased with age of the child. Surprisingly, he found a weak association between maternal education and childhood mortality, particularly at the neonatal level. He suggested, however that it was quite probable that 'the weaker performance of mother's education on childhood mortality in Zambia results from weaker health infrastructures which have inhibited the ability of educated mothers to take advantage of their health knowledge and beliefs (1996, p.396).' Simms, Milimo et al. (1998) have given evidence of the drastic reduction in government health expenditure in Zambia in the 1980s and 1990s, with the result being that an ill child was less likely to be treated with drug therapy. However the conclusion drawn by Nsemukila could also be due to a weak modelling technique, an issue that is discussed in the final chapter.

Nsemukila's study had six key objectives. The first objective was to examine trends and patterns in child mortality since Zambian independence in the mid-1960s. The second objective addressed differentials in child mortality between 1987 and 1991. The next two objectives involved the analysis of individual, household and community factors associated with child mortality and growth patterns. The fifth objective was to establish the channels through which these factors affected child survival by focusing on childcare. The final objective was to analyse the quality of DHS data in estimating child survival. Nsemukila concluded that, whereas neonatal mortality was influenced by bio-demographic factors and the post-neonatal period was impacted to a great extent by behavioural and bio-demographic factors, childhood mortality was mostly influenced by child spacing and the socio-behavioural environment in which the child resided.

Due to space limitations, this study focuses entirely on factors associated with under-five mortality in Zambia, and excludes the other components that were considered in Nsemukila's research. In order to generate comparable results from the 1996 ZDHS, the order of introducing variables into the multivariate analyses will be similar to the earlier study. Details are discussed in the methodology section of chapter 2.

1.6 Organisation of Thesis

Chapter 1 of this paper consisted of the theoretical grounding of the study, its aims and relevant background information on the study area. It also provided a brief review of literature on the topic. The second chapter begins with a discussion of the nature and availability of data that cover mortality. It proceeds to review existing methods of analysis and then gives a detailed description of the analytical framework that has been used. The results are presented in the third and fourth chapter. Finally, Chapter 5 provides a conclusion and policy recommendations.

Chapter 2

DATA ANALYSIS

2.1 Description of Datasets

The data used for this study are from the 1996 Zambia Demographic and Health Survey (ZDHS). The ZDHS is a nationwide survey conducted by the Central Statistics Office, with technical assistance from Macro International Inc. The DHS replaced the World Fertility Surveys of the 1970s and 1980s, which documented determinants of fertility and mortality among women and children. The first DHS in Zambia was conducted in 1992 and the most recent survey took place in 2001/2. For the 1996 survey, there were three sampling stages that took place. The first stage involved the selection of 312 primary sampling units, which were based on the census supervisory areas (CSA) from the 1990 census. The second stage involved the selection of one standard enumeration area (SEA) from each CSA. Both the CSAs and SEAs had probability of selection that was proportional to their size. With a list of all the SEAs in hand, the third stage involved the selection of households for interview. The provinces were stratified into urban and rural areas, yielding a total of 18 sampling strata for the 9 provinces. Women between the ages of 15 and 49 were surveyed as well as men between the ages of 15 and 59 in one-fourth of the households.

2.2 Background Characteristics of Respondents

An overview of the characteristics of women and households in the survey is shown in Table 2.1. The majority (60.3 per cent) of women interviewed are married. Only 25.3 per cent of women surveyed have never been married. The remainder of women are widowed, divorced, or unmarried but living with a partner. Over half live in rural areas. An estimated 56 per cent reside in dwellings with no electricity. The percentage of women with at least primary school education is 72.1. Nearly all of the sampled female respondents are no longer attending school. It is unlikely, therefore, that the education categories would alter significantly beyond the survey date. The selected standard enumeration areas generated a sample with the greatest representation of women from the more urbanised Copperbelt and Lusaka provinces. The least number of respondents are sampled from the North Western and Western provinces. In terms of ethnicity, the Bemba, Tonga, and Nyanja groups make up nearly 69.5 per cent of the survey sample. It is worth noting that although the majority of the provinces in Zambia are multi-ethnic, Bemba is widely spoken in the Copperbelt, Central, Luapula, and Northern Provinces. Tonga communities are concentrated in the Southern province. Nyanja is mostly spoken in the Eastern province but is also widely used in Lusaka and Central provinces.

According to the Living Conditions Monitoring Survey (Zambia Central Statistics Office 1996), economic activity is varied across the country. The Western and Southern provinces rely heavily on livestock farming although drought and disease have had a negative impact on the cattle industry in recent years. Fishing, forestry, agriculture and tourism are found in the Northern and Luapula provinces. The Eastern and North Western province are mainly agricultural regions, with the latter relying on the subsistence farming of cassava and sorghum. The North Western province has the highest percentage of poor people (90 per cent). The Copperbelt and Lusaka provinces are considered as the industrial hubs of the country. Mining and agriculture dominate economic activities in the Central province.

The environmental health factors presented are source of drinking water, time to water source, sanitation facility and floor material. A large proportion (80.6 per cent) has access either to an individual or a public piped water source. The remaining 20 per cent rely on a surface source of drinking water, such as a river or a stream. There is a considerable difference between times to water source for urban and rural residents. The median time to water source is 20 times greater in rural areas compared to urban areas. Access to a flush toilet facility is available for 45.6 per cent of respondents. A further 48.6 per cent use ventilated improved pit latrines. Only a small proportion (4.8 per cent) has no toilet facility. The percentage of women living in homes where the main floor material is either earth or sand is 15.5. The remainder live in structures that have floor material that is less environmentally hazardous to children (wood planks, concrete, parquet), particularly infants who are starting to move freely. The majority (56.6 per cent) of respondents live in households where there are 1 to 2 persons per sleeping room and 92.5 per cent of respondent have 4-or-less persons per sleeping room. Caution must be taken in using this as an indicator of crowding, since there is no way of determining the actual size of the structures (Nsemukila 1996).

Table 2. 1: Features of Women and Households

Background Characteristic	Women: Weighted Percent	Number of Women: Weighted	Number of Women: Un-weighted
Age			
15-19	25	2,003	1,982
20-24	22.8	1,830	1,823
25-29	16	1,286	1,280
30-34	13.5	1,081	1,083
35-39	9.5	758	768
40-44	7.1	568	569
45-49	6.2	494	516
Residence			
Urban	44.9	3,604	3,001
Rural	55.1	4,417	5,020
Province			
Central	8.1	653	748
Copperbelt	19.8	1,588	1,129
Eastern	13.4	1,075	1,118
Luapula	9	726	896
Lusaka	17.5	1,403	1,074
Northern	10.9	872	783
North Western	3.6	288	567
Southern	10.2	816	846
Western	7.5	600	860
Currently attending school			
Yes	8.8	703	673
No	90.7	7,278	7,310
Missing	0.5	40	38
Education			
No education	13.3	1,067	1,168
Primary	58.9	4,721	4,833
Secondary	25	2,007	1,828
Higher	2.8	226	191
Don't know/missing	0.0	1.0	1.0

Characteristic	Residence: Urban	Rural	Total
Sanitation facility			
Own flush toilet	41.2	1.0	15.9
Shared flush toilet	4.4	0.2	1.7
Traditional pit toilet	48.6	55	52.6
Pit latrine	0.3	0.4	0.4
No facility/bush	4.8	42.9	28.8
Other	0.3	0.1	0.1
Missing/Don't know	0.4	0.4	0.4
Electricity			
Yes	44.1	1.5	17.3
No	55.8	98.3	82.5
Floor material			
Earth/sand	14.9	88.4	61.1
Wood planks	0.6	0.1	0.3
Parquet/polished wood	1	0	0.4
Terazzo tile	3.3	0.1	1.3
Concrete/cement	79.9	11.2	36.7
Other	0.2	0	0.2
Missing	0.2	0.2	0.2
Time to water source (minutes)			
Less than 15 minutes	75.8	39.2	52.7
Median time to source	1	20.1	10.8
Persons per sleeping room			
1-2	56.6	53.4	54.6
3-4	35.9	35.9	35.9
5-6	5.5	7.2	6.6
7 or more	1.3	3	2.4
Missing/Don't know	0.7	0.5	0.6

Background Characteristic	Women Weighted Percent	Number of Women Weighted	Number of Women Un-weighted
Current marital status			
Never married	25.3	2,032	1,986
Married	60.3	4,839	4,888
Living together	0.8	63	61
Widowed	4.1	327	313
Divorced	7.2	574	591
Living separately	2.3	184	180
Missing	0	2	2
Religion			
Catholic	24.0	1,927	1,853
Protestant	74.4	5,965	6,029
Muslim	0.3	22	18
Other	0.3	27	25
Missing	0.3	25	25
Ethnicity			
Bemba	35.6	2,854	2,670
Tonga	15.4	1.232	1,242
Northwestern	9.2	737	1,016
Barotse	7.5	604	730
Nyanja	18.5	1,486	1,389
Mambwe	5.7	455	385
Tumbuka	5.5	441	396
Other	2.3	185	166
Don't know/missing	0.3	28	27

Characteristic	Residence Urban	Residence Rural	Total
Source of drinking water			
Piped into residence	46.7	1.7	18.4
Public tap	33.9	5.3	15.9
Well in residence	3.6	3.1	3.3
Public shallow well	2.2	20.1	13.4
Public traditional well	5.1	31.2	21.5
Borehole	4.7	12.5	9.6
Spring	0.2	1.6	1.1
River/stream	0.8	22.3	14.4
Pond/lake	0.3	1.6	1.1
Other	2.4	0.4	1.2
Missing/Don't Know	0.2	0.1	0.1

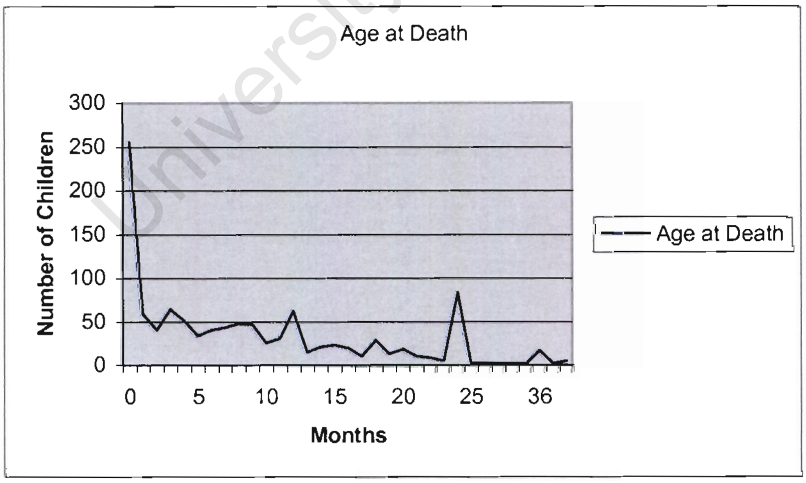
Source: ZDHS 1996, page 17, 20.

2.3 Data Quality

There are several issues to take into account when considering the quality of DHS data. Non-sampling errors arise from mistakes in data collection and processing, misunderstanding of questions and inability to locate the correct household (Institute for Resource Development 1990). Symptoms include digit preference, increased omission of information as time from interview increases, and evidence of adjustments made my interviewers. There was a lack of consistency in age distribution in the 1996 ZDHS and displacement of women by interviewers. The number of women aged 15 and 49 was far less than adjacent ages. Moreover, the sex ratios hinted at a possible misreporting of male births. However, in general, the completeness of information was exceptionally high with very few cases of missing information. Particularly reassuring for this paper is that age at death "was missing for an infinitesimal proportion of non-surviving births (Zambia Central Statistics Office 1997, p.197)."

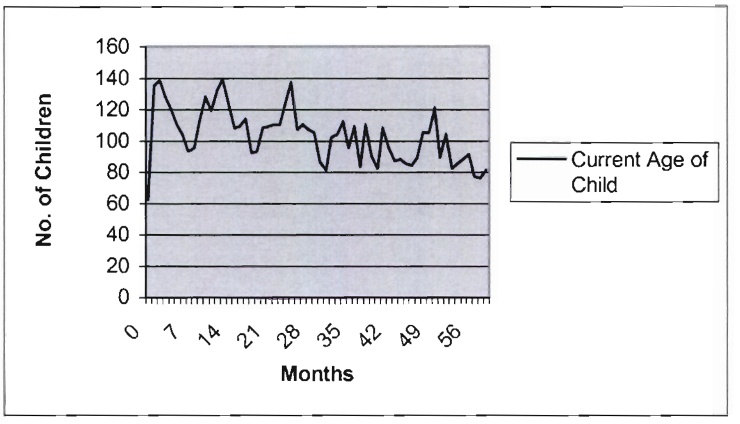
Figure 2.1 shows the distribution of dead children by age at death. The problem of heaping, where deaths are apportioned to rounded digits appears to a serious one particularly at ages 0, 12, 24, and 36 months.

Figure 2.1 Deaths by age of children (in months)– 1996 ZDHS



There is less heaping in the data for the current age of the child, as illustrated in figure 2.2

Figure 2.2 Current age of children (in months)– 1996 ZDHS



Sampling errors are estimates of the variability among all samples that could have been selected from the population, while using the same sampling technique. The ZDHS final report estimated sampling errors using relative errors (the standard error/value of the statistic) and found that in general, national estimates were small, meaning there was little variability. Of interest to this study is that based on the national sample, the relative errors for neonatal, post-neonatal and child mortality rates were very small (0.068, 0.0050, and 0.044 respectively). Furthermore, the design effect was calculated in order to compare the efficiency of the sample design to a simple random sample. A value of greater than 1.0 accounts for the rise in sampling error due to the use of a more complex survey technique. The values of the design effect were 1.018, 1.122 and 1.092 for neonatal, post-neonatal and child mortality respectively (Zambia Central Statistics Office 1997).

In terms of under-five mortality, there are some specific issues that need to be noted. Structural biases occur because of the survey design. Two of these, the selectivity bias and the truncation bias, are particularly important. The selectivity bias occurs because interviews are only carried out with women who are still alive and hence, only the child mortality experience of these women is recorded. Curtis' 1995 study (cited in Kizito 1998, p.50) has noted that the exclusion of the child mortality of dead women can lead to a reduced measure of under-five mortality 'because it is believed the death of the mother increases the probability of death for the child.' The mortality experience of children, whose mothers have died of AIDS, would potentially be excluded from any measure. Truncation of data might take place if women who are over 49 (and hence not included in the interview pool) have given birth, since both they and their offspring would be excluded. The survey limited this problem by collecting data on births five years prior to the survey date.

The quality of data can also be compromised by underreporting of deaths by mothers, especially those that occur early in infancy. Calculating a ratio of deaths under seven days to total neonatal deaths and the ratio of neonatal to infant mortality can check this phenomenon. If the ratios were very small, then this would indicate omission of deaths in the survey results. Also, the trends of these ratios over time can be examined to see whether underreporting increases with time from the survey. Table 2.2 illustrates these ratios and their trends over time. The lower proportions within the years 10-19 years before the survey in the first ratio, suggest slightly higher underreporting of deaths between 0-6 days[4]. It could also be due to heaping on day 7. The fact that the second ratio *decreases* over time is disturbing and might be owing to a greater heaping effect at the one month stage in the case of more recent deaths or more estimates of deaths being reported under one month for increased years preceding the survey. The latter conclusion would be more consistent with the indicators in the first ratio. The pattern could also be explained by changing age pattern as a result of the impact of HIV.

Table 2. 2: Reporting of age at death in days and months

Ratios	**Number of years preceding the survey**				
	0-4	5-9	10-14	15-19	Total 0-19
(0-6 days/0-30 days)*100	62.8	59.1	56.4	51.8	58.5
(Under 1 month/under 1 year)*100	35.2	35.0	40.5	41.4	37.1

Source: ZDHS 1996

The censoring bias is a major drawback of a cross-sectional survey such as DHS because only the status up until the time of the interview is included. Without follow-up interviews using the same cohort of women, it is impossible to tell with absolute certainty, how many children who may have been alive at the time of the interview, go on to die before their fifth birthday. Life tables are valuable in using the gathered information to create such estimates. Life tables are derived by observing what proportion of an initial group of people (often referred to as a cohort) exit from the analysis before reaching the end of the

[4] The effect of censoring during the first 6 days can be ignored since this is such a short period.

interval. However, the life table technique usually assumes a uniform distribution of deaths within intervals. Life table analysis is covered in chapter 3.

2.4 Methodology Used

In this paper, life tables are used for the preliminary analysis in order to determine patterns of mortality based on different conditions. For the multivariate analysis, in order to obtain results that are comparable to Nsemukila's 1992 study, Logistic and Cox Proportional Hazard regression procedures are used to estimate factors associated with under-five mortality for births in the five years preceding the survey. Variables are included in a similar manner to the earlier study. Both preliminary analysis and multivariate regression are estimated using Intercooled Stata software (Stata Corp 1999).

2.4.1 Life Tables

Life tables are one of the most commonly employed demographic methods. Life tables estimate hazard and survivor functions and show the number of subjects at risk in a given interval. The unadjusted life table estimates correspond to the Kaplan-Meier hazard and survival functions.

The life table (or acturial estimate) of survival can be expressed as:

$$S_{Acturial}(t) = \prod_{j=1}^{k}\left(\frac{n'_j - d_j}{n'_j}\right)$$ (Parmer and Machin 1995, p.48)

$n'j$ represents the number of individuals who are at risk in the j^{th} interval. The acturial assumption states that the censoring of survival time is uniform across the interval. d_j are the number of deaths in the j^{th} interval

With life tables, data can be divided into intervals so that neonatal, post-neonatal and child mortality can be analysed. Results of the likelihood ratio[5] and the log-rank[6] equivalence test for intervals can also be presented.

[5] The likelihood ratio test (lrtest in Stata) tests the null hypothesis that there is no significant difference between the more restrictive model and the more complex model (in which case the more restrictive model should be used).

[6] The null hypothesis is that there is no significant difference among categories of a variable.

2.4.2 Logistic Regression

Logistic regression models are a part of the group of generalised linear models and are a widely used model for binary data. The model assumes that there is independence among events. For example, the death of one child is not correlated to death of another. If $\pi(x)$ represents the odds of a successful event, then the model can be expressed in exponential form as:

$$\pi(x) = \frac{\exp(\alpha + \beta x)}{1 + \exp(\alpha + \beta x)}$$ (Agresti 1996 p.103)

The logarithm of the odds of this function, is known as the logit transformation of $\pi(x)$ but because of the limited interpretive power of the logit form, the odds ratio is often preferred (Liao 1994). Logistic regression is very popular in estimating mortality because it measures the odds of death for individuals with certain characteristics when compared with a base category. If correlation of the event is evident, then a random effects model can be adopted. For example, if children are cared for by the same mother and share the same housing environment, they are providing far less information than children from different households.

The drawback of logistic regression is that it cannot take censored events into consideration. This means that it cannot accommodate occasions where the event has not yet occurred by the time of the survey. The Cox Proportional Hazards Regression Model is able to work with censored data.

2.4.3 Cox Proportional Hazards Regression Model

The Cox Proportional Hazard Model is an example of a semi-parametric survival analysis technique. Survival analysis requires that the dependent variable is the waiting time until the occurrence of the event. Censoring occurs if, for some data, the event has not occurred by the time of the interview. There is a range of explanatory variables, which influence the waiting time until the event occurs and the waiting time can be measured in any unit of time, be it seconds, minutes, months, days, or years.

The Cox model states that the hazard for the j^{th} subject in the data is:

$$h(t/\mathbf{x}_j)=h_0(t)\exp(\mathbf{x}_j B_x)$$

The baseline hazard is left unestimated and the model does not impose any restrictions about its shape over time. This assumption is useful if the data renders it impossible to specify the shape of the hazard. If we were to make the wrong assumptions about the baseline hazard $h_0(t)$ then this could translate into incorrect estimates of B_x (Cleves, Gould et al. 2002). It is, however, critical to test the proportionality assumption and to include non-proportional effects if they are significant (Yamaguchi 1991).

2.4.4 Model Selection Procedure and Analysis

At this point it is important to stress that the Nsemukila study made no attempt to identify a "best fitting" model. The aim was to ascertain the effect on under-five mortality of socio-economic and cultural variables when initially, behavioural and then, proximate variables were added to the model. If the pathway of the socio-economic variables ran through the behavioural or proximate variables, then the inclusion of the latter would shift the coefficients of the socio-economic and cultural variables towards 1.00 (Nsemukila 1996). The importance of individual variables was observed through changes in their respective significance levels. The process was referred to as effect mediation.

The focus of this study is to produce results using the 1996 ZDHS data that can be compared to Nsemukila's research, which used the 1992 data. This study was one of the earliest attempts to use the first round of ZDHS data for a comprehensive analysis of under-five mortality. Sampling weights are used in order to remove any bias in estimating standard errors and probability values. Incorporating the pweight (sampling weight) command for the Cox analysis and svy (survey data) command for Logistic regression achieves this adjustment. In addition, the svy command allows for the specification of variables that describe the stratification and primary sampling units. It also reports t—statistics as opposed to the ordinary z-statistic. These preparatory steps for data analysis are particularly critical because due to oversampling[7] of households in three provinces, the 1996 ZDHS is not self-weighting at the national level (Office 1997).

Preliminary analysis of data presents results of life table estimates that are generated with the ltable command in Stata. The results of the life table and Kaplan-

[7] Oversampling occurred in Luapula, North Western and Western provinces because of attempts to produce province level estimates for certain variables.

Meier estimates are very close (differences within 0.001). Due to their proximity, only the results of life table estimates are shown. Prior to survival analysis, the stset command in Stata is used to prepare the data in terms of specifying time span, failure, censuring time, and record identification. The stsplit command then splits the records at specific points in time so that analysis of different survival segments can be carried out. The test based on Schoenfeld residuals (stphtest in Stata) is used to test the proportional hazards assumption. Although this was not carried out in the earlier study, it is included here in order to discuss further methods of research in this area, in the final chapter. The cluster command is used with Stata's stcox in order to produce robust standard errors that are clustered on the primary sampling units.

2.5 Summary of Variables

Choice of variables and their categories was guided by literature on factors associated with under-five mortality and to a large extent, to facilitate comparison with the earlier study. Table 2.3 provides a summary of variables and categories that is used in the multivariate analysis. It also translates the meaning of certain categories in the Zambian context, such as the duration length of education intervals.

Table 2. 3: Summary of Variables

Variable	Description
Region of Zambia	Central, Copperbelt, Eastern, Luapula, North Western, Southern, Western
Place of residence	Urban, Rural
Number of children in a household	0, 1, 2, 3 or more
Religious affiliation	Catholic, Protestant, Other
Language group	English, Bemba, Kaonde, Lozi, Lunda, Luvale, Nyanja, Tonga, Other
Abstinence while breastfeeding	Yes, No
Mother is head of household or wife of head of household	Yes, No
Discussion of family planning with partner	Yes, No
Multiple births	Single, multiple
Size of child at birth	Large, average, small
Preceding birth interval	First birth, 9-23 months, 24-35 months, 36 months or more
Home floor material	Earth/sand/mud, cement, other
Sex of child	Male, female
Age of mother	Under 18, 18 to 24, 25-34, 35 or more
Partner's occupation	Not working, Professional/technical/management, blue collar, agricuture/self-employed, clerical/sales/services
Marital status	Never married, married, formerly married
Months of breastfeeding	0 to 6 months, 7 to 18 months, 19 months or more
Number of tetanus vaccinations	0, 1, 2 or more
Number of marital unions	Once, more than once

Variable	Description
Months of abstinence	0 to 2, 3 to 6, 7 or more
Subsequent birth interval	Less than 24 months, 24-35 months, 36 months or more
Mother currently pregnant	Yes, No/not sure
Mother's highest education level	No education, Primary (grades 1 to 7), Secondary or higher (grades 8 to 12 and higher institutions of learning)
Electricity in household	Yes, No
Source of drinking water	Piped (into house or public source), well (well in residence, public shallow well, public traditional well), other (public borehole, spring, river/stream, pond/lake)
Type of toilet facility	Flush (own or shared), pit latrine (traditional or ventilated), other (no facility or other facility)
Mother's occupation	Not working, paid employment, unpaid employment, self-employed

The next chapter presents results of preliminary analysis. This will be followed by the more in-depth results of multivariate regression.

RESULTS OF PRELIMINARY DATA ANALYSIS

3.1 Results of Life Table Analysis

Tables 3.1 to 3.4 present results of Life Table analysis, which were estimated from the birth history file[8] of the 1996 ZDHS. Improvements in socio-economic characteristics can lead to increased probabilities of survival for children. With the exceptions of partner's occupation and urban/rural place of residence, the log-rank test is highly significant, an indication that there is significant difference in survival probabilities among the respective categories.

3.1.1 Under-Five Mortality by Education of Mother and Partner's Occupation

For neonatal and early post-neonatal mortality, there is no notable difference in survival probabilities among the different education levels of mothers. The main improvement in under-five mortality is among children over one year, whose mothers have attained secondary level education or higher, when compared to those with no education and primary education. Assuming that a woman's partner is also the biological father of the child, neonatal, post-neonatal and childhood mortality is highest among infants whose fathers do not work. However, the log-rank test reveals no significant difference among categories of partner's occupation. The small number of observations in some of the groups possibly influences the significance of the partner's occupation variable.

Table 3. 1: Under-Five Mortality by Education of Mother and Partner's Occupation

Education of Mother

Group		No Education				Primary				Secondary or higher			
Interval		Total	Survival	[95% CI]		Total	Survival	[95% CI]		Total	Survival	[95% CI]	
0	1	1076	0.96	[0.95	0.97]	4729	0.96	[0.96	0.97]	1441	0.97	[0.95	0.97]
1	6	1030	0.92	[0.90	0.93]	4517	0.93	[0.92	0.94]	1382	0.93	[0.92	0.94]
6	12	898	0.88	[0.86	0.90]	3943	0.89	[0.88	0.90]	1212	0.90	[0.88	0.91]
12	24	770	0.84	[0.81	0.86]	3361	0.84	[0.83	0.85]	1040	0.86	[0.84	0.88]
24	60	544	0.79	[0.76	0.82]	2321	0.78	[0.77	0.80]	730	0.84	[0.82	0.86]

Log-rank test:
Chi2(2) 6.89
P=0.0319

Partner's Occupation

Group		Did not work				Profess/Tech/Management				Blue Collar			
Interval		Total	Survival	[95% CI]		Total	Survival	[95% CI]		Total	Survival	[95% CI]	
0	1	50	0.94	[0.82	0.98]	432	0.97	[0.94	0.98]	1637	0.97	[0.96	0.97]
1	6	46	0.85	[0.72	0.93]	415	0.93	[0.90	0.95]	1567	0.94	[0.92	0.95]
6	12	38	0.81	[0.66	0.89]	366	0.89	[0.85	0.92]	1379	0.90	[0.88	0.91]
12	24	30	0.71	[0.54	0.83]	316	0.85	[0.81	0.89]	1199	0.84	[0.82	0.86]
24	60	17	0.71	[0.54	0.83]	240	0.80	[0.74	0.84]	844	0.79	[0.76	0.82]

Partner's Occupation

Group		Agriculture/Self-Employed				Clerical/Sales/Services			
Interval		Total	Survival	[95% CI]		Total	Survival	[95% CI]	
0	1	3503	0.96	[0.96	0.97]	1220	0.97	[0.96	0.98]
1	6	3345	0.92	[0.91	0.93]	1169	0.93	[0.92	0.95]
6	12	2900	0.88	[0.87	0.89]	1030	0.90	[0.88	0.92]
12	24	2448	0.84	[0.83	0.86]	893	0.86	[0.83	0.88]
24	60	1717	0.79	[0.77	0.81]	602	0.80	[0.77	0.83]

Log-rank test:
Chi2(4) 5.61
P=0.2300

3.1.2 Under-Five Mortality by Marital Status, Residence and Electricity

Neonatal mortality is constant based on the marital status of the mother but post-neonatal mortality is more favourable for children whose mothers are either never married or married. Childhood survival is highest for children whose mothers were never married, followed by married and formerly married. In addition, the number of marital unions clearly favours children whose mothers have been married only once. Interestingly, neonatal, post-neonatal and childhood mortality are lower for

[8] The birth history file only considers births that occurred in the five years preceding the survey and therefore excludes older children.

households with no electricity. Survival probabilities are slightly higher in urban households but the log -rank test is insignificant.

Table 3. 2: Under-Five Mortality by Marital Status, Residence and Electricity

Marital Status of Mother

Group		Never			Married			Formerly		
Interval		**Total**	**Survival**	**[95% CI]**	**Total**	**Survival**	**[95% CI]**	**Total**	**Survival**	**[95% CI]**
0	1	379	0.97	[0.94 0.98]	5984	0.96	[0.96 0.97]	883	0.97	[0.95 0.98]
1	6	363	0.94	[0.91 0.96]	5718	0.93	[0.92 0.94]	848	0.91	[0.89 0.93]
6	12	317	0.91	[0.88 0.94]	4969	0.89	[0.88 0.90]	766	0.87	[0.85 0.89]
12	24	265	0.87	[0.83 0.91]	4235	0.85	[0.84 0.86]	670	0.82	[0.79 0.84]
24	60	160	0.83	[0.77 0.88]	2960	0.80	[0.79 0.81]	474	0.75	[0.71 0.78]

Log-rank test:
Chi2(2) 9.24
P=0.0098

Number of Marital Unions

Group		Once			More than once		
Interval		**Total**	**Survival**	**[95% CI]**	**Total**	**Survival**	**[95% CI]**
0	1	5658	0.97	[0.96 0.97]	1193	0.96	[0.94 0.97]
1	6	5415	0.93	[0.92 0.94]	1135	0.92	[0.90 0.93]
6	12	4708	0.89	[0.88 0.90]	1012	0.87	[0.85 0.89]
12	24	4011	0.85	[0.84 0.86]	880	0.81	[0.78 0.83]
24	60	2815	0.80	[0.79 0.82]	608	0.76	[0.72 0.79]

Log-rank test:
Chi2(2) 10.7
P=0.0011

Electricity in House

Group		No			Yes		
Interval		**Total**	**Survival**	**[95% CI]**	**Total**	**Survival**	**[95% CI]**
0	1	6093	0.97	[0.96 0.97]	1115	0.95	[0.93 0.96]
1	6	5846	0.93	[0.93 0.94]	1046	0.90	[0.88 0.91]
6	12	5138	0.90	[0.89 0.91]	881	0.83	[0.80 0.85]
12	24	4441	0.86	[0.85 0.87]	702	0.75	[0.71 0.77]
24	60	3185	0.81	[0.80 0.82]	393	0.70	[0.66 0.73]

Log-rank test:
Chi2(2) 74.1
P=0.0000

Urban/Rural Residence

Group		Urban			Rural		
Interval		**Total**	**Survival**	**[95% CI]**	**Total**	**Survival**	**[95% CI]**
0	1	2389	0.97	[0.96 0.97]	4859	0.96	[0.96 0.97]
1	6	2290	0.93	[0.92 0.94]	4641	0.93	[0.92 0.93]
6	12	2010	0.90	[0.88 0.91]	4044	0.89	[0.88 0.90]
12	24	1738	0.85	[0.83 0.86]	3434	0.85	[0.83 0.86]
24	60	1205	0.81	[0.78 0.83]	2391	0.79	[0.77 0.81]

Log-rank test:
Chi2(2) 0.76
P=0.3838

3.1.3 Under-Five Mortality by Region

The Western province, which largely depends on cattle rearing, has the highest levels of neonatal mortality. Luapula and Western provinces have the highest post-neonatal mortality. Western, Lusaka and Luapula provinces have the highest rates of early childhood mortality. This is an interesting combination of results since Lusaka is a highly urbanised province where household income largely consists of waged employment, whereas Western and Luapula provinces are predominantly farming areas. Luapula and Western provinces dominate late childhood mortality, closely followed by Southern, Northern, Lusaka and Eastern provinces.

Table 3. 3: Under-Five Mortality by Region

Region														
Group		**Central**				**Eastern**				**Lusaka**				
Interval		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**		
0	1	687	0.97	[0.96	0.98]	1149	0.96	[0.95	0.97]	830	0.96	[0.95	0.97]	
1	6	659	0.94	[0.92	0.96]	1099	0.93	[0.92	0.95]	792	0.92	[0.90	0.94]	
6	12	570	0.90	[0.87	0.92]	965	0.89	[0.87	0.91]	690	0.88	[0.85	0.90]	
12	24	483	0.85	[0.82	0.88]	837	0.85	[0.82	0.87]	580	0.83	[0.80	0.85]	
24	60	359	0.82	[0.78	0.86]	566	0.80	[0.76	0.83]	396	0.80	[0.76	0.83]	
Group		**North Western**				**Copperbelt**				**Luapula**				
Interval		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**		
0	1	565	0.97	[0.95	0.98]	954	0.97	[0.96	0.98]	830	0.96	[0.95	0.97]	
1	6	540	0.94	[0.91	0.96]	918	0.94	[0.92	0.95]	796	0.91	[0.89	0.93]	
6	12	471	0.91	[0.88	0.93]	814	0.91	[0.89	0.93]	681	0.85	[0.82	0.87]	
12	24	395	0.88	[0.84	0.90]	700	0.87	[0.84	0.89]	562	0.79	[0.76	0.82]	
24	60	291	0.82	[0.77	0.86]	495	0.81	[0.77	0.84]	378	0.77	[0.73	0.80]	
Group		**Northern**				**Southern**				**Western**				
Interval		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**		
0	1	769	0.97	[0.96	0.98]	805	0.97	[0.95	0.98]	659	0.95	[0.93	0.96]	
1	6	740	0.93	[0.91	0.95]	768	0.95	[0.93	0.96]	619	0.90	[0.87	0.92]	
6	12	651	0.90	[0.87	0.92]	682	0.92	[0.90	0.94]	530	0.86	[0.83	0.89]	
12	24	557	0.87	[0.84	0.89]	602	0.86	[0.83	0.88]	456	0.83	[0.80	0.86]	
24	60	377	0.80	[0.75	0.83]	407	0.79	[0.75	0.83]	327	0.76	[0.72	0.80]	

Log-rank test:
Chi2(2) 21.9
P=0.0052

3.1.4 Under-Five Mortality by Age of Mother

Neonatal mortality is lowest among children whose mothers are between 30 and 34 and highest among teenage mothers of 15 to 19. Post-neonatal and childhood survival favours children born to older women and is considerably lower for women 24 years or younger. Empirical evidence of the link between the age of the mother at birth and child survival is mixed. Rutstein (2000) found that high mortality is found both among mothers who are younger than 18 years and older than 35 years. Although disability risks are known to increase with late pregnancy, Hobcraft, McDonald et al. (1985) note that the risk factor is a very small portion of infant and child mortality in less developed parts of the world. For this data, there is a slight attenuation in the early childhood stage for young mothers

Table 3. 4: Under-Five Mortality by Age of Mother

Age of Mother

Group			**15-19**				**20-24**				**25-29**		
Interval		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**	
0	1	562	0.94	[0.91	0.95]	2270	0.96	[0.95	0.97]	1764	0.97	[0.96	0.97]
1	6	516	0.88	[0.85	0.91]	2159	0.92	[0.90	0.93]	1696	0.93	[0.91	0.94]
6	12	378	0.85	[0.81	0.88]	1866	0.87	[0.85	0.88]	1489	0.89	[0.88	0.91]
12	24	267	0.81	[0.76	0.84]	1560	0.81	[0.80	0.83]	1280	0.85	[0.83	0.87]
24	60	113	0.75	[0.68	0.81]	1041	0.77	[0.74	0.79]	931	0.81	[0.78	0.83]
Group			**30-34**				**35-39**				**40-44**		
Interval		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**		**Total**	**Survival**	**[95% CI]**	
0	1	1369	0.98	[0.97	0.99]	808	0.97	[0.95	0.98]	359	0.96	[0.93	0.98]
1	6	1336	0.95	[0.94	0.96]	770	0.95	[0.93	0.96]	342	0.95	[0.92	0.97]
6	12	1202	0.91	[0.90	0.93]	696	0.93	[0.91	0.94]	318	0.92	[0.88	0.94]
12	24	1057	0.86	[0.84	0.88]	628	0.90	[0.87	0.92]	286	0.89	[0.85	0.92]
24	60	741	0.80	[0.77	0.83]	458	0.83	[0.79	0.86]	228	0.85	[0.80	0.89]
Group			**45-49**										
Interval		**Total**	**Survival**	**[95% CI]**									
0	1	116	0.97	[0.91	0.99]								
1	6	112	0.93	[0.87	0.96]								
6	12	105	0.90	[0.83	0.95]								
12	24	94	0.88	[0.81	0.93]								
24	60	84	0.86	[0.77	0.92]								

Log-rank test:

Chi2(2) 41.02

P=0.000

3.1.5 Under-Five Mortality by Sex of Child and Preceding Birth Interval

Turning to birth intervals, there is little difference between neonatal and post-neonatal survival probabilities for birth intervals of 24 to 35 months and 36 months or more but these two intervals differ considerably in comparison to the shortest interval of 9-23 months, with the latter having a higher risk of death. Research into birth spacing from DHS (Setty-Venugopal and Upadhyay 2002) supports these findings. In this study, shorter birth intervals were associated with maternal depletion syndrome, when a short birth interval prevented a mother from regaining her strength, with a resultant impact on infant survival. The same report found that shorter intervals were associated with premature delivery and reduced milk quantities. Furthermore, sibling rivalry was shown to impact both older and younger children, as they competed for maternal care.

Table 3. 5: Under-Five Mortality by Sex of Child and Preceding Birth Interval

Sex of Child

Group		Male			Female		
Interval		**Total**	**Survival**	**[95% CI]**	**Total**	**Survival**	**[95% CI]**
0	1	3573	0.96	[0.95 0.96]	3675	0.97	[0.97 0.98]
1	6	3387	0.92	[0.91 0.93]	3544	0.94	[0.93 0.95]
6	12	2926	0.88	[0.87 0.89]	3128	0.90	[0.89 0.91]
12	24	2487	0.83	[0.82 0.85]	2685	0.86	[0.85 0.87]
24	60	1734	0.79	[0.77 0.81]	1862	0.80	[0.78 0.82]

Log-rank test:
Chi2(2) 5.85
P=0.0156

Preceding Birth Interval

Group		First Birth			9-23 months			24-35 months		
Interval		**Total**	**Survival**	**[95% CI]**	**Total**	**Survival**	**[95% CI]**	**Total**	**Survival**	**[95% CI]**
0	1	1594	0.95	[0.94 0.96]	1057	0.9535	[0.94 0.96]	2525	0.97	[0.96 0.98]
1	6	1504	0.90	[0.88 0.91]	1003	0.9017	[0.88 0.92]	2425	0.95	[0.94 0.96]
6	12	1298	0.86	[0.84 0.87]	858	0.8531	[0.83 0.87]	2144	0.91	[0.90 0.92]
12	24	1115	0.81	[0.79 0.83]	730	0.798	[0.77 0.82]	1823	0.86	[0.84 0.87]
24	60	772	0.77	[0.74 0.79]	500	0.7426	[0.71 0.78]	1271	0.80	[0.78 0.82]

Group		36+ months		
Interval		**Total**	**Survival**	**[95% CI]**
0	1	1621	0.97	[0.96 0.98]
1	6	1562	0.95	[0.93 0.95]
6	12	1369	0.91	[0.90 0.93]
12	24	1172	0.89	[0.87 0.90]
24	60	822	0.85	[0.82 0.87]

Log-rank test:
Chi2(3) 50.44
P=0.000

Critics of this association would argue that duration of breastfeeding varies; thereby resulting in more rapid pregnancies, a loss of the nutritional benefits of breastfeeding and subsequent infant deaths. Hobcraft, McDonald and Rutstein (1985) argue convincingly that were this argument justified, then it would result in greater differences in *neonatal* deaths associated with short birth intervals and smaller difference when comparing different birth interval and *childhood* deaths. The contrary is true both in their study and in this paper. For childhood mortality, birth intervals of 36 months or more are much more favourable to survival. As expected, there is a clear indication that mortality rates are consistently higher for male children. The ratio of male to female neonatal deaths is 1.5. Both birth intervals and sex of the child have highly significant log –rank test results.

Chapter 4

RESULTS OF MULTIVARIATE ANALYSIS

4.1 Logistic Regression for Neonatal Mortality

Table 4.1 and 4.2 present the results of the logistic regression. The baseline model includes socio-economic and cultural variables. Intermediate behavioural (Table 4.1) and subsequently proximate variables (Table 4.2) are added in order to establish their impact of socio-economic and cultural factors on neonatal mortality.

Model 1 of Table 4.1 shows that only the presence of a bicycle in the household and ethnicity has a significant effect on neonatal mortality. Neonatal mortality is lower in rural than in urban areas. This is a surprising result and may be a consequence of the deteriorating health facilities in urban areas and the increasingly acute nature of urban poverty. Since neonatal mortality is affected by factors linked to the mother's pregnancy and the process of childbirth, the higher urban neonatal mortality suggests a greater impact of health policies on residents of urban areas. However, this result is not statistically significant.

The presence of a bicycle in a home, which is a proxy for household wealth, reduces the odds of neonatal mortality by 31 per cent. Controlling for sexual abstinence increases the significance of ethnicity for the Lozi and Luvale speaking groups. Other behavioural variables, such as tetanus vaccination and whether a woman has sex while breastfeeding, further strengthen the significance of these ethnicity variables but reduce the statistical importance of the socioeconomic variable. Model 6 shows that after controlling for behavioural variables the risk of neonatal mortality is six and three times greater respectively, for the Luvale and Lozi speaking respondents, when compared to the reference group and the results remain statistically significant, whereas these variables go some way in confounding the effect of the presence of a household bicycle. The vast majority of Luvale respondents reside in the North Western province. Also, Lozi respondents are concentrated in the Western province. This might suggest deeply entrenched traditional norms that do not easily respond to "modern" practises such as open discussions of family planning and prenatal tetanus injections. It comes as no surprise, that the Western province has recorded the highest poverty levels (89 per cent) in the country and the highest proportion of extremely poor (Zambia Central Statistics Office 1996), an association that may not have been captured by these variables. The North Western provinces also records high statistics of poverty (76 per cent). Therefore the inclusion of these variables does little to account for the pathways of neonatal mortality for these two ethnic groups.

Children of formerly married mothers have a lower risk of neonatal mortality than other groups in this category. This outcome would suggest that the neonates of women who are either widowed or divorced and who often return to their parent's homes have a greater chance of survival. However, this result is not statistically significant. Goldshceider (1971) claimed that religious ideologies could influence both the size of a family and the use of birth control. He went on to suggest that membership of a religious group could be an indicator of social class in terms of the level of education attained, the selection of profession and the resultant income earned. However, in the present study, religion does not present a significant effect on neonatal mortality.

These results vary considerably, when compared to Nsemukila's study, using the 1992 ZDHS data. In the earlier study, children from rural areas had a significantly higher risk of dying and the presence of a bicycle increased, rather than reduced the risk of neonatal deaths. Mother's religious affiliation showed significantly higher effects in the previous research, with higher survival chances among protestant mothers. The study claimed that this was a result of different religious practices regarding family planning. Another difference is evident in the results of the marital status variable. Nsemukila's study established a lower risk for neonates born into polygamous unions, even after controlling for other variables. Related results were in the association between persistently high neonatal mortality among the Lozi-speaking communities, the lower risk of mortality associated with increased duration of sexual abstinence, and the significantly favourable impact of tetanus injections administered to mothers during pregnancy on the survival of their neonates.

Table 4. 1: Risk of Neonatal Mortality Associated with Socio-Economic, Cultural, and Intermediate Behavioural Factors – Results of Logistics Regression

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<u>Socio-economic Variables</u>						
Region						
Urban (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Rural	0.855	0.835	0.870	0.961	0.964	0.974
Household Bicycle						
Absent (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Present	0.692**	0.662**	0.690**	0.676*	0.679*	0.680*
<u>Cultural Variables</u>						
Religion						
Catholic (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Protestant	0.990	0.940	0.883	0.833	0.834	0.838
Other	0.379	0.211	0.204	0.218	0.222	0.224
Ethnicity						
English speaking (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Bemba speaking	1.343	1.589	1.471	1.560	1.552	1.581
Kaonde speaking	1.301	1.427	1.346	0.784	0.789	0.805
Lozi speaking	1.953	2.858*	2.982*	2.935*	2.923*	3.012*
Lunda speaking	0.576	0.551	0.549	0.675	0.681	0.698
Luvale speaking	3.211*	5.554***	5.323**	6.179**	6.177**	6.200**
Nyanja speaking	1.543	1.889	1.966	1.924	1.924	1.956
Tonga speaking	1.606	1.787	1.559	1.580	1.573	1.570
Other	1.420	3.401	3.240	3.354	3.388	3.549
Marital Status						
Never (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Currently married	1.060	0.925	0.944	1.092	1.155	1.109
Formerly married	0.707	0.622	0.602	0.663	0.677	0.676
Polygamous	1.132	1.084	1.105	1.052	1.114	1.066
<u>Intermediate Behavioural Variables</u>						
Duration of sexual abstinence						
0-2 months (ref)		1.000	1.000	1.000	1.000	1.000
3-6 months		0.383***	0.403***	0.437***	0.438***	0.439***
7+ months		0.286***	0.294***	0.361***	0.361***	0.362***
Tetanus vaccination						
None (ref)			1.000	1.000	1.000	1.000
One			0.843	0.947	0.944	0.931
Two or more			0.581**	0.598**	0.595**	0.582**
Sex while breastfeeding						
No (ref)				1.000	1.000	1.000
Yes				0.204***	0.204***	0.207***
Kinship						
Head/Partner of head (ref)					1.000	1.000
Relative					1.081	1.073
Discusses of FP with partner						
No (ref)						1.000
Yes						1.112
	N=1054	**N=1005**	**N=986**	**N=889**	**N=889**	**N=888**
	F(15, 256)	**F(17, 251)**	**F(19, 248)**	**F(20, 241)**	**F(21, 240)**	**F(22, 239)**
	Prob>F	**Prob>F**	**Prob>F**	**Prob>F**	**Prob>F**	**Prob>F**
	=0.2036	**=0.0000**	**=0.0000**	**=0.0000**	**=0.0000**	**=0.0000**

*P<0.1 **P<0.05 ***P<0.001

Table 4.2 adds bio-demographic and micro-environmental variables to the model (referred to as proximate variables). When considering the results of model 1 and 7, it is clear that controlling for proximate variables does not explain either the household bicycle or ethnicity variables. Multiple births have a highly significant effect on neonatal mortality. A smaller child at birth has a higher risk of mortality and a female child has a significantly higher chance of survival. Surprisingly, the preceding birth interval is not associated with higher deaths among neonates. Both home floor material and the age of the mother are not statistically significant. This is unexpected, as studies have suggested that children of younger mothers would experience higher risks of mortality. However, as mentioned earlier, empirical evidence is mixed on the effect of age of mother on mortality. Also, an earth sand floor would be considered a more risky factor for births and hence for the survival of neonates.

Again, these are very different results from the earlier study. Nsemukila found no significant association between neonatal mortality and the socio-economic variables, when proximate variables were added. In terms of cultural variables, his results showed significantly higher odds of survival for Protestant mothers. The earlier study also established that home floor material explained part of the risk associated with rural mortality. Similarities are in the association between tetanus vaccination and lower mortality risk as well as duration of sexual abstinence and reduced mortality risks. The significantly higher risk of neonatal mortality that is associated with smaller infants at birth is also alike in both studies. The consistent conclusion regarding tetanus vaccinations supports the medical premise that giving mothers tetanus injections while they are pregnant prevents their children from contracting neonatal tetanus. Also, the strong association between neonatal mortality and male births as well as lack of significance of mother's age, correspond to this study's findings.

Table 4. 2: Risk of Neonatal Mortality Associated with Socio-Economic, Cultural, Intermediate Behavioural and Proximate Variables – Results of Logistics Regression

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
<u>**Socio-economic Variables**</u>							
Region							
Urban (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Rural	0.974	0.928	1.048	1.047	1.145	1.127	1.123
Household Bicycle							
Absent (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Present	0.680*	0.608**	0.603**	0.597**	0.610**	0.617**	0.617**
<u>**Cultural Variables**</u>							
Religion							
Catholic (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Protestant	0.838	0.989	0.956	0.885	0.869	0.885	0.882
Other	0.224	0.334	0.331	0.319	0.311	0.378	0.382
Ethnicity							
English speaking (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bemba speaking	1.581	1.818	2.464	2.127	2.272	2.457	2.440
Kaonde speaking	0.805	0.954	1.088	0.830	0.897	0.992	0.986
Lozi speaking	3.012*	3.498*	4.535**	3.527*	3.942*	4.580*	4.575*
Lunda speaking	0.698	1.022	1.135	0.918	1.013	1.041	1.047
Luvale speaking	6.200**	9.078***	11.032***	7.904***	8.425**	9.86**	9.645**
Nyanja speaking	1.956	2.200	3.089*	2.652	2.859	3.233	3.210
Tonga speaking	1.570	1.972	2.464	2.010	2.106	2.285	2.253
Other	3.549	5.261	8.440	6.215	6.860	6.057	6.031
Marital Status							
Never (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Currently married	1.109	0.853	0.983	0.980	0.955	0.919	0.937
Formerly married	0.676	0.644	0.794	0.817	0.805	0.819	0.830
Polygamous	1.066	0.819	0.922	0.940	0.853	0.828	0.837
<u>**Intermediate Behavioural Variables**</u>							
Duration of sexual abstinence							
0-2 months (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3-6 months	0.439***	0.395***	0.377***	0.405***	0.391***	0.384***	0.384***
7+ months	0.362***	0.304***	0.291***	0.307***	0.307***	0.308***	0.311***
Tetanus vaccination							
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
One	0.931	0.806	0.853	0.835	0.815	0.840	0.841
Two or more	0.582**	0.452***	0.448***	0.453***	0.458***	0.470***	0.471***
Sex while breastfeeding							
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Yes	0.207***	0.170***	0.166***	0.139***	0.139***	0.134***	0.134***
Kinship							
Head/Partner of head (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Relative	1.073	1.029	1.008	0.978	0.969	0.940	0.949

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Discusses of FP with partner							
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Yes	1.112	1.182	1.208	1.218	1.241	1.292	1.286
Proximate Determinants							
Birth type							
Single (ref)		1.000	1.000	1.000	1.000	1.000	1.000
Multiple		9.792***	8.077***	8.480***	8.230***	8.468***	8.524***
Size of child at birth							
Large (ref)			1.000	1.000	1.000	1.000	1.000
Average			1.201	1.208	1.236	1.240	1.241
Small			2.529***	2.48***	2.489***	2.595***	2.609***
Preceding birth interval							
First births (ref)				1.000	1.000	1.000	1.000
9-23 months				1.008	1.008	1.065	1.062
24-35 months				0.691	0.717	0.736	0.744
36 months or more				0.854	0.872	0.873	0.871
Home floor material							
Earth/Sand (ref)					1.000	1.000	1.000
Cement/Concrete					1.171	1.153	1.146
Other					1.872	2.080	2.141
Sex of child							
Male (ref)						1.000	1.000
Female						0.558***	0.563***
Age of mother at birth							
<18 years (ref)							1.000
18-24 years							1.401
24-34							1.282
35+							1.337
	N=888	**N=888**	**N=840**	**N=836**	**N=828**	**N=828**	**N=828**
	F(22, 239)	**F(23, 238)**	**F(25, 236)**	**F(28, 229)**	**F(30, 226)**	**F(31, 225)**	**F(34, 222)**
	Prob>F	**Prob>F**	**Prob>F**	**Prob>F**	**Prob>F**	**Prob>F**	**Prob>F**
	=0.0000	**=0.0000**	**=0.0000**	**=0.0000**	**=0.0000**	**=0.0000**	**=0.0000**
*P<0.1 **P<0.05 ***P<0.001							

4.2 Cox Hazards Regression for Post-Neonatal Mortality

Tables 4.3 and 4.4 present the Cox regression for post-neonatal mortality. As in the previous study, the output includes the results of the model chi-square, which tests the null hypothesis that adding a variable to the model improves its overall interpretive power. Each variable's importance is shown by changes in the model chi-square.

In addition, in order to discuss further research on this topic in the next chapter, the results of the Schoenfeld test for the proportional hazards assumption are also displayed. From model 1 of Table 4.3, all variables with the exception of mother's education and number of other wives, have some statistically significant impact on post-neonatal mortality. With the inclusion of behavioural variables, the socio-economic and cultural variables that maintain a significant impact are the number of children living in a household, father's employment and access to electricity. The earlier study assumed that households with fewer children were more susceptible to child mortality. The results here reaffirm that households with more children have a consistently lower risk than those that are mortality prone (the reference category). The post-neonatal mortality risk is significantly higher for children whose father's are employed in agriculture.

Controlling for the duration of sexual abstinence removes the statistical significance in Luapula province but results in increased significance in the Western province. Since the Western province is largely a Lozi-speaking region, this outcome ties in with the results from the analysis of neonatal mortality. Furthermore, the Luapula province is a predominantly Bemba speaking province. Therefore this result would suggest certain tribal customs associated with duration of breastfeeding. Interestingly, the influence of mother's education has no significant effect on post-neonatal mortality. Education is frequently related to lower under-five mortality (Martin et. al 1983; Hobcraft, McDonald and Rutstein 1985). In fact, Martin et. al (1983) specify that the reason why education is such a widely adopted demographic variable is that it is a proxy for higher income, better medical facilities, good nutrition, better housing and more hygienic sanitation. The existence of obstacles to good health practices in Zambia (such as the introduction of user fees at clinics) might be interrupting the expected performance of this variable.

In terms of the behavioural variables, children who are breastfed for longer periods have a significantly lower risk of post-neonatal mortality and proponents of breastfeeding recommend breastfeeding into the second year of life in order to reduce child mortality (Rutstein 2000). In spite of the risk of perinatal transmission of HIV, breastfeeding is still encouraged for women in developing countries such as Zambia, because it provides infants with critical protection against infectious diseases. Mothers who discuss family planning with their partner and who receive two or more tetanus injection lower the risk of post-neonatal mortality among their young. However, both variables are not statistically significant. A longer duration of sexual abstinence is associated with a significantly lower risk of post-neonatal mortality. A surprising result is the significantly higher post-neonatal mortality that is associated with households that have electricity. According to the 1996 Living Conditions Monitoring Survey , only 2 per cent of rural households compared to 45 per cent of urban households in Zambia use electricity for lighting (Zambia Central Statistics Office 1996). Similarly, the 1996 ZDHS found urban-to-rural electricity use to be 44.1 per cent and 1.5 per cent respectively. As with neonatal mortality, this would add weight to the contention of the increased impact of urban poverty on post-neonatal mortality.

Compared with Nsemukila's research, both studies establish that the inclusion of behavioural variables leaves the number of children in a household and father's occupation significantly associated with post-neonatal mortality. However, Nsemukila's research found the type of marital union continually significant. Another difference is the steady significance of the provincial variable for Western province and the access to electricity variable in this study. Among the behavioural variables, the duration of breastfeeding results in significantly lower post-neonatal mortality in both studies, whereas the duration of sexual abstinence is only significant in the present study.

Table 4. 3: Risk of Post-Neonatal mortality associated with socio-economic, cultural, and intermediate behavioural variables

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Socio-economic Variables						
Number of children in household						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
One	0.198***	0.201***	0.203***	0.204***	0.203***	0.198***
Two	0.059***	0.060***	0.061***	0.062***	0.061***	0.059***
Three or more	0.057***	0.0556***	0.057***	0.058***	0.056***	0.058***
Province of residence						
Central (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Copperbelt	0.992	1.016	1.033	1.033	1.000	0.965
Eastern	1.148	1.216	1.244	1.246	1.206	1.332
Luapula	1.551**	1.524*	1.526*	1.515*	1.451*	1.366
Lusaka	1.070	0.947	0.966	0.970	0.991	1.101
Northern	0.976	0.987	0.992	1.001	1.035	1.453
North Western	0.756	0.800	0.811	0.813	0.819	1.028
Southern	0.933	0.939	0.970	0.972	0.961	1.043
Western	1.037	1.166	1.162	1.168	1.175	1.815**
Father employed in agriculture						
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Yes	1.272**	1.272*	1.268*	1.265*	1.306	1.319**
Mother's education						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Primary	0.959	0.946	0.955	0.958	0.968	0.942
Secondary or higher	0.925	0.897	0.913	0.926	0.985	1.013
Mother's occupation						
Not working (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Paid employment	1.50**	1.492**	1.496*	1.489*	1.400*	1.384
Self-employed	1.077	1.043	1.046	1.045	1.034	1.110
Unpaid employment	1.166	1.060	1.057	1.047	1.027	0.895
Access to electricity						
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Yes	1.453***	1.433***	1.422***	1.429***	1.456***	1.502***
Cultural Variables						
Number of other wives						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
One or more	1.110	1.092	1.089	1.064	1.004	1.019
Intermediate Behavioural Variables						
Months of breastfeeding						
0-23 months (ref)		1.000	1.000	1.000	1.000	1.000
24 months or more		0.373***	0.373***	0.373***	0.362***	0.376***
Discusses of FP with partner						
No (ref)			1.000	1.000	1.000	1.000
Yes			0.923	0.921	0.897	0.822

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Number of marital unions						
Once (ref)				1.000	1.000	1.000
More than once				1.114	1.104	1.167
Tetanus vaccination						
None (ref)				1.000	1.000	1.000
One					1.057	1.059
Two or more					0.825	0.841
Duration of sexual abstinence						
0-2 months (ref)						1.000
3-6 months						0.750**
7+ months						0.341***
Number of Observations	5464	5370	5350	5340	5301	5184
Wald Chi-square (degrees of freedom)	589.39(19)	563.96(20)	578.77(21)	578.21(22)	582.82(24)	619.37(26)
Prob>Chi-square	0.000	0.000	0.000	0.000	0.000	0.000
Test of Proportional Hazards Assumption						
Chi-Square	48.290	56.650	63.720	65.020	65.980	75.480
Degrees of Freedom	19.000	20.000	21.000	22.000	24.000	26.000
Prob>Chi-Square	0.000	0.000	0.000	0.000	0.000	0.000

Table 4.4 introduces proximate variables into the analysis of post-neonatal mortality. Controlling for proximate variables has no effect on the significance of either the number of children in a household or the Western province of residence. The inclusion of the source of drinking water variable reduces the significance of father's employment variable. The risk of post-neonatal mortality associated with mothers in paid employment remains significant and is twice as high as for mothers who are not working. This result may point to a level of child neglect associated with working mothers. McDonald (2000) detailed the overwhelming vulnerability of young children in poor Jamaican communities without adequate childcare. This was more pronounced where the extended family structure had broken down. Access to electricity continues to be significant and associated with a higher risk of post-neonatal mortality. The inclusion of type of toilet facility and source of drinking water increases the significance of the risk factor for the Western province. It is

therefore clear that neonates from Western province live in high-risk sanitary conditions.

Turning to the impact of behavioural variables when proximate variables are controlled for, including subsequent birth intervals reduces the significance of duration breastfeeding. This means that women who breastfeed for longer are likely to be associated with longer birth intervals, as would be expected. Controlling for the effects of breastfeeding is critical in determining the extent to which birth intervals are associated with the survival of children, irrespective of breastfeeding (Setty-Venugopal and Upadhyay 2002). Considering the proximate variables while controlling for socio-economic, cultural and behavioural variables results in a significant association between longer birth intervals and lower post-neonatal mortality. Furthermore, "other" source of drinking water, which includes springs, river, and ponds, elevates the risk of post-neonatal mortality by more than two-fold.

Compared to the previous study, the number of children in the household, father's employment, mother's education, tetanus vaccination, and subsequent birth intervals follow similar patterns in both studies. A notable difference is in the reversal that has occurred in terms of access to electricity. Although both remain significant, in Nsemukila's study, no access to electricity was associated with higher mortality whereas the current study finds higher mortality associated with lack of electricity access. In the previous study the mother's present pregnancy status and the discussion of family planning were of significance after adding proximate variables, which is not the case here. Also, the present analysis establishes a constant significance in the Western province variable.

Table 4. 4: Risk of Post-Neonatal mortality associated with socio-economic, cultural, intermediate behavioural and proximate variables

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<u>Socio-economic Variables</u>						
Number of children in household						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
One	0.198***	0.400***	0.403***	0.395***	0.399***	0.407***
Two	0.059***	0.097***	0.096***	0.093***	0.089***	0.089***
Three or more	0.058***	0.072***	0.072***	0.069***	0.066***	0.067***
Province of residence						
Central (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Copperbelt	0.965	0.806	0.781	0.774	0.670	0.758
Eastern	1.332	0.707	0.703	0.712	0.713	0.750
Luapula	1.366	1.259	1.278	1.292	1.183	1.164
Lusaka	1.101	1.348	1.370	1.361	1.301	1.502
Northern	1.453	1.467	1.500	1.500	1.359	1.316
North Western	1.028	1.218	1.185	1.178	1.076	1.011
Southern	1.043	0.975	0.972	0.968	1.079	1.005
Western	1.815**	2.19*	2.123*	2.108*	3.037**	2.895**
Father employed in agriculture						
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Yes	1.319**	2.012***	1.999***	2.001***	2.276***	1.846*
Mother's education						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Primary	0.942	0.758	0.773	0.796	0.788	0.757
Secondary or higher	1.013	0.984	1.022	1.055	1.022	1.027
Mother's occupation						
Not working (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Paid employment	1.384	2.008**	1.964**	1.945**	1.943**	2.018**
Self-employed	1.110	0.822	0.817	0.806	0.817	0.788
Unpaid employment	0.895	0.445	0.455	0.458	0.384	0.395
Access to electricity						
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Yes	1.502***	2.066***	2.041***	2.018***	1.911***	1.968***
<u>Cultural Variables</u>						
Number of other wives						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
One or more	1.019	1.251	1.249	1.271	1.303	1.330
<u>Intermediate Behavioural Variables</u>						
Months of breastfeeding						
0-23 months (ref)	1.000	1.000	1.000	1.000	1.000	1.000
24 months or more	0.376***	0.786	0.796	0.805	0.793	0.808
Discusses of FP with partner						
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Yes	0.822	1.241	1.243	1.236	1.188	1.258

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Number of marital unions						
Once (ref)	1.000	1.000	1.000	1.000	1.000	1.000
More than once	1.167	1.279	1.289	1.279	1.340	1.373
Tetanus vaccination						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
One	1.059	0.991	1.001	1.009	1.053	1.069
Two or more	0.841	0.726	0.740	0.753	0.762	0.750
Duration of sexual abstinence						
0-2 months (ref)	1.000	1.000	1.000	1.000	1.000	1.000
3-6 months	0.750**	0.639**	0.640**	0.651**	0.603**	0.625**
7+ months	0.341***	0.328***	0.328***	0.333***	0.297***	0.297***
Proximate Variables						
Subsequent birth interval						
Less than 24 months (ref)		1.000	1.000	1.000	1.000	1.000
24 to 35 months		0.405***	0.404***	0.398***	0.379***	0.381***
36 months or more		0.282***	0.285***	0.276***	0.258***	0.262***
Age of mother						
Less than 18 years old (ref)			1.000	1.000	1.000	1.000
18 to 24 years old			0.819	0.791	0.835	0.908
25 to 34 years old			0.718	0.692	0.688	0.717
35 years or older			0.576	0.562	0.575	0.588
Currently pregnant						
No or not sure (ref)				1.000	1.000	1.000
Yes				0.796	0.747	0.779
Type of toilet facility						
Flush (ref)					1.000	1.000
Pit latrine					0.927	0.684
Other					0.667	0.464
Source of drinking water						
Piped (ref)					1.000	1.000
Well						1.846
Other						2.260*
Number of Observations	5184	1919	1919	1919	1901	1900
Wald Chi-square (degrees of freedom)	619.37(26)	329.06(28)	315.33(31)	304.22(32)	332.21(34)	349.51(37)
Prob>Chi-square						
Test of Proportional Hazards Assumption						
Chi-Square	75.480	80.580	88.750	89.460	90.850	119.710
Degrees of Freedom	26.000	28.000	31.000	32.000	34.000	37.000
Prob>Chi-Square	0.000	0.000	0.000	0.000	0.000	0.000

4.3 Cox Hazards Regression for Childhood Mortality

Table 4.5 summarises the results of the Cox Hazards regression on childhood mortality with the inclusion of intermediate behavioural variables. Controlling for behavioural variables fails to explain patterns of risk associated with number of children in a household. However mortality in Southern province is partially explained by the behavioural variables. In particular, the inclusion of duration of sexual abstinence reduces the risk of mortality associated with children born in this part of the country. Higher maternal education is associated with lower risk of child mortality.

Controlling for number of marital unions, number of tetanus injections and the duration of sexual abstinence explains some of the risk in this category, which would suggest more "modern" behaviour among educated mothers. As in the previous models in this study, access to electricity continues to be associated with higher risk of mortality, and remains unexplained even after adding behavioural variables to the model. It would appear that the impact of urban poverty is not restricted to the post-neonatal stage of life. In terms of the behavioural variables, a longer duration of breastfeeding, receiving the required number of tetanus injections and longer duration of sexual abstinence are all associated with lower child mortality.

Compared to Nsemukila's study, there are parallels in the continued significance of number of children in a household and the manner in which mother's education is explained by the inclusion of behavioural variables. Also, the duration of breastfeeding is highly significant in both studies. However, the earlier study found number of marital unions remained significant.

Table 4. 5: Risk of child mortality associated with socio-economic, cultural, and intermediate behavioural variables

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<u>Socio-economic Variables</u>						
Number of children in household						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
One	0.185***	0.199***	0.200***	0.198***	0.201***	0.177***
Two	0.064***	0.065***	0.064***	0.063***	0.064***	0.059***
Three or more	0.034***	0.035***	0.036***	0.035***	0.033***	0.030***
Province of residence						
Central (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Copperbelt	1.664	1.682	1.711	1.713	1.715	1.505
Eastern	1.308	1.367	1.376	1.376	1.511	1.355
Luapula	1.275	1.249	1.241	1.243	1.244	1.154
Lusaka	1.347	1.384	1.413	1.412	1.469	1.443
Northern	0.885	0.878	0.879	0.864	0.928	0.694
North Western	0.946	1.025	1.038	1.027	1.070	1.087
Southern	2.276***	2.255*	2.336***	2.325***	2.314**	2.301*
Western	1.026	1.304	1.293	1.302	1.391	1.336
Father employed in agriculture						
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Yes	0.971	0.992	0.984	0.988	0.979	0.946
Mother's education						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Primary	1.062	1.077	1.124	1.114	1.170	1.146
Secondary or higher	0.561**	0.552**	0.580*	0.567	0.625	0.586
Mother's occupation						
Not working (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Paid employment	0.961	0.863	0.865	0.866	0.855	0.826
Self-employed	1.083	1.098	1.112	1.119	1.098	1.074
Unpaid employment	0.411	0.437	0.442	0.446	0.425	0.514
Access to electricity						
No (ref)	1.000	1.000	1.000	1.000	1.000	1.000
Yes	1.618***	1.520**	1.516**	1.504**	1.621***	1.787***
<u>Cultural Variables</u>						
Number of other wives						
None (ref)	1.000	1.000	1.000	1.000	1.000	1.000
One or more	1.172	1.196	1.202	1.227	1.268	1.228
<u>Intermediate Behavioural Variables</u>						
Months of breastfeeding						
0 to 23 months (ref)		1.000	1.000	1.000	1.000	1.000
24 months or more		0.332***	0.335***	0.333***	0.337***	0.334***
Discusses of FP with partner						
No (ref)			1.000	1.000	1.000	1.000
Yes			0.901	0.900	0.938	0.950

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Number of marital unions						
Once (ref)			1.000	1.000	1.000	1.000
More than once				0.887	0.858	0.814
Tetanus vaccination						
None (ref)					1.000	1.000
One					0.882	0.896
Two or more					0.644*	0.654*
Duration of sexual abstinence						
0-2 months (ref)						1.000
3-6 months						0.812
7+ months						0.650*
Number of Observations	4018	3955	3939	3930	3905	3809
Wald Chi-square (degrees of freedom)	335.86(19)	321.30(20)	323.65(21)	324.43(22)	370.70(24)	416.12(26)
Prob>Chi-square	0.000	0.000	0.000	0.000	0.000	0.000
Test of Proportional Hazards Assumption						
Chi-Square	38.120	43.120	43.990	47.730	49.220	55.830
Degrees of Freedom	19.000	20.000	21.000	22.000	24.000	26.000
Prob>Chi-Square	0.006	0.002	0.002	0.001	0.002	0.000

Table 4.6 factors proximate variables into the study of child mortality. The number of children in a household, mother's secondary school level education and access to electricity remain, for the most part unexplained by the additional variables, although part of the risk associated with access to electricity is accounted for. An important observation is that these variables explain the risk associated with child mortality in the Southern province. The inclusion of subsequent birth intervals reduces the significance of the behavioural variable duration of breastfeeding. As before, this would indicate longer birth intervals are associated with longer periods of breastfeeding.

Among the proximate variables, longer periods of breastfeeding are associated with lower child mortality. Children with access to a flush toilet facility have a higher risk of mortality than those using a pit latrine or other source, which brings up questions of sanitation, particularly in urban areas where such facilities are more widely used. Also, water sourced from a well and from other surface sources leads to higher risks of child mortality. However, none of the proximate variables are statistically significant at this stage.

Contrary to this study, in Nsemukila's work, the absence of electricity in a household is found to be associated with higher mortality. In addition, higher risk of child mortality was present in children of polygamous unions. The absence of family planning discussions with one's partner exerted an upward influence on childhood mortality and remained unexplained by the proximate variables in the model. Surprisingly, shorter duration of breastfeeding was associated with lower child mortality in the earlier study.

Table 4. 6: Risk of child mortality associated with socio-economic, cultural, intermediate behavioural and proximate variables

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
<u>**Socio-economic Variables**</u>					
Number of children in household					
None (ref)	1.000	1.000	1.000	1.000	1.000
One	0.177***	0.455*	0.452*	0.437*	0.419*
Two	0.059***	0.096***	0.096***	0.092***	0.086***
Three or more	0.030***	0.033***	0.033***	0.032***	0.030***
Province of residence					
Central (ref)	1.000	1.000	1.000	1.000	1.000
Copperbelt	1.505	0.876	0.877	0.923	0.975
Eastern	1.355	0.676	0.675	0.651	0.642
Luapula	1.154	0.842	0.848	0.957	0.866
Lusaka	1.443	1.618	1.609	1.660	1.878
Northern	0.694	0.459	0.458	0.500	0.468
North Western	1.087	0.712	0.714	0.741	0.691
Southern	2.30**	2.256*	2.253*	2.015	2.040
Western	1.336	1.676	1.689	1.192	1.170
Father employed in agriculture					
No (ref)	1.000	1.000	1.000	1.000	1.000
Yes	0.946	1.333	1.336	1.215	1.048
Mother's education					
None (ref)	1.000	1.000	1.000	1.000	1.000
Primary	1.146	0.869	0.874	0.875	0.885
Secondary or higher	0.586	0.428*	0.429*	0.434*	0.431*
Mother's occupation					
Not working (ref)	1.000	1.000	1.000	1.000	1.000
Paid employment	0.826	1.112	1.114	1.123	1.191
Self-employed	1.074	1.139	1.136	1.120	1.091
Unpaid employment	0.514	0.283	0.280	0.309	0.286
Access to electricity					
No (ref)	1.000	1.000	1.000	1.000	1.000
Yes	1.787***	1.811*	1.809*	1.823*	1.838*
<u>**Cultural Variables**</u>					
Number of other wives					
None (ref)	1.000	1.000	1.000	1.000	1.000
One or more	1.228	0.880	0.880	0.834	0.832
<u>**Intermediate Behavioural Variables**</u>					
Months of breastfeeding					
0-23 months (ref)	1.000	1.000	1.000	1.000	1.000
24 months or more	0.334***	0.715	0.714	0.725	0.714
Discusses of FP with partner					
No (ref)	1.000	1.000	1.000	1.000	1.000
Yes	0.950	0.847	0.847	0.859	0.889

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Number of marital unions					
Once (ref)	1.000	1.000	1.000	1.000	1.000
More than once	0.814	1.009	1.006	1.013	1.032
Tetanus vaccination					
None (ref)	1.000	1.000	1.000	1.000	1.000
One	0.896	1.325	1.312	1.300	1.293
Two or more	0.654*	1.022	1.015	1.020	1.017
Duration of sexual abstinence					
0-2 months (ref)	1.000	1.000	1.000	1.000	1.000
3-6 months	0.812	0.849	0.851	0.877	0.879
7+ months	0.650*	0.848	0.852	0.905	0.890
Proximate Variables					
Subsequent birth interval					
Less than 24 months (ref)		1.000	1.000	1.000	1.000
24 to 35 months		0.841	0.835	0.863	0.844
36 months or more		0.823	0.809	0.847	0.848
Currently pregnant					
No or not sure (ref)			1.000	1.000	1.000
Yes			0.932	0.935	0.953
Type of toilet facility					
Flush (ref)				1.000	1.000
Pit latrine				0.956	0.760
Other				1.309	0.980
Source of drinking water					
Piped (ref)					1.000
Well					1.749
Other					1.589
Number of Observations	3809	1392	1392	1381	1381
Wald Chi-square (degrees of freedom)	416.12(26)	151.68(28)	154.34(29)	163.05(31)	168.67(33)
Prob>Chi-square	0.000	0.000	0.000	0.000	0.000
Test of Proportional Hazards Assumption					
Chi-Square	55.830	51.610	52.080	53.550	56.170
Degrees of Freedom	26.000	28.000	29.000	31.000	33.000
Prob>Chi-Square	0.001	0.004	0.005	0.007	0.007

Chapter 5

DISCUSSION AND CONCLUSION

5.1 Introduction

The objective of this paper was to establish the factors that were associated with under-five mortality in Zambia using the 1996 Zambia Demographic and Health Survey, and compare the findings to an earlier study that used the data from the first round of Zambia Demographic and Health Surveys. The construction of variables and the techniques of analysis of data were geared towards generating comparable results.

5.2 Main Findings

Life table analyses showed patterns of improvement in under-five mortality that were associated with socio-economic, bio-demographic and micro-environmental factors. The Western province stood out with the highest mortality patterns. A surprising result was found in the negative impact of electricity in the household on under-five mortality. Already, evidence of urban poverty was appearing in the preliminary analysis of data.

The logistic regression on neonatal mortality found that socio-economic variables had a significant effect of reducing the risk of mortality, whereas among the cultural variables, higher mortality was evident among Lozi and Luvale respondents, who reside predominantly in the Western and North Western provinces respectively. The intermediate behavioural variables had the effect of reducing neonatal mortality. In particular, a longer duration of sexual abstinence and a greater number of tetanus injections increased neonatal survival prospects. The proximate variables that were of significance were multiple births (increased neonatal mortality), size of a child at birth (a small child was associated with higher neonatal mortality), and the sex of a child (male children had significantly higher mortality). Generally speaking, the inclusion of behavioural and proximate variables failed to explain the impact of the socio-economic and cultural variables on neonatal mortality. This lack of influence is exactly in line with Nsemukila's findings.

The inclusion of behavioural and proximate variables went further in explaining the socio-economic and cultural variables at later stages in a child's life. Support of this is found by Trussel and Hammerslough (1983) who maintained that socio-economic covariates affect the mortality of older children. At the post-neonatal stage, this was the case for the province of residence variables and for parent's occupation. At the childhood stage, this was true for mother's education, province of residence and the electricity variables. As in Nsemukila's study, the importance of maternal education in reducing mortality risk appeared to be at the later stages of under-five mortality. Yet, the weak performance of this variable would suggest, that the collapse of the health system obviates mothers with added knowledge, from using their comparative advantage for the benefit of their offspring, as intimated by Nsemukila (1996). Proof of this link between education and better health practises is highlighted by the fact that the significance of lower mortality among mothers with secondary or higher education is largely explained by factors such as discussion of family planning and receipt of tetanus injections. It could also be compounded by the high drop out rates in schools, which has reduced the strength of this variable as a proxy for good knowledge and practises of health and hygiene. Possibly, another measure of learning is needed in order to capture the informal knowledge transfer among communities.

The socio-economic and cultural variables that were significant in explaining post-neonatal mortality were number of children in a household (more children being associated with lower mortality), province of residence (significantly higher mortality in Luapula and Western provinces), mother's occupation (higher mortality rates for children with mother's in paid employment – an indicator of urban life), father's employment in agriculture (higher risk for children whose father's were employed in this field) and access to electricity (the presence of electricity being a hindrance to survival). Among the behavioural variables, longer duration of breastfeeding and longer periods of abstinence were associated with lower post-neonatal mortality. The proximate variables significantly impacting post-neonatal mortality were subsequent birth interval (longer intervals being associated with lower mortality) and source of drinking water (other source of water such as river or stream affecting mortality negatively).

Regarding child mortality, the socio-economic and cultural variables that were influential were number of children living in household, province of residence for Southern province (a significantly high mortality risk which was partly explained by the inclusion of behavioural variables and proximate variables), mother's education (significantly lower mortality for children of mother's with secondary education or higher level, although this too, was explained by the inclusion of behavioural and proximate variables that were associated with modern lifestyles) and access to electricity (higher mortality for households with access to electricity but this was partly explained by the process of variable inclusion). The individual behavioural variables that displayed significance were duration of breastfeeding (longer duration was associated with lower child mortality but this was explained by the inclusion of proximate variables) and duration of sexual abstinence (longer periods associated with lower mortality but this is also explained by the inclusion of proximate variables). None of the proximate variables in themselves had an impact on child mortality. This is contrary to Nsemukila's findings, where a number of proximate variables were found to be significant in explaining childhood mortality.

Perhaps the most interesting finding of this research is in the performance of the community level socio-economic variables. The electricity variable consistently resulted in a significant increase in mortality. The importance of this result cannot be underestimated. The negative ramifications of the Structural Adjustment Programme (SAP) and the removal of price controls have been most pronounced in urban areas, where there is a greater reliance on wage earnings and where increasingly larger portions of a household's disposable income are spent on food, with considerably less available for health care of children. The effects of urban poverty have been worsened by the introduction of user fees at hospitals and clinics. This argument can draw on the findings of the 2002 Zambia Poverty Reduction Strategy Paper that established that the introduction of hospital user fees in 1993 resulted in a drop in antenatal and family planning attendance and a 76 per cent reduction in sexually transmitted diseases treatment (IMF 2002).

The consistently high under-five mortality among the inhabitants of the Western, North Western and to some extent Southern, provinces is of great concern and warrants further discussion. A detailed profile of the economic status of these households is found in 1996 Living Conditions Monitoring Survey. The Western province has the highest percentage of female-headed households and the lowest per capita household income, which came to one-third of the value in Lusaka province. The percentage of poor people is highest in North Western province (90 per cent). An estimated 76 per cent of households in Southern province and 63 per cent of households in the Western province had experience acute food shortages. Clearly, socio-economic differences among provinces have accelerated the pace of under-five mortality in certain areas of the country. Finally, the Cox regression analysis produced significant results for tests based on the Schoenfeld residuals. This would indicate a deviation from the proportional hazards assumption.

5.3 Policy Implications

A crucial policy implication of this study is that if survival of under-fives is to be improved, there is a critical need to develop access and quality of health care throughout the country, particularly with the current HIV/AIDS situation increasing pressure on the health sector. Efforts to target pregnant mothers within the health system must be increased since the positive benefit of vaccination during pregnancy has been demonstrated. The impact of economic structural reform has had a severe effect in urban areas and efforts should be made to make health services as viable as possible for the urban poor. The rising unemployment rate has intensified the urban poverty situation. Furthermore, the fact that HIV prevalence is more than twice as high in urban areas as in rural areas (Zambia Central Statistics Office 2003) is a likely contributing factor. Government initiatives should focus on encouraging investment in the sectors that have the greatest potential of mitigating the effects of urban poverty. Strategic sectors include mining and manufacturing. Moreover, higher budgetary allocations into small-scale business schemes are encouraged so that the productive asset base of the urban poor is extended. The importance of a safe source of water has been shown to significantly reduce the impact of post-neonatal mortality. Clearly, there is an urgent need for investment in the water supply and sanitation sectors.

The positive impact of breastfeeding on post-neonatal and childhood mortality suggests that this practice should be encouraged. Concerns about perinatal transmission of HIV should be considered within the framework of the overriding benefits of breastfeeding for young infants. Since women's education is shown to have a significant effect in lowering childhood mortality, efforts should be made to improve retention rates of female learners in secondary schools and tertiary institutions. This is particularly important since only 27.8 per cent of respondents in the 1996 ZDHS has achieved secondary or higher level education.

There is a positive impact of longer subsequent birth intervals on post-neonatal survival and strategies that provide women with practical and affordable options for birth spacing should be promoted. In addition, since longer duration of sexual abstinence is consistently associated with higher survival at all segments of a child's life, this practice should be encouraged together with more modern family planning approaches. Furthermore, policies for poverty reduction should recognise the unique challenges facing certain parts of the country. Special attention should be given to regional intervention in the Western and North Western provinces, where poverty levels are particularly heightened. Large-scale investments, such as the Kariba and Kafue hydroelectric scheme in the Southern provinces, should be implemented in such a way as to improve the welfare of local communities. A priority should be the reduction of the acute variations among regions. Policy interventions should therefore not only aim at national strategies but at region-specific programmes.

5.4 Areas for further Study

Although data quality did not prove to be a major drawback to this study, it would be of great relevance to use the more recent 2000/1 dataset in this analysis once it becomes available, in order to establish whether levels have improved or worsened. One unusual finding that requires further investigation is the decrease in child mortality as the number of children in the household increases since it is possible that this result is being confounded by the age of mother. Also, splitting the analysis into different age categories could minimize the effect of age heaping. The significant results of the tests based on the Schoenfeld residuals indicate a deviation from the proportional hazards assumption in the Cox regression analysis. As mentioned earlier, Nsemukila stressed that his investigation was not intended to fit a "best model." For comparison purposes, similar methods for constructing variables and analysing data are used in this study. However, this result would suggest that it would be useful to apply another methodology to this area and investigate whether similar results would be obtained. Another method that has been used to study under-five mortality in other parts of Africa (Kizito 1998; Siyam 2002) is the random effects model. A random effects model would help to control for survival outcomes among siblings. Also, in a piece-wise log rate model the risk of failure is assumed to be constant within the segmented groups but to vary between groups. The advantage of this method is that the assumption of proportionality is not fixed, although other assumptions of a Poisson procedure apply.

It would also be useful to incorporate the use of the Living Conditions Monitoring Surveys into this type of analysis in order to estimate more closely the role of household economic activities and expenditure (particularly spending on health care) on child survival.

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